



IDW '10

THE 17TH INTERNATIONAL DISPLAY WORKSHOPS

Workshops on

- LC Science and Technologies (LCT)
- Active Matrix Displays (AMD)
- FPD Manufacturing, Materials and Components (FMC)
- Plasma Displays (PDP)
- EL Displays and Phosphors (PH)
- Field Emission Display and CRT (FED)
- Organic LED Displays (OLED)
- 3D/Hyper-Realistic Displays and Systems (3D)
- Applied Vision and Human Factors (VHF)
- Projection and Large-Area Displays and Their Components (PRJ)
- Electronic Paper (EP)
- MEMS and Emerging Technologies for Future Displays and Devices (MEET)
- Display Electronic Systems (DES)
- Flexible Displays (FLX)

Topical Sessions on

- Touch Panels and Input Technologies (INP)
- Lighting Optics, Devices and Systems (LIT)

Final Program

***Fukuoka International Congress Center
Fukuoka, Japan
December 1(Wed) – 3(Fri), 2010***

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PROGRAM HIGHLIGHTS

Scientific and technological advances in research and development on information displays can be found at the 17th International Display Workshops (IDW '10). Features of the IDW '10 include the integration of the following fourteen workshops as well as two topical sessions focusing on recent progress of lighting and input technologies.

Workshops on

- LC Science and Technologies
- Active Matrix Displays
- FPD Manufacturing, Materials and Components
- Plasma Displays
- EL Displays and Phosphors
- Field Emission Display and CRT
- Organic LED Displays
- 3D/Hyper-Realistic Displays and Systems
- Applied Vision and Human Factors
- Projection and Large-Area Displays and Their Components
- Electronic Paper
- MEMS and Emerging Technologies for Future Displays and Devices
- Display Electronic Systems
- Flexible Displays

Topical Sessions on

- Touch Panels and Input Technologies
- Lighting Optics, Devices and Systems

The three-day conference will feature 599 papers, including a keynote address, an invited address, 99 invited papers, 220 oral presentations, and 278 poster presentations. Following plenary session of keynote and invited addresses in the Wednesday morning, presentations will begin and continue in eight parallel oral sessions through Friday. Poster sessions and author interviews will enable participants to discuss topics in detail. IDW '10 will also present "IDW Best Paper Awards" and "IDW Outstanding Poster Paper Awards" based on paper originality and technical significance to information displays. Exhibits by universities and display industry-related businesses will also be featured from Wednesday to Friday in parallel with workshops. IDW '10 should be of interest to not only researchers and engineers, but also managers of companies and institutions in the display community.

Workshop on LC Science and Technologies (LCT)

Recent advances in LC materials and device technologies are presented. The sessions cover from fundamental studies to recent development in LCD technologies. New LC materials & modes including blue phase display, LC alignment processes, display measurement, fast-response LCDs, high performance LCDs and emerging new applications are discussed.

Workshop on Active Matrix Displays (AMD)

AMD is the workshop for the core technologies of most advanced FPD applications, covering the various technologies of Si-TFT, Oxide TFT, Organic TFT, OLED, integrated sensors, flexible devices and novel applications. It is recognized as one of the largest workshop in IDW. The recent trend in paper presentations tends to focus on Oxide TFT, which are expected to find applications in the next generation of OLED and flexible devices. This year, we devote seven for AMD alone, and three for joint sessions, which cover a broader range of device/process to applications. Given the expectations surrounding environmental aspects, a range of interesting paper presentations are expected.

Workshop on FPD Manufacturing, Materials and Components (FMC)

The FMC workshop covers the recent developments and achievements in the field of flat panel displays. The cutting-edge technologies of the optical films, color filters, LCD backlighting systems, optical components, manufacturing technologies, and measurement systems are highlighted. Recycling of FPD materials and environmental safety technologies are included as highlighted topics.

Workshop on Plasma Displays (PDP)

The PDP workshop consists of 15 oral and 10 poster presentations. Similar to the last year, there will be many excellent presentations on protecting layers. Improvements in conventional MgO, as well as the understanding of the high-efficiency and long-life operation of new materials including SrCaO, are investigated. We will have many presentations from China. Dr. Yan, in his invited talk, will introduce R&D as well as business trends in PDP activities in China. Other invited talks include presentations on 3D PDP from LG Electronics, green PDP from Samsung SDI, and improvement of picture quality of 2D/3D PDP from Panasonic. It should be noted that Pusan National University is going to introduce a high-resolution Quad-FHD PDP.

Workshop on EL Displays and Phosphors (PH)

This workshop covers the latest R&D achievements in inorganic ELDs, phosphors for emissive displays and solid-state illumination as well as LEDs. The workshop consists of invited talks, contributed papers and poster papers. These will present phosphors for LEDs, PDPs, ELDs, FEDs, lighting and computational approaches for phosphors including interesting topics such as quantum dot EL and synthesis techniques for phosphors.

Workshop on Field Emission Display and CRT (FED)

This workshop covers the entire field of CRT and field emission display technologies. Recent progress in various backlight units for LCD equipped with carbon nanotube (CNT) field emitter arrays is presented. Structures of field emitters with focusing electrodes, field emission characteristics and various field emitter materials, such as CNTs, HfN, and nanocrystalline silicon, are also discussed.

Workshop on Organic LED Displays (OLED)

This workshop includes recent developments in OLED materials, devices, display systems, solution process technologies and new device architecture. OLED materials and technologies based on printing methods are expected for large size and low cost applications. Device fabrication process and architecture for mass productions are also presented.

Workshop on 3D/Hyper-Realistic Displays and Systems (3D)

This workshop focuses on recent progress in 3D/hyper-realistic image systems and related visual technologies. It also covers stereoscopic/3D display, holography, 3D image quality, and 3D contents. This year, two sessions are held together with the "Display Electronic Systems (DES)" and "Applied Vision and Human Factors (VHF)" workshops. Invited talks include topics from the forefront of 3D imaging technologies, and recent research into advanced display systems.

Workshop on Applied Vision and Human Factors (VHF)

This workshop provides a forum for lively discussion of the latest academic and industrial R&D in the field of applied vision and human factors associated with display technology, covering a wide range from fundamental theory to commercial applications, including methods for improved contrast, multi-primary displays, color reproduction, dynamic characteristics, and the assessment and improvement of image quality and the viewing environment. This year sees four invited talks, held jointly with the DES and 3D workshops, on color reproduction, multi-primary displays, and the safety of 3D systems. Excluding Late News, there will be 29 oral presentations over eight sessions, plus 11 posters. A particular feature of this year's workshop is the number of topical papers related to color, including multi-primary displays.

Workshop on Projection and Large-Area Displays and Their Components (PRJ)

In this workshop, the latest technologies in the field of projection display will be discussed. Rapidly growing technologies such as pico-projectors with newly developed green laser and novel optical systems are highlighted. As laser technologies applied to projection displays become popular, new despeckling methods will be proposed. Also, near-eye and other applications based on projection technologies that are becoming a reality, and new methods are presented. Ongoing progress in the fields of large-area displays for applications such as 3D systems and digital signage will be discussed as well.

Workshop on Electronic Paper (EP)

This workshop focuses on current topics in electronic paper including rewritable paper, paper-like displays and flexible displays. There is currently an eager demand for developments in e-paper technologies due to the emergence of e-books, e-newspapers, electronic shelf labels, and other applications. Various novel technologies in electrophoretic, liquid crystal, electrowetting, electrochromic, liquid powder and toner display systems will be reported on. Systems, devices, materials, human factors and applications in this field are expected to be discussed.

Workshop on MEMS and Emerging Technologies for Future Displays and Devices (MEET)

The workshop is unique in covering all aspects of MEMS, nanotechnologies and emerging technologies concerning future displays, imaging devices, and emerging electron devices. It seeks to broaden the horizons of display and imaging technologies into cutting-edge technologies. Research areas such as materials, basic physics and fabrication process are included. Among all the MEMS and display conferences in the world, this is the only opportunity for MEMS and cutting-edge technology researchers to gather and discuss such devices. Authorities in this field are invited from top research institutions around the world. The invited speakers are from Univ. of Cambridge, QD Vision (MIT's venture company), Ecole Polytech, Uni-Pixel Displays, Qualcomm, Nagoya Univ., Kyushu Univ., Univ. of Tokyo and Toyota Technological Institute. With excellent contributed papers, this workshop invites participants who wish to open a new field of displays, imaging devices and emerging devices.

Workshop on Display Electronic Systems (DES)

This workshop covers all aspects of display systems in relation to electronics of video data processing, interface technologies, cooperative operations between display components such as cells and backlights, sensors, and applications in the new areas such as 3D video. We have set up a new session on visible light communications, which are emerging technologies for the promotion of new applications. In addition, the systems for a wide and high dynamic range of color reproduction such as multi primary color systems, high-fidelity, high-frame-rate, high-resolution, and low power consumption systems, are focused on.

Workshop on Flexible Displays (FLX)

Recently, there is much attention on flexible display technologies. The technologies are spread in a wide range of fields from material science to a practical application. The hottest sessions cover all aspects of flexible display technologies including electronic paper, flexible flat panel display, display materials, TFT and substrate technologies, which are interrelated with AMD, FMC, OLED and EP-WS.

Topical Session on Touch Panels and Input Technologies (INP)

This topical session covers all aspects of input technologies including materials, devices and systems. We expect that INP will open up brand new fields by fusing input and display technologies. INP sessions will be held by the related workshops on DES, AMD, FMC and EP. In addition to the recent activities in the popular touch panel technology, 3D input systems for 3D displays, new user interface technologies and the most advanced image sensor technologies are featured in this year's session.

Topical Session on Lighting Optics, Devices and Systems (LIT)

The LIT is a topical session that covers all aspects of lighting related to displays and eco-friendly illumination systems. The cutting-edge technologies of light sources, such as the lasers for projectors, the backlights for LCDs, and the corresponding materials, are topics that will be looked at closely.

IDW Best Paper Award and IDW Outstanding Poster Paper Award

IDW will present "IDW Best Paper Award" and "IDW Outstanding Poster Paper Award". The award committee of IDW will select the most outstanding papers from those presented at IDW '10. The award winners will be announced on the IDW website and given a plaque after the conference.

Exhibition

The IDW '10 Exhibition, which will be held from December 1 through December 3, covers materials, components, manufacturing and measuring equipments, software systems and other related products for display devices. Please join-in and enjoy discussions at exhibitors' booths (2F Lobby, 4F Lobby).

December 1: 12:00 – 18:00

December 2: 10:00 – 18:00

December 3: 10:00 – 14:00

GENERAL INFORMATION

SPONSORSHIP

IDW '10 is sponsored by the Institute of Image Information and Television Engineers (ITE) and the Society for Information Display (SID).

CONFERENCE SITE

Fukuoka International Congress Center
2-1, Sekijo-machi, Hakata-ku
Fukuoka 812-0032, Japan
Phone: +81-92-262-4111 Fax: +81-92-262-4701

ON-SITE SECRETARIAT

Telephone and fax machines for IDW '10 use will be temporarily set up in the secretariat room (Room 405) at the Fukuoka International Congress Center (November 30-December 3). Phone/Fax: +81-92-282-8364

BANQUET

A buffet-style banquet will be held on December 1 from 19:30 to 21:30 at the Crowne Grand Ball Room (2F) in ANA Crowne Plaza Fukuoka. As the number of tickets is limited, you are urged to make an advance reservation through the website.

EVENING GET-TOGETHER WITH WINE

A get-together will be held on November 30 from 18:00 to 20:00 at RACONTER (1F) in the conference site. Wine (Sponsored by Merck Ltd., Japan) will be served to participants with a relaxed atmosphere for informal discussion.

REGISTRATION

Registration is available in advance and also on-site. However, on-site registrants may not be able to obtain books, if there are an unexpectedly large number of on-site registrations. Advance registration is strongly recommended.

Registration Fees

The registration fee for IDW '10 includes admission to the conference and CD-ROM of the proceedings. Additional ¥7,000 will be charged for those who want the proceedings in book format. For users who do not have CD drives on their computers, we will provide the data at the conference site. Detailed information will be announced on the website.

	Paid by Oct. 29	After Oct. 29
Individual Member (ITE/SID/ASO*)	¥ 30,000	¥ 40,000
Non-Member**	¥ 40,000	¥ 50,000
Student***	¥ 8,000	¥ 10,000
Life Member of ITE/SID	¥ 8,000	¥ 10,000
Banquet	¥ 7,000	¥ 10,000

*ASO: Academic Supporting Organizations
(See p. 11 as well as "Supporting Organizations and Sponsors" at the end of each workshop section.)

**Non-Member: If you intend to join either ITE or SID, one year membership fee will be subsidized by IDW '10 committee.

***Photocopy of student ID is required.

Please note that the reduced registration fee must be paid by October 29. The full fee will be charged for payments made later than October 29. Also note that *the number of banquet tickets to register on site is limited.*

For additional sets of the proceedings (Book and CD-ROM)

At the conference site	¥ 8,000
Air mail after the conference	¥ 15,000
Domestic mail after the conference	¥ 10,000

Additional sets of Book and CD-ROM can be purchased only those who have completed payment by November 19.

Payment

Three ways are provided for registration.

(1) e-Registration

Access the following URL.

<http://www.idw.ne.jp/regist.html>

e-Registration will be accepted until November 19, 2010.

(2) Mail or Fax Registration

Complete the registration form (download from the website) and send it to the secretariat together with all necessary payments no later than November 19, 2010.

IDW '10 Secretariat

c/o Bilingual Group Ltd.

3-3-6 Kudan Minami, Chiyoda-ku Tokyo 102-0074, Japan

Phone: +81-3-3263-1345 Fax: +81-3-3263-1264

E-mail: idw@bilingualgroup.co.jp

The registration fee should be remitted by one of the following methods.

1. Credit Card
2. Bank Transfer to:

Bank: Bank of Tokyo-Mitsubishi UFJ
(Swift Code: BOTKJPJT)

Branch: Ichigaya Branch (Branch No. 14)

Account No.: 1474095 (Ordinary Account)

Account: IDW

Please attach a copy of the bank receipt with the registration form to avoid any confusion.

All above payments should be made in **JAPANESE YEN**.

Also, please note that personal and traveler's checks are not accepted.

(3) On-site Registration

Conference registration desk will be open:

November 30 (Tue.) 17:00 – 20:00

December 1 (Wed.) 8:00 – 18:00

December 2 (Thu.) 8:00 – 18:00

December 3 (Fri.) 8:00 – 13:00

The on-site registration fee will be payable by:

1. Cash (JAPANESE YEN only)
2. Credit Card (VISA or MasterCard only)

Bank transfer, bank check, or personal/traveler's check are not accepted.

Cancellation Policy

Refunds for registration, banquet, additional sets of proceedings etc. will be made upon receipt by IDW '10 secretariat of written cancellation by **October 29**. For cancellations received after October 29 or no-shows, refunds will not be made. However, after IDW '10 closes, a set of the proceedings will be sent to the registrants who have paid the registration fees. If it becomes difficult to hold IDW '10 due to infectious disease and other unavoidable factors, we will substitute the IDW with the mail delivery of the IDW '10 proceedings at a later date to all those who have registered for participation.

INQUIRIES

IDW '10 Secretariat

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3-3-6 Kudan Minami, Chiyoda-ku Tokyo 102-0074, Japan

Phone: +81-3-3263-1345 Fax: +81-3-3263-1264

E-mail: idw@bilingualgroup.co.jp

ACADEMIC SUPPORTING ORGANIZATIONS (ASO)

The Chemical Society of Japan

The Electrochemical Society of Japan (ECSJ)

The Illuminating Engineering Institute of Japan

The Imaging Society of Japan

The Institute of Electrical Engineers of Japan

The Institute of Electronics, Information and Communication
Engineers (IEICE)

The Institute of Image Electronics Engineers of Japan

Japan Ergonomics Society (JES)

The Japanese Liquid Crystal Society (JLCS)

The Japan Society of Applied Physics

The Virtual Reality Society of Japan

The Society of Polymer Science, Japan

FUNDS

Grant-in-Aid for Scientific Research (KAKENHI: 2264002) from MEXT

The Asahi Glass Foundation

**For final updated information, please visit our website,
<http://www.idw.ne.jp/10record.html>.**

Evening Get-Together with Wine

Tuesday, November 30, 2010

18:00 – 20:00

at RACONTER (1F),

Fukuoka International Congress Center

(Sponsored by Merck Ltd., Japan)

See page 9 for details

TRAVEL INFORMATION

ACCOMMODATIONS

JTB Tokyo Metropolitan Corp. will handle arrangements for your hotel reservations.

Hotel reservations can be made at the IDW official website.
<http://www.idw.ne.jp/accommodation.html>

JTB Tokyo Metropolitan Corp.
Corporate Sales Office Yokohama

Phone: +81-45-316-4602 Fax: +81-45-316-5701
Office Hours: 9:30-17:30 (Weekdays only)
E-mail: jtb_convention@met.jtb.jp

There will be an on-site travel information desk during the conference period to handle arrangements for transportations.

VISAS

Visitors from countries whose citizens must have visas should apply to Japanese consular office or diplomatic mission in their respective country. For further details, please contact your travel agency or the local consular office in your country.

Attention: For some countries' citizens, official documents prepared by the secretariat will be needed. Please ask the secretariat at least two months before the conference.

CLIMATE

The average temperature in Fukuoka during the period is around 12°C in the daytime and 4°C at night.

BANQUET

Wednesday, December 1, 2010

19:30 – 21:30

Crowne Grand Ball Room (2F)

ANA Crowne Plaza Fukuoka

See page 9 for details

FUKUOKA

Fukuoka City (also known as “Hakata”) lies on the northern coast of Kyushu, the southernmost of the four main islands of Japan. The population of the city is approximately 1.4 million people, making it the 7th largest city in Japan.

Being the closest major city in Japan to the Korean Peninsula and China, Fukuoka has from ancient times been a gateway for economic and cultural exchanges with its Asian neighbors. On the basis of these historical and geographical links, the city is working on many levels to strengthen its relationships with the rest of Asia, towards the goal of becoming a “focal point for exchange in Asia”.

PLACES OF INTEREST

Dazaifu Tenmangu Shrine

Nishitetsu trains are available from Tenjin to Dazaifu Tenmangu (about 20 minutes by train and then 5 minutes on foot). Here, at the head shrine of all the Tenmangu Shrines in Japan, the god of learning, Michizane Sugawara, is worshipped. The plum tree to the right of the main building as you face it is called Tobiume (the flying plum tree), because it is said that the tree flew here to be with Michizane.

Kyushu National Museum

This museum is located a 5-minute walk from Dazaifu Tenmangu Shrine, and is Japan’s newest National Museum after Tokyo, Kyoto, and Nara. Based on the concept of “Understanding Japanese culture from an Asian viewpoint”, various valuable exhibits depict Japan’s blossoming relationships with other Asian countries over a long time.

Fukuoka City Museum

Covered with half-mirrored windows, this museum stands with the Fukuoka Tower rising behind it (about 15 minutes by bus from Hakata Station). There are 4 different exhibition rooms and a special exhibition room for visiting exhibitions. The Gold Seal, one of Japan’s national treasures, is exhibited in the Permanent Exhibition Room.

Uminonakamichi

Uminonakamichi is a peninsula connecting Shikanoshima Island in Higashi Ward to mainland Fukuoka. A large peninsula measuring about 8 km in length and about 2.5 km in width at its widest point, Uminonakamichi is a recreation area with a park in its central to north-western region. The JR Kashii Line and prefectural roads run parallel through Uminonakamichi, providing a popular scenic route. Those who prefer a boat ride can catch a ferry operated by Fukuoka City at the Bayside Place Hakata Futoh.

Yatai (Street Stalls)

“Hakata” is famous for “Hakata Ramen”. One of the special features of nighttime Hakata is “yatai”, street stalls that appear on the streets in the evening in Nakasu, Tenjin, and other areas. Yatai offer a range of hot tasty foods including Hakata Ramen, and a chance to rub shoulders with the locals.

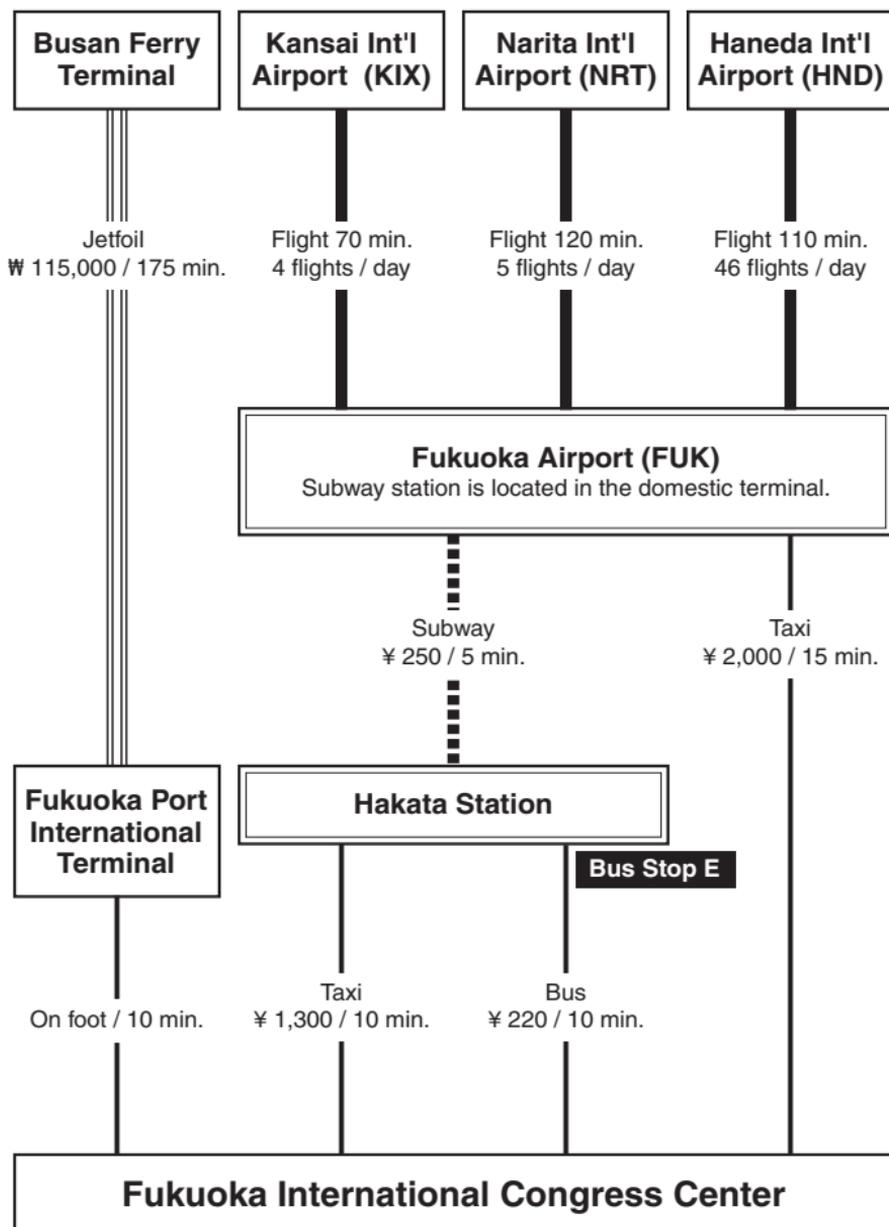
More information is available at the following websites:

<http://www.city.fukuoka.lg.jp/english/index.html>

<http://www.welcome-fukuoka.or.jp/english/>

<http://www.city.fukuoka.lg.jp/showcase/english/index.html>

Access to Conference Site



Flight information on this page may be changed in October. Please confirm the details with each airline company.

(as of October 31, 2010)

Bus

Nishitetsu customer center

Phone: +81-92-303-3333

One Day Pass is available. (¥ 600)

For more information, please refer to the following website.

<http://jik.nnr.co.jp/Tschedule/gb/>

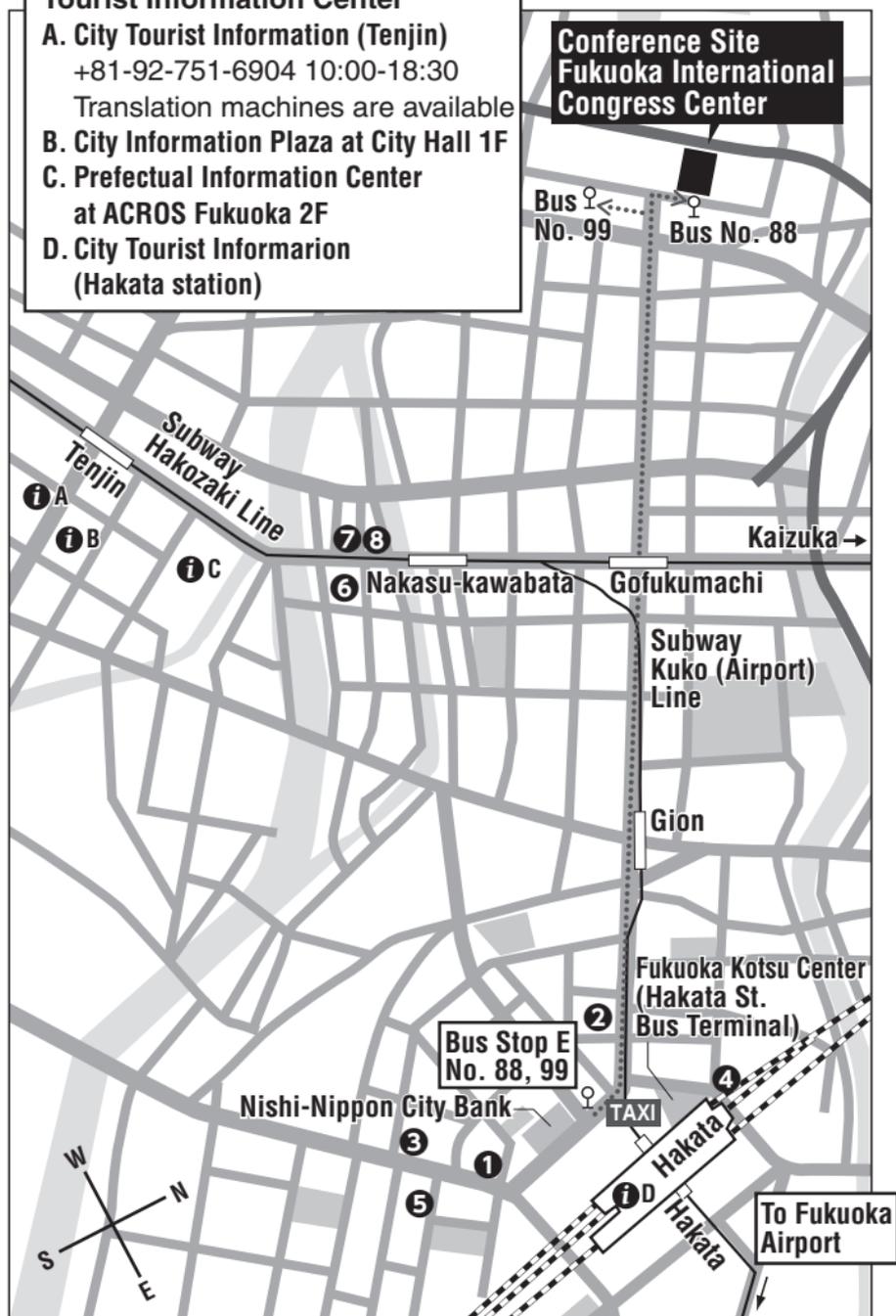
Hotel Map

Tourist Information Center

- A. City Tourist Information (Tenjin)**
+81-92-751-6904 10:00-18:30
Translation machines are available
- B. City Information Plaza at City Hall 1F**
- C. Prefectural Information Center at ACROS Fukuoka 2F**
- D. City Tourist Informarion (Hakata station)**

Conference Site
Fukuoka International Congress Center

Bus No. 99 Bus No. 88



- | | |
|--|-----------------------------------|
| ① ANA Crowne Plaza Fukuoka
(Banquet Site) | ⑤ Yaoji Hakata Hotel |
| ② Hotel Nikko Fukuoka | ⑥ Hakata Excel Hotel Tokyu |
| ③ Sutton Place Hotel Hakata | ⑦ IP Hotel Fukuoka |
| ④ Nishitetsu Inn Hakata | ⑧ Best Western Fukuoka Nakasu Inn |

IDW Best Paper Award

This award will go to the most outstanding paper selected from those presented at IDW '10. The 2010 award winners will be announced on the IDW website: <http://www.idw.ne.jp/award.html>

IDW Outstanding Poster Paper Award

This award will go to the most outstanding paper selected from those presented at IDW '10 poster presentation. The 2010 award winners will be announced on the IDW website: <http://www.idw.ne.jp/award.html>

EXHIBITION

12:00 – 18:00 Wednesday, Dec. 1, 2010

10:00 – 18:00 Thursday, Dec. 2, 2010

10:00 – 14:00 Friday, Dec. 3, 2010

2F Lobby, 4F Lobby

Fukuoka International Congress Center

Free admission with your registration name tag

Plenary Sessions

Wednesday, December 1

Plenary

10:20 - 10:30

Main Hall

Opening

Master of Ceremony: N. Ibaraki, Executive Chair, AIST, Japan

Opening Remarks

10:20

K. Betsui, General Chair, Hitachi, Japan
R. Hattori, Program Chair, Kyushu Univ., Japan

10:30 - 11:15

Main Hall

Keynote Address

Co-Chairs: R. Hattori, Program Chair, Kyushu Univ., Japan
 K. Betsui, General Chair, Hitachi, Japan

Keynote Address

10:30

The Artistic & Scientific World in 8K Super Hi-Vision

Y. Kawaguchi
Univ. of Tokyo, Japan

The Ultra HDTV system consists of an 8k horizontal spatial resolution and 60 frames per second temporal resolution. This advanced development of 8K Ultra HDTV enable us to verify a wide variety of new possibilities.

11:15 - 12:00

Main Hall

Invited Address

Co-Chairs: T. Miyashita, Program Vice-Chair, Tohoku Univ., Japan
 M. Date, Program Vice-Chair, NTT COMWARE, Japan

Invited Address

11:15

TAOS-TFTs: History and Perspective

H. Hosono
Tokyo Inst. of Tech., Japan

Since the first report of a-IGZO-TFT in late 2004, extensive research has been performed toward real application to the backplane of next generation FPDs. This paper reviews the material design concept of transparent amorphous oxide semiconductors (TAOS) and unique features of TAOS-TFTs along with next challenge.

Workshop on LC Science and Technologies

Wednesday, December 1

13:20 - 16:20

Poster/A.I. Room

Poster LCTp1: LC Materials

LCTp1 - 1 **Effects of LC Compositions on Polymer Stabilized Blue Phase LCs**

*L.-Y. Wang, T.-H. Huang, N. Sugiura, W.-L. Liao,
C.-C. Han*, C.-J. Lung*, P.-L. Jung*, H.-C. Lin**

AU Optronics, Taiwan

**Nat. Chiao Tung Univ., Taiwan*

The compositions of polymer stabilized blue phase liquid crystals (PS-BPLCs) relating to the thermal properties and electro-optical ones which are important for both display performance and productivity were investigated in this paper. By optimizing quantity of chiral-dopants and new monomers, temperature range of the BPLCs could successfully be enlarged.

LCTp1 - 2 **Electro-Optic Response in Blue Phase LC**

*J.-Y. Chou, H.-Y. Chen, S. Chen**

Feng Chia Univ., Taiwan

**Chunghwa Picture Tubes, Taiwan*

In PI-less technology, we don't need PI materials and solvent materials that can attain green process. The final results have some advantages, such as high contrast ratio, high brightness, viewing angles. Finally, we have successively developed a new cell process without PI process for VA mode.

LCTp1 - 3 **High UV Light Resistance and Low Rotational Viscosity LC**

K.-C. Wang, P.-C. Huang, A.-C. Chen, K.-L. Cheng

ITRI, Taiwan

We present the novel trifluoro-methyl vinyl (TfV) liquid crystal materials which possess high photostability. Voltage holding ratio (VHR) result is sustained after the irradiation. TfV LCs provide a reliable UV stability compared with F-containing LCs. Plus, mixtures with the TfV LCs exhibit lower rotational viscosity than well-known bis-cyclohexyl diluents.

LCTp1 - 4 Synthesized Novel Dendritic Molecules and Broadening of Temperature Range in Liquid Crystalline Blue Phases*S. Shibayama, H. Higuchi, H. Kikuchi**Kyushu Univ., Japan*

Liquid Crystalline Blue Phases are promising for applications to tunable photonic liquid crystals because they have three-dimensional photonic bands for visible wavelength. However, narrow temperature range of BPs is a problem to be solved for practical applications. We report the expanded temperature range of BPs with novel dendritic molecules.

LCTp1 - 5 Synthesis and Properties of Novel LCs with Fluorinated Alkenyl Side Chains*T. Sugita, S. Ihara, T. Asai, H. Koh**AGC SEIMI Chem., Japan*

Novel LCs with fluorinated alkenyl side chain have been prepared by using Tetrafluoroethylene. Some of these LCs show low bulk viscosities and moderate virtual clearing points. It is possible that some of these LCs will be useful LC materials for AM LCDs.

LCTp1 - 6 Direct Observation of Polymer Network Structure on Polymer Stabilized Blue Phase*M. Kwak, H. Kwon, D. Han, J. Jeon, J. Park, S. Choi, Y. Choi, D. Koo**LG Display, Korea*

The polymer network structure of polymer stabilized blue phase was directly observed with SEM. As a result of analyzing the polymer of defect structure was clearly detected, polymer chain after eliminate liquid crystal, organized network form like form of sponge. The polymer chain was changed according to the temperature condition.

LCTp1 - 7 Influence of Heating Stir Process on Light-Emitting Properties in LC Electrochemiluminescent Cells*M. Tanimoto, T. Horiuchi, M. Honma, T. Nose**Akita Pref. Univ., Japan*

From the measurement of optical density and photoluminescent intensity in organic fluorescent dye-doped liquid-crystal (LC) cells, heating temperature dependence of both dye concentration and fluorescent quantum yield in sample preparation process have been investigated together with luminance properties of LC electrochemiluminescent cells.

LCTp1 - 8 Difference in the Long-Term Image Degradation of LCD Caused by Two Kinds of Known Impurities Added to the Host Nematic

M. Akimoto^{}, Y. Higuchi^{*}, M. Inoue^{*,**}, Y. Ueda^{*},
S. Kobayashi^{*}, K. Takatoh^{*}*

^{}Tokyo Univ. of Sci., Yamaguchi, Japan*

*^{**}Toyo, Japan*

We investigate the long-term image degradation of LCDs caused by ionic impurities which is intentionally added to a host nematic LC material. Here we use two kinds of illustrative impurities: 4-(Dimethylamino) pyridine and Stearoyl chloride. It turns out that these impurities lead to different kinds of image degradation of LCDs.

LCTp1 - 9L Alignment of Rod-Disc Molecule by AC Electric Field

*S.-E. Kim, J. H. Jung, E. K. Song, K. S. Ha, S. H. Lee,
K.-U. Jeong*

Chonbuk Nat. Univ., Korea

Molecular orientation of chemically linked rod-disc liquid-crystalline in an anti-parallel rubbed LC cell was investigated under vertically applied alternative current electric fields. It was concluded that molecular frustrations under the vertical AC electric field occurred as a result of the competition among rods attached to both sides of the disc.

LCTp1 - 10L Direct Observation of Biaxiality in a Thermotropic Compound Through Measurement of Electro-Optic Characteristics

*B. W. Park, D. H. Song, H.-B. Kwon, E.-J. Choi, J. C. Kim,
T.-H. Yoon*

Pusan Nat. Univ., Korea

^{}Kumoh Nat. Inst. of Tech., Korea*

We investigated biaxiality of a thermotropic compound through the measurement of its electro-optic characteristics. We observed the U-shaped behavior in the V-T curve of the compound, which may be attributed to the biaxiality of the compound.

SID 2011

International Symposium, Seminar and Exhibition

May 15-20, 2011

Los Angeles, California, U.S.A.

LCTp1 - 11L All-Optically Controllable Random Laser Based on a Dye-Doped Liquid Crystal Added with a Photoisomerizable Dye

C.-R. Lee, J.-D. Lin, P.-Y. Huang, T.-S. Mo, S.-Y. Huang***

Nat. Cheng Kung Univ., Taiwan

**Kun Shan Univ. of Tech., Taiwan*

***Chung Shan Medical Univ., Taiwan*

This study investigates an all-optically controllable random laser in a dye-doped liquid-crystal (DDLC). The all-optical controllability is attributable to isothermal N \leftrightarrow I phase transitions of LCs due to *trans* \leftrightarrow *cis* isomerizations of azo-dye, which can vary spatial fluctuations of dielectric property of LCs, subsequently change the lasing intensity of the random laser.

LCTp1 - 12L Fundamental Properties of Extremely Thick PDLC by Using Porous PMMA Materials

T. Ito, R. Ito, M. Honma, T. Nose

Akita Pref. Univ., Japan

Polymer dispersed liquid crystal (PDLC) is investigated by using nematic liquid crystal and porous PMMA materials to attain millimeter-wave (MMW) and/or terahertz-wave (THz) LC control devices. Extremely thick porous PMMA materials are successfully constructed by phase separation in ethanol/water solution and their morphology are observed by SEM.

LCTp1 - 13L Physical Property Improvement of Coatable Polarizer by Photocurable Lyotropic LC Solution

Y.-G. Kim, Y.-J. Bae, K.-U. Jeong, S.-H. Shin, M.-H. Lee*

Chonbuk Nat. Univ., Korea

**Korea Inst. of Ind. Tech., Korea*

We report new preparation method of coatable polarizer from photocurable lyotropic chromonic liquid crystal solution. Thin film polarizer was prepared by coating a photocurable solution of perylenediimide in the chromonic nematic phase with subsequent photocuring. The new method provided various advantages such as excellent coating characteristics and improved mechanical/chemical stability.

Asia Display 2011

Kunshan, China

LCTp1 - 14L Distributed Feedback Laser with Optoelectronic Tunability in Dye-Doped Cholesteric Liquid Crystal with Coated Photoconductive Layer

*C.-R. Lee**, *Huang S.-C.**, *S.-H. Lin**, *Z.-Y. Lin**,
*S.-Y. Huang***, *****, *T.-S. Mo*****

**Univ. of Electro-Optical Sci. & Eng., Taiwan*

***Univ. of Optometry, Taiwan*

****Univ. of Ophthalmology, Taiwan*

*****Univ. of Elect. Eng., Taiwan*

This work investigates, for the first time, an optoelectronically-tunable distributed feedback laser that is based on a planar DDCLC cell with a coated photoconductive (PC) layer. The CLC reflection band and the lasing wavelength of the DDCLC can be tuned by optoelectrical effect.

13:20 - 16:20

Poster/A.I. Room

Poster LCTp2: LC Alignment

LCTp2 - 1 Photoalignment Properties of 2- and 3-Thienylacrylates Bearing Laterally Fluorinated Azobenzene Moieties

G. Hegde, *D. Chambers-Asman***, *A. V. Matharu**,
L. Komitov

Gothenburg Univ., Sweden

**Nottingham Trent Univ., UK*

***Univ. of York, UK*

The photoalignment properties of thin films made from several azo-containing thiophene-based acrylate is reported. Inclusion of a lateral fluoro-substituent(s) provides excellent photo alignment ability whereas the non-fluorinated counterpart tends to give unsatisfactory alignment quality. The study showed that 3-substituted thiophenes give better photoalignment quality than their 2-substituted thiophene isomers counterparts.

LCTp2 - 2 Photoalignment Ability of Thin Films of Bishydrazones Derived from 3,4-Dipropyloxythiophene

R. A. Alla, *G. Hegde*, *K. Ravi**, *A. V. Adhikari**,
*K. A. Krishnamurthy**, *L. Komitov*

Gothenburg Univ., Sweden

**Nat. Inst. of Tech., India*

Photoalignment LC promoted by thin films of bishydrazone derived from 3, 4 dipropyloxythiophene is studied. Results show that bishydrazone without methyl group in their structure is promoting planar alignment parallel whereas the ones with methyl group in the structure are promoting planar alignment perpendicular to light polarization direction.

LCTp2 - 3 Investigation of the Photoalignment Effect of 1,3,4-Oxadiazoles Bearing 2-Fluoro-4-Methoxy Phenyl Moiety

R. A. Alla, G. Hegde, A. M. Isloor, C. B**, P. Shetty***, L. Komitov*

Gothenburg Univ., Sweden

**Nat. Inst. of Tech., India*

***Syngene Int., India*

****Manipal Univ., India*

A new series of 1,3,4-oxadiazole derivatives containing 2-fluoro-4-methoxy moiety were synthesized by refluxing mixture of acid hydrazide 3 with different aromatic carboxylic acid. Photoalignment studies were performed which indicates that the position of fluorine plays vital role in promoting planar alignment either parallel or perpendicular to the light polarization direction.

LCTp2 - 4 Uniformity Enhancement of LC Inorganic Alignment Layer Deposited by the Obliquely Oriented Incidence Direction of Sputtering

J. Kim, G.-J. Lee, K.-J. Yang, H.-K. Lyu, B.-D. Choi

Daegu Gyeongbuk Inst. of S&T, Korea

An inorganic LC alignment layer is widely investigated because of thermal and photochemical stability of LC alignment layer. For uniform LC alignment layer, we compared the conventional oblique deposition with 2-step oblique deposition method by sputtering techniques.

LCTp2 - 5 Hysteresis Reduction in EO Characteristics of Photo-Aligned IPS-LCDs with Polymer-Surface-Stabilized Method

Y. Nagatake, Y. Iimura

Tokyo Univ. of A&T, Japan

An In-Plane-Switching (IPS) LCD manufactured using a photoalignment [PA] method appears the hysteresis at EO performance. In this paper, to solve the problem in PA method, we used a polymer-surface-stabilized (PSS). We have demonstrated a PA method combined to a PSS method is a useful and attractive LC alignment method.

IDW Best Paper Award

This award will go to the most outstanding paper selected from those presented at IDW '10. The 2010 award winners will be announced on the IDW website: <http://www.idw.ne.jp/award.html>

LCTp2 - 6 Effect of Photocurable Monomers on Homeotropic LC Alignment Behaviors of LC/Photocurable Monomer System

J. M. Lee, H. Kang, J.-H. Lee, J. S. Park, J.-C. Lee*, D. Kang*

Soongsil Univ., Korea

**Seoul Nat. Univ., Korea*

We have investigated the effect of photocurable monomers on homeotropic liquid crystal (LC) alignment properties in an LC/photocurable monomer system through UV irradiation. Different homeotropic LC alignment behaviors and electro-optical performances were observed depending on the type and concentration of photocurable monomers and UV irradiation time.

LCTp2 - 7 LC Alignment on Micrograting Structures Photofabricated from Photo-Polymerizable LCs

A. Tsuno, H. Yoshida, H. Kubo, A. Fujii, M. Ozaki

Osaka Univ., Japan

Coexistence of geometric and surface orientation was prepared through the fabrication of micrograting from photo-polymerizable liquid crystals via two-photon excitation direct laser writing. Anchoring energies which were stronger by a factor of 10 were obtained compared to those fabricated from a non-liquid crystalline photopolymer.

LCTp2 - 8 Control of Pretilt Angle and Formation of Bistable Surface by Depositing Alignment Materials by Utilizing an Electro-Spray Deposition Method

Y. Kudoh, Y. Nakanishi, T. Nakano, S. Saito, T. Takahashi

Kogakuin Univ., Japan

An infinite number of minute domains which consist of two kinds of alignment materials were formed on substrate surfaces by the ESD method. The amount of spouted solution of alignment material was varied to control the pre-tilt angle or to give bistable characteristic for the nematic LC cell.

LCTp2 - 9L Alignment of Liquid Crystal on Ion Beam Treated ITO Surface Directly without PI Coating

S. Hwang, J. H. Lee, H. K. Shin, T.-H. Yoon, J. C. Kim

Pusan Nat. Univ., Korea

We propose a liquid crystal (LC) alignment method that can align LC molecules on ion beam treated indium-tin-oxide (ITO) surface. We found that the exposure energy and time need to be over 200 eV and 10 s, simultaneously, for a high quality homogeneous alignment on the ITO surface.

LCTp2 - 10L Selection of Easy Axis by Liquid Crystal on Rubbed PVCi Surface*R. Yamaguchi**Akita Univ., Japan*

We reported that LCs with and without polar groups aligned perpendicular and parallel to a rubbing direction on a rubbed PVCi surface, respectively. Easy axis control of the PVCi was realized by mixing LCs and an alignment patterning was successfully demonstrated by exposing with unpolarized UV light.

13:20 - 16:20**Poster/A.I. Room****Poster LCTp3: Characterizations****LCTp3 - 1 Mechanism for Lattice-Shaped Mura in TFT-LCD***B. C. Woo, K. H. Kim, J. S. Kim, W. H. Kim, S. Y. Han**Samsung Elect., Korea*

Mechanism for lattice-shaped mura is proposed by characterizing the optical properties of LC showing different transmission. The edge in LC droplet exposed in air evaporated more rapidly. These result in the higher concentration of polar singles in edge of dotted LC droplet, leading to the higher Δn and higher transmittance.

LCTp3 - 2 Characterization of Vertical Alignment Film by X-ray Reflectivity*I. Hirose, T. Koganezawa, H. Ishii***Japan Synchrotron Radiation Res. Inst., Japan***Nissan Chem. Inds., Japan*

Existence thin and low density top layer at surface of VA polyimide film, which was considered to be side chains, was detected by X-ray reflectivity. Furthermore, high density layer about 2 nm in thick just below the top layer was found.

LCTp3 - 3 Measurement of Optical Parameters for Birefringent Film Stack*H. T. La, T. Sato**ZEON, Japan*

We described a method for measuring the optical parameters of birefringent stacks consisting of two optical films. The method was applied to a stack sample which is consisted of two stretched plastic films as an example.

LCTp3 - 4 Simultaneous Measurement of Elastic Constants and Anchoring Energy of Homeotropic and Homogeneous Nematic LC Cells by a Capacitance Method

K. Iwaya, H. Naito, H. Ichinose^{}, M. Klasen-Memmer^{**}, K. Tarumi^{**}*

Osaka Pref. Univ., Japan

^{}Merck, Japan*

*^{**}Merck KGaA, Germany*

We have proposed a method for determining simultaneously elastic constants and anchoring energy of nematic liquid crystal (NLC) cells by measuring capacitance – voltage characteristics. The applicability of the present method has been demonstrated in both homeotropic and homogeneous NLC cells.

LCTp3 - 5 Exact Modeling for Nucleation of Defects by Using a Fast Q-Tensor Method

W. S. Kang, S. H. Hur, H. J. Yoon^{}, G. D. Lee*

Dong-A Univ. of Elect. Eng., Korea

^{}Sanayi Sys., Korea*

We apply the surface anchoring energy term to the fast Q-tensor method. Also, we investigate the value of the order parameter S around the surface layer and the generation and motion of defects in the pi cell using the fast Q-tensor method with weak anchoring strength.

LCTp3 - 6 Temperature Dependence of Leslie Viscosity Coefficients of Nematic LC with Negative Dielectric Anisotropy Determined from Transient Current Using a Genetic Algorithm

M. Oka, K. Iwaya, Y. Iwata, H. Naito, M. Inoue^{}, H. Ichinose^{**}, M. Klasen-Memmer^{***}, K. Tarumi^{***}*

Osaka Pref. Univ., Japan

^{}Toyo, Japan*

*^{**}Merck, Japan*

*^{***}Merck KGaA, Germany*

We have derived the analytical expressions of the transient current in homeotropic nematic liquid crystal cells and have determined the Leslie viscosity coefficients by fitting the analytical expressions to the experimental data using a genetic algorithm. The applicability of the algorithm is demonstrated by determining the Leslie viscosity coefficients at different temperatures.

LCTp3 - 7 Determination of Polar Anchoring Energy Based on SOITE Method by Combining a Voltage Correction

K. Tachibana, K. Goda, Y. Kaneko, M. Inoue*,
M. Kimura, T. Akahane*

Nagaoka Univ. of Tech., Japan

**Toyo, Japan*

We proposed a method for determining the surface polar anchoring energy coefficient of nematic liquid crystal cell based on symmetric oblique incident transmission ellipsometry (SOITE) method in which the applied voltage diminution is compensated. The validity of this technique was confirmed by the numerical calculations.

13:20 - 16:20

Poster/A.I. Room

Poster LCTp4: LCD Modes

LCT

LCTp4 - 1 New Pixel Design for PVA Mode LCD Color Shift Improvement

*C.-H. Huang, C.-C. Chen, H.-C. Liang**

Chunghwa Picture Tubes, Taiwan

**Chung Yuan Christian Univ., Taiwan*

Off-axis image quality of MVA Mode LCD has been improved by new pixel design. The simulated result shows that gamma shift at large view angle (i.e. 60 deg) of new Pixel design is reduced 40% compared with conventional PVA design, resulting in decreased color shift at off-axis viewing positions.

LCTp4 - 2 Viewing Angle Switching LCDs Using Large Optically Anisotropic Behaviors of Twisted-Nematic LCs

C.-H. Lin, R.-H. Chiang, M.-L. He, C.-W. Chen, C.-T. Kuo

Nat. Sun Yat-Sen Univ., Taiwan

This work proposes a viewing angle switching (VAS) panel using twisted-nematic liquid-crystals (TN-LCs). With the proposed panel, a display is only perceived clearly at a downward direction in a narrow viewing angle mode to ensure high privacy protection. Additionally, the proposed VAS panel achieves a high transmittance of 95%.

LCTp4 - 3 Comparison of the Cell Process Margin at Each LC Mode

Y. B. Lee, K. H. Park, S. K. Lee

BOE-HF, China

In this paper, we could know the cell process margin at each LC Modes. We compared the T-V characteristics of pre-tilt and cell gap deviation by LC simulator. We confirmed that the FFS mode's cell process margin is wider than other wide viewing angle LC Modes.

LCTp4 - 4 Advanced Twist Nematic LCD

I.-F. Wang, F. W. Kuo, G.-S. Chao, C.-H. Yu
Hannstar Display, Taiwan

An new advanced twist nematic (ATN) liquid crystal display mode which perform wide viewing angle and high contrast has been demonstrated. The ATN is unlike traditional TN mode that exhibits normally-white state and low contrast ratio. It exhibits normally-black state and contrast ratio exceeds 2000:1.

LCTp4 - 5 Switching between Bistable States by Applying Vertical and Horizontal Fields in Chiral Tilted-Homeotropic Nematic LC Cell

T. Nakadate, T. Takahashi, S. Saito
Kogakuin Univ., Japan

Fundamental properties in the bistable chiral tilted-homeotropic nematic (BCTHN) LC device consisting of a nematic LC with a negative dielectric anisotropy are investigated. The switching between bistable states in the (0.2π) and $(-\pi/2, 3\pi/2)$ types of BCTHN devices by applying a vertical field and a horizontal field is investigated.

LCTp4 - 6 47-in. Full HD Transparent Display without Polarizer Using S-IPS Mode LCD Panel

S. H. Park, E. D. Kim, J. S. Park, J. K. Kang, K. H. Lee,
M. C. Jun, I. J. Jung
LG Display, Korea

Transparent 47-in. full HD S-IPS mode with backlight system has been developed. This technology is removing polarizer to make transparent display in IPS mode and design polarized light from TBLU. It is possible to reproduce the window displays by turning on TBLU at indoors and turning off TBLU at outdoors.

LCTp4 - 7 Improvement of Correlated Color Temperature Tracking in In-Plane Switching LCD

S.-H. Ji, S. H. Han, J. M. Yoon, I. C. Park, M. C. Jun,
I. J. Jung
LG Display, Korea

We introduce a method to improve tracking of correlated color temperature (CCT) in the in-plane switching LCD. On the basis of the simulation, we fabricated 17-in. IPS LCD panel to verify the optical characteristic. It exhibits more than 50 percent decrease compared to the conventional IPS LCD in the Δ CCT.

LCTp4 - 8 Reverse Twist Nematic Mode on Stacked Alignment Layer Method

*S. I. Jo, S. W. Choi, A. R. Yoon, S. G. Lee, Y.-J. Lee,
C.-J. Yu, J.-H. Kim*

Hanyang Univ., Korea

We propose an inverse twisted nematic mode without chiral dopant. Using a doubly stacked alignment layer, the enhancement of azimuthal anchoring strength is obtained on the vertical alignment layer and gives rise to a stably twisted configuration in the presence of an applied voltage.

LCTp4 - 9 Low Gray Level Color Shift in Twisted Nematic LCD

F. G. Xu, L. B. Mao, Y. W. Chiu, D. C. Chung, T. S. Jen

InfoVision OptoElect., China

Twisted Nematic (TN) TFT LCD has color shift issue at oblique viewing angles. Cell retardation and back light were investigated in our experiments, color shift will be decreased with the increasing of retardation, reddish or blueish which came from the influence of backlight spectrum.

LCTp4 - 10 Minimize Gamma Variation in TFT-LCD

F. G. Xu, L. B. Mao, Y. W. Chiu, D. C. Chung, T. S. Jen

InfoVision OptoElect., China

The influence of cell parameters and Analog VDD (AVDD) voltage to TFT-LCD's Gamma were investigated. According to the experimental results, pretilt angle and AVDD voltage are key parameters to Gamma, the twist angle and cell gap also have impacts on it. These data are important reference information to process ability control.

LCTp4 - 11 Low-Voltage-Driving LC Lens

*M. Ye, B. Wang, M. Uchida, S. Yanase, S. Takahashi,
M. Yamaguchi*, S. Sato*

Akita R&D Ctr., Japan

**Mitsubishi Materials Elect. Chems., Japan*

An approximately 1 μm thickness thin film of insulator is introduced into a liquid crystal lens cell replacing the substrate between the patterned electrode and the liquid crystal layer. The distance between electrodes decreases drastically, and the driving voltages drops from several tens of volts to only several volts.

LCTp4 - 12 Tunable LC Lens Using Stacked Alignment Layers

*F. Fan, M.-C. Tseng, A. Murauski, H.-S. Kwok,
V. Chigrinov*

Hong Kong Univ. of S&T, Hong Kong

A tunable liquid crystal (LC) lens is achieved using stacked alignment layers. The stacked alignment layer consists of photoalignable homogeneous alignment material and rubbed vertical alignment material. By exposing the stacked alignment layer under UV laser, a lens-like phase retardation profile is got due to the variable pretilt angle.

LCTp4 - 13 Four Primary-Color Pixel Design for Wide Color Gamut

*Y.-H. Kim, S.-H. Han, S. H. Ji, H. S. Lee, J. M. Yoon,
I. C. Park, M. C. Jun, I. J. Jung*

LG Display, Korea

We developed a multiple primary color LCD's (Red, Green, Blue, Cyan). The Color Gamut was extended 103% of NTSC standard. And, we find the optimum solution of asymmetric 4 Primary-Color structure minimizing luminance decreasing ratio.

LCTp4 - 14L Optical Configuration for a Dual Mode Liquid Crystal Display with Infinite Memory Time and High Contrast Ratio

T. Kim, J. H. Lee, C. G. Jhun, S.-B. Kwon*, T.-H. Yoon,
J. C. Kim*

Pusan Nat. Univ., Korea

**Hoseo Univ., Korea*

We propose an optical configuration for a dual mode liquid crystal display with a d/p ratio of 0.25 for infinite memory time and π -twist state as dark state for high contrast ratio. As a result, we obtained a high contrast ratio of 250:1.

LCTp4 - 15L Optical Design of a Bistable TN Cell

D. H. Song, J. H. Lee, K.-H. Kim, J. C. Kim, T.-H. Yoon

Pusan Nat. Univ., Korea

Liquid crystal shutter glasses are used in conjunction with a display screen to create the illusion of a three dimensional image. In this paper, we introduce TN mode fabricated by a dual frequency liquid crystal (DFLC) material with a fast response to remove the flicker.

LCTp4 - 16L Fast Switching of In-Plane Switching Cell with Pixel-Isolating Polymer Walls

J.-W. Kim, D. H. Song, J. C. Kim, T.-H. Yoon
Pusan Nat. Univ., Korea

We propose the in-plane switching liquid crystal mode with the pixel-isolating polymer wall structure using reactive mesogen. With the multi-dimensional LC alignment effect, the proposed mode shows faster response time characteristics than the conventional IPS mode without any loss of the transmittance.

LCTp4 - 17L Tunable Fresnel Lens Using Surface Modification of Vertical-Aligned Liquid Crystals

K. Lin, S. Jeng, T. Chen, S. Hwang*
Nat. United Univ., Taiwan
**Nat. Chiao Tung Univ., Taiwan*

A simple method to make a switchable liquid crystal Fresnel lens with high diffraction efficiency and a low driving voltage was proposed by photo-induced surface modification of vertical alignment layer. Remarkable diffraction efficiency close to the theoretical limit was detected and demonstrated to depend sensitively on the applied voltage.

LCTp4 - 18L Fundamental Performance of Birefringence Imaging System Using a Liquid Crystal Phase Shifter

T. Nose, Y. Aizawa, K. Okano, H. Muraguchi, N. Ozaki, M. Honma, R. Ito
Akita Pref. Univ., Japan

OCB cell is combined with a polarization microscope to construct a birefringence imaging system by introducing the phase shifting interferometry technique. Basic performance of the system is investigated by using a tiny biological sample and quantitative birefringence images are successfully demonstrated.

LCTp4 - 19L Improvement of EO Characteristics for the Reversed-TN LCD by Using Polymer Wall

Y. Ohike, Y. Toko, S. Saito, T. Takahashi*
Graduate School of Kogakuin Univ., Japan
**Stanley Elec., Japan*

The Reversed-TN LCD has a low threshold voltage and a steep sharpness characteristic is known when the d/P_0 is increased. However, the reversed state is unstable for operating. In this study, polymer walls are formed in the cell to stabilize the reversed state and improvement of sharpness characteristic is attempted.

LCTp4 - 20L Passive Matrix Driving Scheme for Bistable Chiral Splay Nematic Liquid Crystal Display with Cross-Talk-Free

*Y. Jin, Z. Hong, J. G. Ying, C. G. Jhun, S. B. Kwon,
J. H. Lee*, T. H. Yoon*, J. C. Kim**

Hoseo Univ., Korea

**Pusan Nat. Univ., Korea*

The BCSN mode is one of promising mode, because it can be operated both as a storage and a monostable device. In this paper, we propose the passive matrix driving scheme for BCSN liquid crystal display. With a dual frequency liquid crystal material, we can suppress the cross-talk effect.

LCTp4 - 21L The Novel Applications and Research of Axial Symmetric Dye-Doped Liquid Crystal Films via Photoalignment Method

*S.-W. Ko, A. Fuh, T.-H. Lin**

Nat. Cheng Kung Univ., Taiwan

**Nat. Sun Yat-Sen Univ., Taiwan*

The research of axially symmetric dye-doped liquid crystal film is demonstrated in paper. Axially symmetric devices were used generally in symmetric optics, such as converting polarized light into axially, azimuthally or vortically light. The novel applications have also been presented in this paper, as polarization-independent liquid crystal lens and tunable donut beam.

LCTp4 - 22L Fast Response Time in Twisted Nematic Mode with a Dual Frequency Liquid Crystal Material for Shutter Glasses

S. H. Han, J. G. Ying, Y. Zhang, Z. Hong, Y. Jin, Y. W. Seo, S. S. Shin, C. B. Moon, C. G. Jhun, M. R. Shin,
J. S. Lim*, J. R. Seo*, B. K. Seo**

Hoseo Univ., Korea

**Bokja Girl's High School, Korea*

Liquid crystal shutter glasses are used in conjunction with a display screen to create the illusion of a three dimensional image. In this paper, we introduce TN mode fabricated by a dual frequency liquid crystal (DFLC) material with a fast response to remove the flicker.

LCTp4 - 23L Fast Switching of Silica Nanoparticle-Doped Hybrid Aligned Nematic Device

*C.-Y. Huang, C.-C. Lai, Y.-J. Huang, J.-H. Chen,
H.-C. Song*

Nat. Changhua Univ. of Education, Taiwan

We improve the response time of the silica nanoparticle-doped HAN cell. A low-frequency AC pulse-voltage driving scheme accelerates the LC relaxation, decreasing the response time of the cell. In the multistable mode, the obtained response time is ~ 23 ms, which is $\sim 4\%$ of our previous result.

13:20 - 16:20

Poster/A.I. Room

Poster LCTp5: Transflective LCDs

LCT

LCTp5 - 1 Extraordinarily Wide-View and Wide Spectral Bandwidth Transflective LCDs

C.-H. Lin, R.-H. Chiang, M.-L. He, C.-W. Chen

Nat. Sun Yat-Sen Univ., Taiwan

This work presents a simple compensation method for widening the viewing angle of transflective liquid-crystal displays (TR-LCDs). Based on the proposed compensation method, the compensated TR-LCDs exhibit a wide spectral bandwidth and a viewing angle of 80° for contrast-ratio (CR) $>100:1$ and $>30:1$ in transmissive and reflective modes, respectively.

LCTp5 - 2 A New Double-Cell Gap Transflective OCB-LCD with In-Cell Compensation Film

I. Fukuda, Y. Sakamoto, T. Ishinabe, T. Uchida***

Kanazawa Inst. of Tech., Japan

**Tohoku Univ., Japan*

***Sendai Nat. College of Tech., Japan*

A new double-cell-gap transflective OCB-LCD with an in-cell compensation film was designed to improve response time and viewing-angle performance of transflective displays. We verified that wide viewing angle and high luminance could be achieved by optimizing design parameters of the LCD, even if the on voltage is lowered to 3 V.

LCTp5 - 3 Design of Transflective LCD Using a Reflective Polarizer without Sub-pixel Division

H.-J. Jin, K.-H. Kim, J. C. Kim, B.-H. Cheong,
H.-Y. Choi*, S. T. Shin*, T.-H. Yoon*

Pusan Nat. Univ., Korea

**Samsung Elect., Korea*

We propose a LCD mode switchable between reflective and transmissive modes without sub-pixel division. By placing a reflective polarizer between the two LC layers, we can employ the entire pixel area for both reflective and transmissive modes. The proposed structure can have transmittance and reflectance higher than conventional transflective LCDs.

LCTp5 - 4 Transflective LCD Using Two Modes

M. S. Park, B. C. Jang, J. Yi, J. H. Kwon, J. S. Gwag

Yeungnam Univ., Korea

We present a transflective liquid crystal display using two modes that are splay state and 180° twisted state obtained from the pi-cell. Here, the splay state operated by horizontal field is used for transmissive part, while the 180° twisted state with vertical field is used for reflective part.

LCTp5 - 5 Single Gap Transflective Vertically Aligned LCD

*D. W. Kwon, D. H. Kim, S. H. Lim, S. J. Shin, J. H. Her,
Y. J. Lim, S. H. Lee*

Chonbuk Nat. Univ., Korea

A transflective liquid crystal display associated with surface polymer-stabilized vertical alignment mode is proposed. The retardation of liquid crystal layer and its azimuthal tilting direction are determined via polymerization of reactive mesogen. As a result, new device with high performance is achieved without using any compensation film or in-cell retarder.

LCTp5 - 6 Withdrawn

----- Break -----

16:40 - 18:05

Room 502

LCT1: Photo Alignment Technology

Chair: H. Okada, Univ. of Toyama, Japan

Co-Chair: I. Hirose, Japan Synchrotron Radiation Res. Inst.,
Japan

LCT1 - 1: Invited The UV²A Technology for Large Size LCD-TV Panels

16:40

*K. Miyachi, N. Kimura, Y. Yamada, S. Mizushima
Sharp, Japan*

We developed the new photo-alignment technology for the large size LCD-TV panel and we successfully applied it to our generation-ten factory. The transmittance, contrast ratio and response time of our panels are drastically improved to evolve the LCD-TVs to the next generation.

LCT1 - 2 Analysis and Implementation of PI Less Technology Applied in TFT-LCDs

17:05

*C. W. Su, J. T. Lien
Chunghwa Picture Tubes, Taiwan*

In PI-less technology, we don't need PI materials and solvent materials that can attain green process. Besides, we don't need complex fabrication and expensive equipment which can achieve saving process time and cost down. The final results have some advantages, such as high contrast ratio, high brightness, viewing angles. Finally, we have successfully developed a new cell process without PI process for VA mode.

LCT1 - 3 Withdrawn**LCT1 - 5L Advanced UV Alignment Technology in IPS-LCD for the Improvement of Color and Viewing Angle**

17:25

*H. J. Ahn, J. W. Woo, C. H. Kwak, W.-S. Kim,
M.-S. Yang, Y.-K. Hwang, I.-J. Chung
LG Display, Korea*

The advanced UV alignment technology was developed to overcome the drawbacks of conventional IPS-LCD. The prototype panel by using UV technology shows wider viewing angle and low color shift compared with the rubbing method. It is thought that the symmetrical LC orientation with zero pretilt angle would induce these enhancements.

LCT1 - 4 Surface Control with Reactive Mesogen for Fast Switching LCD Modes

17:45

*Y.-K. Moon, M.-G. Choi, T.-M. Kim, J.-H. Jeong,
Y.-J. Lee, C.-J. Yu, J.-H. Kim
Hanyang Univ., Korea*

We propose an advanced method to improve response time characteristics of the liquid crystal displays (LCDs) through stacking reactive mesogen (RM) on the alignment layer. The RM polymers enhance the surface anchoring strength, and thus the response time of the LCDs was significantly improved, especially in relaxation time.

Author Interviews

18:00 – 19:00

Thursday, December 2

9:00 - 10:25

Room 502

LCT2: High Performance LC Technology

Chair: M. Inoue, Toyo, Japan
 Co-Chair: K. Miyachi, Sharp, Japan

LCT2 - 1: *Invited* Analysis of Compare Ion Density with Image Sticking Level on Real TFT-LCD Panels

9:00

M. Kwak, H. Kwon, D. Han, J. Jeon, J. Park, S. Choi, Y. Choi, D. Koo

LG Display, Korea

With the use of Ion Density measuring method, the amount of moving ions within TFT-LCD panel was measured. As a result, the mount of moving ions within the panel affected image sticking, and also the measured amount equalled the image sticking evaluation result.

LCT2 - 2 Effect of Process and Material on TFT-LCD's Image Sticking

9:25

Z.-F. Su, S.-N. Zhang, L.-B. Mao, Y.-W. Chiu, D.-C. Chung, T.-S. Jen

InfoVision OptoElect., China

Effects of the process parameter and material on the image sticking have been investigated through experiments. The experimental results show that rising PI pre-bake temperature, reducing cell process steps of color filter and shorting the Q-time and the color resist material with lower VHR are useful in image sticking improvement.

LCT2 - 3 Vertical Alignment of LC with Pretilt by an Ordering Effect of Alkylsiloxane Self-Assembled Monolayers on an Ion-beam-Irradiated SiO₂ Surface

9:45

J.-S. Park, K.-Y. Seok, S.-W. Hwang, J.-C. Kim*, T.-H. Yoon*, J.-H. Kim**, H.-R. Kim*

Kyungpook Nat. Univ., Korea

**Pusan Nat. Univ., Korea*

***Hanyang Univ., Korea*

We investigated a vertical alignment (VA) method of liquid crystals (LCs) by using Alkylsiloxane self-assembled monolayers (SAM) prepared on an anisotropic surface, which was produced by oblique ion beam irradiation. Depending on the surface anisotropy produced on the underlying SAM layer, the pretilt of LC in VA can be controlled. With our method, multi-domain VA LC configuration can be easily and stably obtained by controlling the ion-beam irradiation conditions.

LCT2 - 4 Photo Patterned Micro Polarizer

10:05

T. Du, L. Yao, F. Fan, V. Chigrinov, H. S. Kwok
Hong Kong Univ. of S&T, Hong Kong

In this paper, a photoaligned micro patterned polarizer has been proposed, which is capable of making patterns down to the size of 2 μm . The patterned polarizer consist of three stacked layers including a conventional linear polarizer, a quarter wave plate and a photo patterned quarter wave plate.

----- Break -----

10:40 - 11:55

Room 502

LCT3: New Functional LCDs

Chair: M. Kwak, LG Display, Korea

Co-Chair: K. Ishikawa, Tokyo Inst. of Tech., Japan

LCT3 - 1 Energy Efficient LCDs (e^2 -LCDs) Using Photonic Crystal Structure Based on Cholesteric LC Materials

10:40

M. Suzuki, N. Fujiwara
Merck, Japan

Photonic crystals based on cholesteric liquid crystal materials doped with fluorescent dyes have been developed as simultaneous light emitting and reflecting layer. Novel energy efficient LCDs having the photonic crystal layers can utilize not only backlight but also ambient light.

LCT3 - 2 A Novel Structure of Full Color Cholesteric LCD

11:00

C.-H. Hsieh, Y.-S. Tsai, Y.-C. Lai, Y.-C. Liao, K.-T. Chen,
C.-C. Lai, J.-W. Shiu, G.-W. Wu, S.-Y. Fuh
ITRI, Taiwan

We provided a high reflectance and great color performance of the new structure design for full color cholesteric LCD. This new structure can provide the reflectance close to the triplet stacked ChLCD and wider color gamut but only required two ChLC layers and much simpler driving system hardware.

LCT3 - 3 The Simulation of Single Layer Ch-LCD Panel Design and Color Adjustment Evaluation

11:20

M.-Y. Lu, K.-J. Hu, T.-T. Chang, Y.-Y. Lin, Y.-H. Bai,
W.-J. Li
ITRI, Taiwan

The capability of color exhibition and its accuracy on ChLCD are influenced by the spectrum characteristic of material used, circuit driver and manufacturing process advancement. However, it cost a lot on experiment during development stage. Therefore, color simulation can assist to reduce cost and indicate correct direction of research development.

LCT3 - 4L **In-Plane Switching of a Bent-Core LC(PAL1) with Negative Dielectric Anisotropy in the Homeotropic Cell**
11:40

*Y. Jang, J. K. Vij, C. Tschierske**

Trinity College Dublin, Ireland

**Martin Luther-Univ., Germany*

Electro-optic behavior of bent-core LC(PAL1) in the nematic phase has been studied under vertical alignment. Optically biaxial nematic phase (N_b) is evidenced by measurement using a photoelastic modulator(PEM) and the material in this phase is switchable through the minor director with an in-plane electric field.

----- Lunch -----

13:20 - 14:40

Room 502

LCT4: High Performance LCDs

Chair: M. Suzuki, Merck, Japan

Co-Chair: H. Wakemoto, Toshiba Mobile Display, Japan

LCT4 - 1 **Fast Response TN-LCDs Using Ultra Short Pitch LC Materials**
13:20

K. Takatoh, M. Akimoto, K. Shinohara, Y. Nakamura, S. Kobayashi

Tokyo Univ. of Sci., Yamaguchi, Japan

TN-LCDs with LC materials of the pitch length shorter than the twice of cell width was found to be formed by applying electric field to 270 degree STN-LCD possessing splayed twist molecular arrangement and stabilized by using UV curable monomer. The decay time is improved drastically by using USP TN-LCDs.

LCT4 - 2 **Novel Design of Single Cell Gap Wide-View Transflective LCD Using Twist Fringe-Field Switch Mode without Retarder**
13:40

K.-T. Huang, Y.-W. Hung, K. Chen, L.-L. Huang, W. C. Fang

HannStar Display, Taiwan

A novel single cell-gap transflective liquid crystal display (LCD) with FFS mode has been proposed. The transmissive region is homogeneous aligned. And reflective region is partial twisted and tilted to reach single gap design. In addition, the VT and VR curve is similar by optima pixel electrode width, space, twist and tilt angle in reflective region.

LCT4 - 3 **Withdrawn**

LCT4 - 5L Advanced Hybrid FPA Technology for the VA Mode**14:00***M. Miyakawa, S. Suwa, T. Isozaki, M. Nakamura,
T. Urabe**Sony, Japan*

We developed the advanced Hybrid Field induced Photo-reactive alignment (FPA) technology using FPA alignment material and vertical alignment material. This technology could improve the trade-off property and realize the faster falling response as well as the lower black level.

**LCT4 - 4 Newly Developed Reverse Twisted Nematic LCD
Showing Steep Electro-Optical Characteristics****14:20***M. Akimoto, N. Motoishi, M. Nishitateno, Y. Toko*,
K. Takatoh**Tokyo Univ. of Sci., Yamaguchi, Japan
Stanley Elec., Japan

We present a newly developed reverse twisted nematic liquid crystal display (RTN-LCD) endowed with low pretilt angles. We found that the electro-optical characteristics of the present low pretilt angle RTN-LCD is much steep enough to achieve the maximum duty ratio of 1/480 for multiplex drive.

----- Break -----

LCT

15:00 - 16:10**Room 502****LCT5: Emerging LC Application**

Chair: K. Takatoh, Tokyo Univ. of Sci., Yamaguchi, Japan

Co-Chair: T. Yamaguchi, Chisso Petrochem., Japan

**LCT5 - 1 A Full-Resolution and Glasses-Free 3D Display
Using the OCB-III with a Light Directional Backlight****15:00***T. Higano, K. Nakao, Y. Tanaka, H. Takahara, J. Hanari,
H. Wakemoto**Toshiba Mobile Display, Japan*

We have developed a full-resolution and glasses-free 3D display with no pseudoscopic image in which the OCB-III mode with black insertion and light directional backlight have been applied. The fast response of OCB, black insertion and backlight switching enable us to separate the right/left images clearly and achieve low 3D-crosstalk.

**LCT5 - 2 Image Quality Simulation of Field Sequential Color
15:20 Display with Limited LC Response Time**

*Y.-S. Huang, H.-L. Hou, W.-C. Sun
AU Optronics, Taiwan*

The image quality of field sequential color (FSC) with limited LC response time were simulated by modifying eye-trace integration of MPRT program; we successfully simulated the color mixing phenomenon in FSC with real LC case, the color shift caused by slow LC response can also been demonstrated.

**LCT5 - 3L High-Speed Liquid Crystal Polarization Modulator
15:40 for Time-Multiplexed Stereoscopic 3D Applications**

J. Osterman, T. Scheffer
LC-TEC Displays AB, Sweden
Motif, USA

A high-speed liquid crystal polarization modulator suitable for time-multiplexed stereoscopic 3D applications is proposed. By using a double-cell structure together with a novel driving scheme, polarization compensation can be achieved to hide the optical response during the liquid crystal relaxation process, enabling fast powered switching between two polarization output states.

**LCT5 - 4L An Addressing Technique to Drive Blue Phase LCDs
15:55**

*T. Ruckmongathan
Raman Res. Inst. Bangalore, India*

Bit slice addressing (BSA) is proposed to preserve color purity of images at all angles in fast responding liquid crystal displays with simple data drivers. About 80% reduction in data driver circuit and an average 26.9% reduction in backlight power are achieved with BSA!

Author Interviews

18:00 – 19:00

Friday, December 3

9:00 - 10:20	Room 204
LCT6: Nanostructured LC	

Chair: M. Funahashi, Kagawa Univ., Japan

Co-Chair: M. Kimura, Nagaoka Univ. of Tech., Japan

LCT6 - 1 **Experiment-Based Proposal of Novel Fast-Switching LCDs Using Field-Induced Isotropic-Nematic Transition**

9:00

M. Kosuge^{,**}, S. Naemura^{*}, N. Koma^{**}, T. Tsuyuki^{**}, K. Fujimura^{*}*

^{}Tottori Univ., Japan*

*^{**}Sony Mobile Display, Japan*

The electro-optic effect based upon the electric-field-induced isotropic-nematic transition was investigated using cells with an appropriate electrodes-configuration and surface treatment. Its exhibits a hysteresis-free large optical-transmittance change with viewing-angle-independent deep-dark-level and the response times are less than 1msec, enabling a novel display featuring fast switching and high image quality.

LCT6 - 2 **Electro-Optic Response of Blue Phases**

9:20

H. Choi, H. Higuchi, H. Kikuchi

Kyushu Univ., Japan

The relation between electro-optic response and chiral pitch was investigated in blue phase I and II, respectively in detail. The result also showed that the hysteresis for the transmittance according to the electric field did not appear before the induced phase transition occurs.

LCT6 - 3 **Enhancement of Electro-Optical Performance of Narrow-Gap TN-LCDs by Doping Newly Synthesized Nanoparticles**

9:40

B. Kundu, Y. Shirashi, H. Sawai, K. Takeuchi^{}, N. Toshima, S. Kobayashi*

Tokyo Univ. of Sci., Yamaguchi, Japan

^{}DIC, Japan*

By doping newly synthesized nanoparticles of $P\gamma$, β CyD-ZrO₂ into the host media of narrow-gap TN-LCD the reductions of both the threshold voltage by ~30% and the response times by 20 – 50% were obtained at 25°C and 0°C. These effects are analyzed and clarified through a material research on NLCs and computer simulation.

LCT6 - 4 **Nanoparticle-Mediated Polyimide for Pretilt Angle Control of LC Devices**

10:00

S.-C. Jeng, S.-J. Hwang^{}, Y.-M. Shieh^{*}, S.-C. Chen^{*}*

Nat. Chiao Tung Univ., Taiwan

^{}Nat. United Univ., Taiwan*

The pretilt angles θ_p of LC molecules can be controlled by using conventional polyimide alignment (PI)doped with Polyhedral Oligomeric Silsequioxanes (POSS) nanoparticle. The addition of POSS changes the surface energy of the PI and generates the variable θ_p over the range of $0^\circ < \theta_p < 90^\circ$ depending on the POSS concentration.

----- Break -----

10:40 - 11:55

Room 204

LCT7: New LCD Design

Chair: T. Ishinabe, Tohoku Univ., Japan
 Co-Chair: S. Komura, Hitachi Displays, Japan

LCT7 - 1 **New MVA Design to Improve Color Washout for Mobile Applications**
10:40

Y.-P. Kuo, S.-C. F. Jiang, C.-H. Shih, W.-M. Huang
AU Optronics, Taiwan

We've designed high performance MVA display utilizing different protrusion ratio in one sub-pixel to improve color washout and GTG response time. We get better washout performance, and the washout value improve ratio is 33% lower than conventional MVA and GTG response time reducing range is 36% lower than conventional MVA.

LCT7 - 2 **Transfer 26-in. WXGA LC-TV from TN to Symmetrical Viewing-Angle MVA Mode with Only One-Mask Change without ITO Slits and Protrusions**
11:00

H. L. Ong, J. Chou, X. Y. Wang, Y. Qiao*, Y. W. Chiu*, D. C. Chung*, T. S. Jen**
Kyoritsu Optronics, Taiwan
**InfoVision OptoElect., China*

We successfully transferred a 26-in. WXGA LC TV from the low-end TN to the high-performance AIFV MVA, without protrusions, without ITO slits, and only changed one TN mask. The AIFV MVA process is high-yield and low-cost. The measured transmission of 5.1-5.5% is greater than all published MVA and IPS LC TV.

LCT7 - 3 **TFT-LCD with CVA Technologies**
11:20

H. Zheng, L. Zhou, T.-C. Chung, Y. Qiao, X. Huang, C. Zeng, D. Zhang, C.-T. Liao, Y.-W. Chiu, T.-S. Jen
InfoVision OptoElect., China

We developed a series of CVA technology for high performance and low cost LCD TV applications. The CVA shows a high contrast ratio of over 3500:1, the omni viewing angle performance, and comparatively better gamma dispersion characteristics by adopting a low cost design whose CF without the protrusion bump.

LCT7 - 4L **Fast LC Devices with Lowest Control Voltage**
11:40

A. Andreev, V. Ezhov, I. Kompanets, A. Sobolev***
P.N. Lebedev Physical Inst., Russia
**STEL, Russia*
***Megavision, JSC, Russia*

Novel FLC cells were developed with the response time of about 30÷70 μ s under the electric field 1.0÷2.0 V/ μ m for 1.0 μ m layer thickness (reflectance mode) and 1.3 μ m (transparent mode). Stereo glasses with shutters modulating the light with the frequency 200 Hz at \pm 1.5 V and 1000 Hz at \pm 3.0 V were manufactured.

Author Interviews

16:20 – 17:20

Supporting Organization:

The Japanese Liquid Crystal Society (JLCS)

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Workshop on Active Matrix Displays

Wednesday, December 1

15:00 - 16:25

Room 501

AMD1: AM-LCD

Chair: H. J. Kim, Yonsei Univ., Korea
 Co-Chair: M. Hiramatsu, Toshiba Mobile Display, Japan

AMD1 - 1: *Invited* Characteristics, Their Applications and Trends of LED Backlights

15:00

*K. Otoi, T. Shinomiya, T. Masuda, H. Murakami,
 H. Ichioka, K. Fujiwara, K. Hashimoto, T. Murai
 Sharp, Japan*

LED backlights are becoming major backlight modules of displays instead of CCFL backlights. We summarize characteristics of LED backlights from the viewpoints of LED packages, optical designs, control systems and evaluations with their applications. Then we refer to the trends of LED backlights discussing merits and demerits of those characteristics.

AMD1 - 2 Modeling and Measurement of Ultra-Low Leakage Current of a-IGZO TFTs and New Driving Method of LCDs

15:25

*H. Godo, A. Miyanaga, K. Kusunoki, K. Toyotaka,
 T. Nishi, K. Moriya, S. Fukai, Y. Kubota, K. Wakimoto,
 J. Koyama, S. Yamazaki, Y. Oikawa, K. Okazaki*,
 M. Sakakura**

*Semiconductor Energy Lab., Japan
 Advanced Film Device, Japan

We showed that an a-IGZO TFT has ultra-low leakage current by measurement. We realized new driving method by taking advantage of ultra-low leakage current of an a-IGZO TFT. As a result, the power consumption in displaying images at 1/180 fps is approximately 1/10000 of that at 60 fps.

AMD1 - 3 Advanced Pixel Potential Shift Driving for Flicker Reduction

15:45

*M. Yoshiga, T. Inada, M. Shibazaki, S. Kawata, Y. Matsui,
 H. Watsuda, K. Hashimoto, C. W. Lin*, K. Sano*, D. L. Ting**

*TPO Displays Japan, Japan
 Chimei Innolux, Taiwan

We've successfully developed Advanced Pixel Potential Shift (APPS) driving for flicker reduction to compensate photo leak voltage loss through TFT. Furthermore with backlight luminance sensor it is possible to increase aperture ratio by reducing storage capacitance size. Thus backlight power reduction is also feasible with newly developed APPS driving.

AMD1 - 4 Novel Data Line Sharing Method in AMLCDs for High Resolution Displays

16:05

*W. S. Choi, Y. H. Jang, K.-S. Park, Y. G. Chang,
S. C. Choi, T. W. Moon, J. Y. Seo, H. N. Cho, N. W. Cho,
S. B. Ryu, J. Y. Yang, C.-D. Kim, Y. K. Hwang, I.-J. Chung
LG Display, Korea*

A novel data line sharing method, suitable for high resolution and fast frequency display, has been developed, which has a symmetrical pixel structure. Moreover, we have successfully fabricated the 17.1-in. AMLCD WXGA panel with the new method and the a-Si TFT based circuit integration technology of LG Display's own.

----- Break -----

16:40 - 17:40

Room 501

AMD2: System on Panel & Sensing Device

Chair: A. Heya, Univ. of Hyogo, Japan
Co-Chair: M. Inoue, Chimei Innolux, Japan

AMD2 - 1 Withdrawn**AMD2 - 4L Dynamic Self-Refreshing Memory-in-Pixel Circuit for Ultra Low Power 302ppi LTPS TFT-LCD**

16:40

K. Yamashita, M. Shibasaki, H.-Y. Liang, Y. Matsui,
S. Kawata, C.-J. Chang*, M. Yoshiga, N. Sumi,
T.-Y. Cheng*, T.-W. Kuo*, E.-L. Deng*, W.-J. Lin*
TPO Displays Japan, Japan
Chimei-Innolux, Taiwan

An ultra low power dynamic Self-Refreshing-Pixel Memory In Pixel (SRP-MIP) circuit with 302 ppi is integrated into a 2.65-in. VGA (480RGBx640) transfective LTPS TFT-LCD by using new VA mode. The power consumption in MIP mode is 200 μ W, while keeping the transmissive aperture ratio of 20%.

AMD2 - 2 A Novel Pixel Design of 4-in. QHD TFT-LCD with New Reliable Integrated a-Si Scan Driver (RASD)

17:00

*H. R. Han, W. C. Wang, M. C. Yu, W. C. Tsai, T. H. Lin,
C. H. Huang, H. Y. Chang, M. H. Tsai, F. C. Wu,
W. T. Liao
Wintek, Taiwan*

A novel 4-in. QHD a-Si TFT-LCD with reliable integrated a-Si scan driver (RASD) has been developed. This new circuit is able to resist the V_{th} shift of a-Si TFT after a long-term operation. Furthermore, by introducing fast-switching liquid crystal with protrusion free pixel design, fast response display can also be achieved.

AMD2 - 3 The Polarity Bias Control of Indium Zinc Oxide Thin Film Transistor for Gas Sensor Application

17:20

*L.-F. Teng, P.-T. Liu, Y.-T. Chou, Y.-S. Fan**Nat. Chiao Tung Univ., Taiwan*

An obvious V_{th} shift was observed after gate-bias stress and recovered. This metastability was attributed to the interaction between the exposed a-IZO backchannel and oxygen/moisture from the atmosphere, regardless of the polarity of stress voltage. This water/moisture sensitivity characteristic can be used for gas sensor application.

Author Interviews

18:00 – 19:00

Thursday, December 2

9:00 - 10:20

Room 501

AMD3: Si TFT

Chair: M. Yoshiga, TPO Displays Japan, Japan

Co-Chair: S. Horita, JAIST, Japan

AMD3 - 1 Advanced 405 nm Laser Diodes Crystallization of a-Si Film for the Fabrication of Microcrystalline-Si TFTs

9:00

K. Morimoto, N. Suzuki, M. Yuri, K. Yamanaka, J. Milliez, X. Liu***Panasonic, Japan***Panasonic, USA*

We have proposed a novel crystallization method of a-Si using 405 nm laser diodes and applied it to the fabrication of bottom gate microcrystalline-Si TFTs for the first time. High performance TFTs were successfully demonstrated and the advantage of a 405 nm wavelength was also verified with heat flow simulation.

AMD3 - 2 Fabrication of 15-in. HD WXGA AMOLED Panel with Micro-Crystalline Silicon TFTs by the Indirect Thermal Crystallization (ITC) Method

9:20

*K.-T. Kim, J. H. Bae, S. Lee, B. G. Choi, H. K. Lee, S. K. Kim, K.-S. Park, C.-D. Kim, Y. K. Hwang,**I.-J. Chung**LG Display, Korea*

15-in. HD WXGA AMOLED panel has been fabricated with microcrystalline silicon TFTs adopting indirect thermal crystallization (ITC) method. We developed a-Si TFT based bottom gate process of 7masks, which is suitable for a large sized panel. ITC-TFT showed high mobility and reliable electrical characteristics in a full range of the panel.

AMD3 - 3 **A High Resolution Polymorphous 3ATI AMOLED
9:40** **Display Based on a Low Mask Count Top Gate
Process**

*M. Herrmann, P. Schalberger, H. Baur, N. Fruehauf
Univ. of Stuttgart, Germany*

We processed a grayscale-compliant 3ATI type display with high resolution driven by an integrated gate driver based on our new polymorphous silicon top gate process. Due to the selective deposition of n-doped silicon onto metal D/S contacts a lower mask count compared to well established bottom gate processes was achieved.

AMD3 - 4 **Drain Bias Effect on Characteristics of Leakage
10:00** **Current for Various Back-Surface State Density**

*C.-S. Wei
AU Optronics, Taiwan*

Device leakage current for drain bias effect has been investigated. Furthermore, the back-surface state density is a key parameter for lower the reverse sub-threshold leakage current under smaller drain operation. Display application for high drain operation was also introduced when device off-state driving region was different.

AMD

----- Break -----

10:40 - 12:10

Room 204

FLX5/AMD4: Flexible Active-Matrix Devices

Chair: K. Tsukagoshi, NIMS-MANA, Japan

Co-Chair: T. Shiro, Teijin, Japan

FLX5/ **Invited Application of Organic Thin-Film Transistors**
AMD4 - 1: **for Circuits on Flexible Foils**

10:40

P. Heremans^{,**}, K. Myny^{*,**}, H. Marien^{**},
E. V. Veenendaal^{***}, S. Steudel^{*}, J. Genoe^{*},
M. Steyaert^{**}, G. H. Gelinck^{****}*

^{}imec, Belgium*

*^{**}Katholieke Univ. Leuven, Belgium*

*^{***}Polymer Vision, the Netherlands*

*^{****}Holst Ctr. TNO, the Netherlands*

We present the state of the art of digital and analog circuits (in particular code generators for RFID tags, amplifiers, AC-DC and DC-DC converters) using organic TFTs on plastic foil, and discuss some design considerations needed to overcome today's technology limitations.

FLX5/ AMD4 - 2: Invited A Rollable OTFT-OLED Display

11:05 *I. Yagi, M. Katsuhara, A. Yumoto, N. Kobayashi, M. Noda, R. Yasuda, S. Ushikura, G. Yukawa, N. Hirai, K. Nomoto, T. Urabe*

Sony, Japan

A rollable OLED display, which can be rolled-up in a radius of 4 mm, is driven by a newly-developed OTFT backplane. The backplane equips with an integrated gate driver circuit and it is constructed of OTFTs using a self-developed organic semiconductor, a PXX derivative.

FLX5/ AMD4 - 3 The High Stability and Uniformity a-IGZO Thin Film Transistors Array for AM-OLED Application

11:30 *J.-Y. Yan, H.-C. Yao, Y.-P. Chen, C.-Y. Hung, Y.-Y. Wu, K.-Y. Ho, H.-C. Cheng*

ITRI, Taiwan

The high stability and uniformity amorphous InGaZnO₄ TFTs were fabricated on plastic substrate. We optimize the process and abandon the ES layer to reduce photomask and processing time. The mobility, SS and V_{th} of a-IGZO TFTs is 7.33 cm²/Vs, 0.42 V/dec and 0.79 V. The lifetime of AMOLED is exceeding 10 years.

FLX5/ AMD4 - 4 Full Color AM-LCDs on Flexible Glass Substrates

11:50 *S. Hoehla, S. Garner*, M. Hohmann, O. Kuhls, X. Li*, A. Schindler, N. Fruehauf*

Univ. of Stuttgart, Germany

**Corning, USA*

We have realized a full color 4-in. quarter-VGA amorphous Silicon AM-LCD on 75 μm flexible glass substrates. With this work we demonstrate that the incorporated ultra-thin glass substrates have suitable properties to be compatible with a standard color AM-LCD process and achieve active matrix backplanes with reliable performance.

----- Lunch -----

IDW '11

The 18th International Display Workshops

December 7-9, 2011

Nagoya Congress Center

Nagoya, Japan

<http://www.idw.ne.jp>

13:20 - 16:20

Poster/A.I. Room

Poster AMDp: Active-Matrix Devices**AMDp - 1 New Compensation Method for Image Distortion by the Ripple of Common Electrode in TFT-LCDs***K. H. Kim, W. K. Moon, M. S. Kim, J. H. Park, J. K. Song***Samsung Elect., Korea***Sungkyunkwan Univ., Korea*

The ripple of common electrode by internal capacitive coupling in TFT-LCDs makes a falling-off in image quality like horizontal crosstalk and greenish phenomenon. To improve these defects, some compensation methods have been used since long ago, but not perfect. This paper proposes more advanced methods to maximize the improvement effect.

AMDp - 2 Withdrawn**AMDp - 3 A Novel Depletion Mode IGZO TFT Gate Driver Embedded with a Level Shifter***B. Kim** , S. B. Ryu** , S. C. Choi** , S.-H. Choi** ,
Y. H. Jang** , K.-S. Park** , C.-D. Kim** , Y.-K. Hwang** ,
I.-J. Chung** , M.-K. Han****Seoul Nat. Univ., Korea****LG Display, Korea*

We propose and design a new gate driver embedded with a level shifter employing depletion mode In-Ga-Zn-O thin film transistors. The SPICE simulation results exhibit that the gate driver successfully generates an output-pulse without any distortion. The proposed circuit would be an important building block for an oxide TFT display.

AMDp - 4 Stabilization for Integrated Gate Driver Circuit with High Temperature Operation in Large-Sized Panel*C.-D. Tu, C.-E. Wu, C.-L. Lin**Nat. Cheng Kung Univ., Taiwan*

A new gate driver circuit using 11 TFTs, one capacitor and 4 signals is proposed. Based on the measurement of a-Si:H TFT, the threshold voltage shift can be reduced by adjusting the duty ratio. The simulation result shows the proposed circuit can implement over than 24 hours at high temperature.

AMDp - 5 A Voltage Regulator Using Chopper Comparators for LTPS-TFT

*T. Mizuno, M. Yoshida
Tokai Univ., Japan*

In this paper, a voltage regulator using chopper comparators for LTPS-TFT (Low Temperature Poly Silicon-Thin Film Transistor) is proposed. The proposed circuit can reduce the maximum deviation rate of the output voltage (V_{OUT}) for the device mismatch. In addition, the power efficiency of the proposed circuit is 58%.

AMDp - 6 A Novel a-Si TFT Gate Driver with Simplified Logic Circuit for Three Level Driving Application

*J. Lu, Y. Qiao, C.-T. Liao, T.-C. Chung, T.-S. Jen
InfoVision OptoElect., China*

A novel circuit with a simple four-TFT- three-clock structure which was implemented to GIA for reducing the cost of TFT-LCD was proposed. It could output the three- level waveform. By implementation of this 3-level gate driving scheme, both low cost and high aperture ratio could be achieved simultaneously.

AMDp - 7 An Active-Matrix Backplane Design Using Shadow-Masking Techniques to Create Economically Attractive Devices with Integrated Drivers

*C. E. Harrigal, W. Little
Advantech US, USA*

Through shadow-masking techniques, we have economically produced active-matrix backplanes with integrated driving circuitry. The TFT's have speeds and currents necessary to drive E-Paper and OLED front-planes. Additionally, they have leakage currents low enough to have power consumption advantages.

AMDp - 8 Integrated Potentiostat Using Thin-Film Transistors with Electrochemical Cell

Y. Imuro^{}, K. Bundo^{**}, Y. Sagawa^{**}, K. Setsu^{*},
M. Kimura^{*,***,****}*

^{}Ryukoku Univ., Japan*

*^{**}Nara Inst. of S&T, Japan*

*^{***}Joint Res. Ctr. for S&T, Japan*

*^{****}Innovative Materials & Processing Res. Ctr., Japan*

We developed an integrated potentiostat using TFTs with an electrochemical cell. Poly-Si TFTs and three electrodes are fabricated on a glass wafer. Cyclic voltammetry for enzyme and redox reactions is executed, and a glucose concentration of 0.4 mM can be detected, which is sufficient sensitivity for some medical applications.

AMDp - 9 Embedded Touch Sensing Circuit Using the Body Capacitance for AMOLED Displays

Y.-J. Park, S.-J. Seok, S.-H. Park, O. Kim
POSTECH, Korea

The embedded touch sensing circuit is proposed and simulated for AMOLED display. Unlike LCD which has a variable capacitor, there is no a variable capacitor in OLED structure so that we artificially make the variable capacitor in the sensing pixel to detect the touch using the concept of body capacitance.

AMDp - 10 Peculiar Charge Pumping Characteristics and Exploration of MOS Interfaces in Large-Grain LTPS TFTs

T. Kato, G. Kawachi, T. Tsuchiya*
Shimane Univ., Japan
**ALTEDEC, Japan*

The charge-pumping characteristics in LTPS-TFT were investigated to understand the electronic-properties near the MOS interface. It was found from the investigation that there are some scattered dense regions of interface traps, which are considered to correspond to joining points of the grain boundaries.

AMD

AMDp - 11 Polycrystalline Silicon Thin Film Transistors with Simultaneous Realization of Threshold Voltage Adjustment and Nickel Drive-in

W. Zhou, S. Zhao, R. Chen, M. Wong, H.-S. Kwok
Hong Kong Univ. of S&T, Hong Kong

A new fabrication process of metal induced crystallization polycrystalline silicon (poly-Si) Thin Film Transistors (TFTs) is proposed. Threshold voltage adjustment and nickel drive-in is simultaneous realized by boron implantation after nickel sputtering. Threshold voltage of TFTs is greatly reduced, while the current on/off ratio, mobility and sub-threshold slope are maintained.

AMDp - 12 Characteristics of Thin Film Transistors Fabricated by Solid Phase Crystallization and High Speed Lateral Crystallization Induced by Micro-Thermal-Plasma-Jet Irradiation

*S. Hayashi, S. Higashi, H. Murakami, S. Miyazaki**
Hiroshima Univ., Japan
**Nagoya Univ., Japan*

Thin Film Transistors (TFTs) were fabricated by Solid Phase Crystallization (SPC) and High Speed Lateral Crystallization (HSLC) Si films fabricated by Micro-Thermal-Plasma-Jet irradiation with different plasma-substrate gap. Characteristic variation of SPC-TFT was suppressed to less than 1%, while HSLC-TFT achieved a very high field effect mobility of 260 cm²/Vs.

AMDp - 13 Crystallization of Sputtered Si Films by Blue Laser Diode Annealing (BLDA) for Photo-Sensor Application

J. D. D. Mugiraneza, K. Shirai, T. Suzuki, T. Okada, T. Noguchi, H. Matsushima, T. Hashimoto*, Y. Ogino*, E. Sahota**

Univ. of the Ryukyus, Japan

**Hitachi Computer Peripherals, Japan*

Results of various spectroscopic methods showed the thick sputtered-Si films entirely crystallized with preferred orientation as (111) after BLDA. Superficial layer turns into lateral grains while underlying layer grows into columnar grains. Photo-electrical characteristics show BLDA is promising for fabrication of advanced poly-Si photo-sensor and for thin film photovoltaic cells.

AMDp - 14 Microwave Remote H⁺ Plasma Passivation for Self-Release Nickel Induced Crystallization (SR-NIC) Polycrystalline Silicon Thin-Film Transistors (TFTs)

S. Zhao, W. Zhou, R. Chen, Z. Meng, M. Wong, H. S. Kwok

Hong Kong Univ. of S&T, Hong Kong

In this study, microwave remote H⁺ plasma treatment was applied to self-release nickel induced crystallization (SR-NIC) polycrystalline silicon thin-film transistors (poly-Si TFT). By applying microwave remote plasma treatment, intra-grain and grain boundary trap states in the poly-Si film can be passivated. So, performance of p-channel TFT can be improved significantly.

AMDp - 15 Withdrawn

AMDp - 16 Dependence of Poly-Crystallization on Scanning Velocity of Blue-Multi-Laser-Diode Annealing (BLDA)

K. Shirai, J. D. D. Mugiraneza, T. Suzuki, T. Okada, T. Noguchi, H. Matsushima, T. Hashimoto*, Y. Ogino*, E. Sahota**

Univ. of the Ryukyus, Japan

**Hitachi Computer Peripherals, Japan*

Undoped amorphous Si (a-Si) thin films prepared by radio frequency (RF) sputtering were poly-crystallized by changing the scanning velocity of BLDA. Arbitrary grain size structure and high crystallinity of grains can be realized for the sputtered a-Si film by controlling the scanning velocity of BLDA.

AMDp - 17 Influence of Grain Size on Gate Voltage Swing and Threshold Voltage of Poly-Si Thin Film Transistors

F. Oshiro, K. Shirai, T. Noguchi, T. Ohachi, H. M. Koo**, H. S. Choi***

Univ. of the Ryukyus, Japan

**Doshisha Univ., Japan*

***LG Display, Korea*

A model of the gate voltage swing considering interface trap, bulk trap and grain size is proposed. The threshold voltage can be given to estimate I_d - V_g characteristics by grain size and Si thickness. The proposed model successfully explains a behavior of practical TFT in weak and strong inverted region.

AMDp - 18 Crystallization Mechanism of a-Ge and a-Si Films by SR Soft X-Ray Irradiation

Y. Nonomura, S. Amano, A. Heya, N. Isoda, S. Miyamoto, K. Kanda, N. Matsuo, T. Mochizuki, T. Sadoh, M. Miyao**

Univ. of Hyogo, Japan

**Kyusyu Univ., Japan*

We investigated low-temperature crystallization of a-Ge, a-Si and a-SiGe films by the SR soft X-ray irradiation at storage ring current of 25-220 mA and dose quantity of 50 mA·h. The relationship between electron excitation-atom movement process, thermal process and the storage ring current are investigated.

AMDp - 19 Plasma Annealing of ZnO:Al Capping Layer for Thin-Film Transistors

N. Ohta, Y. Imamura, S. Sato, D. Ohba, H. Shimizu, H. Shirai*

Saitama Univ., Japan

**Saitama Ind. Tech. Ctr., Japan*

The rapid thermal annealing of a-Si/SiO₂/ZnO:Al(AZO) heterostructure was studied using the rf thermal plasma jet of argon. The crystallization of Si and AZO layers was enhanced without creating intermixing layer at the Si/SiO₂/AZO interfaces by adjusting the plasma conditions. These findings are effective to improve the TFT performance.

AMDp - 20 Effect of Back-Channel Treatment on the Photo-Leakage Current of a-Si TFTs

C.-Y. Yang, C. Y. Lin, S.-C. Huang, C.-Y. Huang, H.-L. Chen

AU Optonics, Taiwan

Different treatments onto the back-channel region of a-Si TFTs are performed, including different plasma treatments. By comparing namely the "beta" parameter, it is discovered that beta is the smallest under H₂ treatment and the largest as no treatment is performed, which just corresponds to the photo-leakage behaviors under these treatments.

AMDp - 21 Systematic Measurement of Negative Gate Bias Instability and Application for Power Consumption Display

*C.-S. Wei, S.-W. Huang, P. M. Chen, J.-S. Chen,
C. T. Peng, W.-M. Huang*

AU Optronics, Taiwan

Negative bias stress with variously gate bias driving board have several reliability results when gate bias duty ratio and wait time as the next gate bias driving was applied. Results show that permanent degradation and instantly recovery was observed when gate bias driving mode was different.

AMDp - 22 Influence of Silicon Nitride and Amorphous Silicon on the Stability of Amorphous Silicon Thin-Film Transistors

*C.-Y. Hou, S.-H. Lin, J.-K. Chang, H.-L. Chen,
C.-H. Chen*

AU Optronics, Taiwan

A systematic study of amorphous silicon (a-Si) TFTs fabrication process with high stability for driver circuit application has been investigated. Using the bias temperature stress measurement, it is discovered that the threshold voltage shift is more dominated by the quality of the active layer than the dielectric layer.

AMDp - 23 Determining Factor of the Preferential Crystal Orientation of the Growth of Microcrystalline Silicon Films by rf PE-CVD of a SiH_2Cl_2 and H_2 Mixture for Silicon Thin-Film Transistors

D. Ohba, Z. Tang, H. Shirai

Saitama Univ., Japan

The factor determining the preferential crystal orientation in the growth of microcrystalline silicon films was studied by the rf PE-CVD of a SiH_2Cl_2 and H_2 mixture. The sticking process of deposition precursors and/or reconstruction of Si clusters within the subsurface region determines the growth of the preferential (220) crystal orientation.

AMDp - 24 Highly Stable Amorphous Indium-Gallium-Zinc Oxide TFT with Photosensitivity Organic Passivation Layer for AM-OLED Display

*L. C. Lee, H. C. Ting, F. W. Chang, T. H. Shih,
C. W. Chou, H. H. Lu, C. Y. Chen, Y. H. Lin*

AU Optronics, Taiwan

A method to improve the amorphous IGZO TFTs environment stability is demonstrated in this study. An organic passivation layer without acryl element has high anti-water absorption ability. [1, 2] The TFTs were effectively fabricated with good performance by using conventional process.

AMDp - 25 Three TFT Pixel Circuit with Highly Stable OLED Current for AMOLED

*K.-W. Chou, C.-C. Hung, F.-C. Chang, C.-L. Lin
Nat. Cheng Kung Univ., Taiwan*

This work proposes a novel voltage-programming pixel circuit for AMOLED using a-Si:H technology. The proposed 3T1C circuit can stabilize the output current regardless of V_{TH} shift and OLED degradation. Experimental results indicate that the OLED current degradation is less than 3% over more than 16 h of operation.

AMDp - 26 Frequency Characteristics of Solution-Processed Organic Field-Effect Transistors with Self-Aligned Electrodes

T. Nagase^{,**}, H. Hatta^{*}, Y. Miyagawa^{*}, T. Kobayashi^{*,**},
S. Murakami^{***}, M. Watanabe^{****}, K. Matsukawa^{****},
H. Naito^{*,**}*

^{}Osaka Pref. Univ., Japan*

*^{**}The Res. Inst. for Molecular Elect. Devices, Japan*

*^{***}Tech. Res. Inst. of Osaka Pref., Japan*

*^{****}Osaka Municipal Tech. Res. Inst., Japan*

We have fabricated the solution-based organic FETs with polymer gate insulators using a self-aligned method and investigated their frequency characteristics. The fabricated organic FETs exhibit electrically stable operation and have extremely low parasitic capacitance. Impedance spectroscopy of organic FETs with self-aligned electrodes reveals frequency-dependent channel formation process in FET structure.

AMDp - 27 Polymer Thin-Film Transistors with a Solution-Processed Passivation Layer

*F.-C. Wu, Y.-T. Chen, Y.-W. Jang, H.-L. Cheng
Nat. Cheng Kung Univ., Taiwan*

Poly(3-hexylthiophene)-based (P3HT) thin-film transistors (TFTs) made from different solvents were fabricated. After covering the P3HT active layers with a solution-processed passivation layer, the mobility of P3HT TFTs was enhanced. We suggest that some vacancies in the P3HT active layers should be filled with solvent molecules to promote carrier transport.

AMDp - 28 Synergistic Effect of Light Illumination and Bias-Stress on Threshold Voltage Shift of Ink-Jet Printed TIPS-Pentacene Thin-Film Transistor

*T. H. Hwang, S. H. Lee, S. H. Kim, M. H. Choi, J. Jang
Kyung Hee Univ., Korea*

We have studied the electrical stability of the ink-jet printed TIPS-pentacene TFT with Ag source/drain electrodes. We have measured the gate bias-stress effect in dark, and the gate bias effect under light illumination. The results are discussed with the carrier trappings at the interface and in the bulk.

AMDp - 29 Anomalous Photocurrent Characteristic at Negative Gate Bias

*T. Inoue, M. Tsubuku, M. Takahashi, A. Miyanaga,
S. Yamazaki*

Semiconductor Energy Lab., Japan

We conducted light irradiation to IGZO TFT at negative bias applied to its gate and found anomalous photocurrent characteristics. On calculation model, we well reproduced this phenomenon by assuming relaxation time with different length for holes and electrons. This analytical technique will be effective in discussing levels in the bandgap.

AMDp - 30 Effects of Additive Elements on TFT Characteristics in Amorphous IGZO Films under Light Illumination Stress

S. Morita, S. Yasuno, A. Miki, T. Kugimiya

Kobe Steel, Japan

We have studied effects of additive elements on light-induced threshold voltage (V_{th}) shift in amorphous IGZO TFTs. By addition of Hf or Si, V_{th} shift due to light illumination, negative-bias and thermal stress was successfully suppressed. The suppression could originate from a decrease in hole trap at the gate-IGZO interface.

AMDp - 31 Direct Correlation of Photo Conductivity Decay with Transistor Performance in Amorphous Oxide Semiconductor Films Evaluated by Microwave Photo Conductivity Decay Method

*S. Yasuno, S. Morita, A. Miki, T. Kugimiya, F. Ojima**

Kobe Steel, Japan

**Kobelco Res. Inst., Japan*

The microwave photoconductivity decay method was applied to evaluate film quality of IGZO, an amorphous oxide semiconductor. The peak reflectivity was correlated with transistor performance. Also, μ -PCD mappings over the films were undertaken. The μ -PCD method was useful to predict device performance of AOS TFTs fabricated under various process conditions.

AMDp - 32 Study on Oxygen-Dependent Instability of Amorphous In-Ga-Zn-O TFT and Completely Stable Device under Both Positive and Negative Bias Stresses

W.-T. Chen, H.-W. Zan, S.-Y. Lo, S.-C. Kao, C.-C. Tsai, J.-H. Lin, C.-H. Fang*, C.-C. Lee**

Nat. Chiao Tung Univ., Taiwan

**AU Optronics, Taiwan*

An experiment is conducted to verify the origin of stress-induced instability in an amorphous indium-gallium-zinc-oxide (a-IGZO) thin-film transistor. It is found that the oxygen ratio in an IGZO layer strongly influences the device stability under bias stress. For realizing an adequately stable device, post-annealing and passivation are performed in order.

AMDp - 33 Effect of Active Layer Thickness on the Indium-Gallium-Zinc-Oxide TFTs

S.-J. Kim, S.-Y. Lee*, J.-Y. Kwon*, W.-G. Lee**, K.-S. Yoon**, Y.-W. Lee***, M.-K. Han**

**Seoul Nat. Univ., Korea*

***Samsung Elect., Korea*

IGZO TFTs with various active-layer thicknesses were investigated. V_{TH} of TFT with 400 Å activelayer was -0.6 V at R.T. and shifted 0.83 V at 230°C while that of TFT with 700 Å active-layer was -1.2 V and shifted 2.3 V. We have investigated the effect of active-layer thickness on the IGZO TFTs.

AMDp - 34 Channel Dimension and Hysteresis Behavior on ALD-Prepared Transparent ZnO Thin Film Transistor

W.-S. Choi, Y.-J. Kwack, J.-S. Lee, E.-S. Chun

Hoseo Univ., Korea

Different thickness of active layer in ZnO bottom-contact thin-film transistors (TFTs) were fabricated by using injector type atomic layer deposition (ALD). The properties of the ZnO TFT were influenced by the active thickness and width-to-length (W/L) ratio of device. The hybrid gate dielectrics were examined to investigate hysteresis behaviors.

AMDp - 35 Shadowmask-Controlled Circuit Fabrication - an Obsolete Technology Resurrected

T. P. Brody, C. E. Harrigal, W. Little

Advantech US, USA

Advantech has revived the shadowmask process of manufacturing TFT circuits, which promises low cost, in-line system fabrication of active matrix backplanes and other circuits. We discuss the philosophy and justification of the revived process and report on initial results of color AMOLED and e-paper backplanes.

AMDp - 36L Evaluation of Hall Effect in Micro Poly-Si Hall Devices to Analyze Electron Transport in Poly-Si Films

H. Hashimoto^{}, Y. Yamaguchi^{*}, M. Hirako^{*}, T. Yamaoka^{*}, M. Kimura^{*,**,**}*

^{}Ryukoku Univ., Japan*

*^{**}Joint Res. Ctr. for S&T, Japan*

*^{***}Innovative Materials & Processing Res. Ctr., Japan*

Hall effect in micro poly-Si Hall devices is evaluated to analyze electron transport in poly-Si films. The Hall voltage has offset voltage even when magnetic field is zero. The polarity is reversed when control current is reversed. The offset voltage is caused by zigzag paths of the electron transport.

AMDp - 37L Dependence of Trap Density in SPC Poly-Si TFT on Temperature and Time of Post Annealing

M. Kimura

Ryukoku Univ., Japan

Dependence of trap densities in SPC poly-Si TFTs on post annealing temperature and time is evaluated using low-f C-V characteristics and extraction algorithm. The trap densities can be reduced by increasing the temperature and time, which is brought by the extinction of crystal defects. The activation energy is roughly 2 eV.

AMDp - 38L High-Performance Amorphous InGaZnO Thin-Film Transistors with High-k Sm₂O₃ Gate Dielectrics

F.-H. Chen, Y.-H. Shao, W.-C. Li, T.-M. Pan

Chang Gung Univ., Taiwan

In this paper, we developed high-k Sm₂O₃ indium-gallium-zinc oxide thin-film transistor (IGZO TFTs) with and without RTA treatment. The high-k Sm₂O₃ oxide TFT device annealed at 400°C exhibited better electrical characteristics in terms of a large effective carrier mobility, high-driving current, low-threshold voltage, and high I_{ON}/I_{OFF} current ratio.

AMDp - 39L High-performance LTPS TFT for High-k Tb₂O₃ with CF₄ Plasma Treatment

F.-H. Chen, Z.-H. Li, Y.-H. Shao, W.-C. Li, T.-M. Pan

Chang Gung Univ., Taiwan

The high-k Tb₂O₃ poly-Si TFT device using a 20 W plasma power treatment exhibited good electrical performances, including a high effective carrier mobility, a low-threshold voltage, a small subthreshold slope, and a high I_{ON}/I_{OFF} current ratio. It also enhanced electrical reliabilities including hot carrier and positive bias temperature instability.

AMDp - 40L Performance Enhancement of Organic Thin-Film Transistors Using Bathophenanthroline:Cs Electron Injection Layer

J. Kim, H. Son, J. Yang, M. Yi

Pusan Univ. of Elec. Eng., Korea

We fabricated organic thin film transistor (OTFT) with Bphen:Cs electron injection layer between organic semiconductor(C_{60}) and metal electrode to improve the electrical performances. Mobility and on-current of the device with Bphen:Cs electron injection layer were increased more than twice compared with the normal device without the injection layer.

AMDp - 41L Predicting Realistic Reliability Using DC Bias Stress

Y.-J. Hsu, M.-H. Lee, J.-T. Peng, W.-M. Huang

AU Optronics, Taiwan

A new method was proposed for predicting reliability of TFT during realistic panel operations. Based on traditional bias-temperature stress data, more accurate predictions regarding threshold voltage shift can be obtained and used in real panel operations.

AMDp - 42L Bias Dependent of Threshold Voltage Shift of a-Si:H TFT with DC and AC Stress on the Gate Electrode

S. W. Jeong, D. Y. Park, H. Choi, K. H. Moon, Y. S. Choi, D. H. Koo

LG Display, Korea

We have investigated the threshold voltage shift(ΔV_{th}) of a-Si:H TFTs induced by Bias-Temperature-Stress(BTS) conditions. Our Research showed that, the ΔV_{th} has bias-dependence due to the various DC(direct current) BTS. Also, instead of DC BTS, AC(alternating current) BTS was applied to extrapolate the ΔV_{th} induced by reliability evaluation.

AMDp - 43L Width Dependent Degradation of Amorphous Si:H Thin Film Transistors Due to Self-Heating Effect

D. Y. Park, D. H. Nam, S. W. Jeong, H. Choi, K. H. Hoon, Y. S. Choi

LG Display, Korea

In this paper, we have investigated the channel width effect on the stability of a-Si:H TFTs. Results of this paper show that the electrical stress causes positive V_T shift and subthreshold slop degradation. As the channel width gets wider, the degradation derived under stress is more increased.

AMDp - 44L Gate-Drain-Bias Stress Study of Amorphous In-Ga-Zn-O TFTs

C.-Y. Wu, Y.-C. Kao, C.-Y. Huang, C.-N. Lin, C. H. Chen
AU Optronics, Taiwan

The stability of amorphous indium gallium zinc oxide (α -IGZO) TFTs under different gate and drain bias stress is discussed in this paper. The stress effect of different channel-width testkey is also shown in this article.

AMDp - 45L Self-Assembled Monolayer Gate Dielectric for Low Voltage Driving Pentacene Thin-Film Transistors

D. Lee, J. H. Lee, S. W. Kim, J.-S. Kim, D. Y. Jeon*
KAIST, Korea
**Imperial College London, UK*

In this study, pentacene thin-film transistors were fabricated with n-octadecylphosphonic acid as self-assembled monolayer gate dielectric on a plastic substrate. Also we fabricated pentacene TFTs with SiO₂ dielectric on a Si wafer for comparison. The range of V_G was remarkably decreased from -40 V to -3 V comparing to SiO₂ dielectric devices.

AMDp - 46L Lateral Large-Grained Low-Temperature Poly-Si_{1-x}Ge_x TFTs on Glass Substrate

Y. Okabe, K. Kondo, K. Hirose, J. Suzuki*, K. Kitahara*, A. Hara*
Tohoku Gakuin Univ., Japan
**Shimane Univ., Japan*

We fabricated lateral large-grained poly-Si_{0.95}Ge_{0.05} TFTs on glass substrates at a low process temperature of 550°C and obtained a field-effect mobility of 130 cm²/Vs. This value is larger than those of previously reported researches. We realized the fabrication of high-performance TFTs with reduced thermal damage to glass substrates.

AMDp - 47L Solution Process for Metal Oxide Thin Film Transistors under 350°C Post-Annealing

W. H. Jeong, J. H. Bae, K. M. Kim, D. L. Kim, Y. S. Kim, S. J. Kim, H. J. Kim, M.-K. Ryu, K.-B. Park*, J.-B. Seon*, S.-Y. Lee**
Yonsei Univ., Korea
**Samsung Advanced Inst. of Tech., Korea*

We have investigated solution process for metal oxide thin film transistors under post-annealing temperature of 350°C. Process engineering which includes materials, precursors, and gate insulators acts important roles under 350°C post-annealing process for large-area deposition.

16:40 - 18:05

Room 501

AMD5/OLED6: AM-OLED

Chair: D. Pribat, SungKyunKwan Univ., Korea

Co-Chair: Y. Fujisaki, NHK, Japan

**AMD5/
OLED6 - 1: Invited Process Development of Amorphous Indium-
Gallium-Zinc-Oxide Thin-Film Transistors for Large
Size AMOLED Applications**

16:40

*H.-C. Ting, H.-H. Lu, T.-H. Shih, L.-C. Lee, C.-W. Chou,
L.-P. Shin, S.-S. Wang, T.-C. Wan, C.-Y. Chen, Y.-H. Lin**AU Optronics, Taiwan*

In this paper, we will show how to approach a-IGZO TFTs AMOLED in Gen 6 Fab currently. We evaluated the TFTs structure from bottom gate coplanar to BCE type with Mo/Al/Ti as S/D electrode. Using photosensitive organic passivation layer and TiO_x coating to improved the device performance and stability.

**AMD5/
OLED6 - 2 High Mobility Oxide Semiconductor TFT for Circuit
Integration of AM-OLED**

17:05

*E. Fukumoto, T. Arai, N. Morosawa, K. Tokunaga,
Y. Terai, T. Fujimori, T. Sasaoka**Sony, Japan*

We have developed a high mobility and high reliability oxide semiconductor TFT which used ITZO as a channel material. Its mobility and ΔV_{th} after 20,000sec of BTS test were 30.9 cm²/Vs and 0.1 V. We have achieved a stable enhancement type TFT, which realizes circuit integration for AM-OLED.

**AMD5/
OLED6 - 3 A New Simple Pixel Circuit Compensating the
Threshold Voltage for AMOLED Displays**

17:25

*Y.-I. Hwang, Y.-S. Park, K.-N. Kim, B.-H. Kim,
B. H. Berkeley, S.-S. Kim, B.-D. Choi***Samsung Mobile Display, Korea***Sungkyunkwan Univ., Korea*

We propose new simple pixel compensation circuits with three or four thin film transistors (TFTs) and one capacitor. In addition to compensating the deviation of the threshold voltage of the driving TFTs, we can compensate IR-drops and reduce the number of components in compensation circuits with these novel circuits.

**AMD5/
OLED6 - 4
17:45** **4.1-in. Full Color AMOLED Driving by Top Gate
Nanocrystalline Silicon Thin Film Transistor Array**
*K.-Y. Ho, H.-C. Lin, H.-S. Dai, P.-F. Lee, C.-C. Hsu,
S.-Y. Peng, C.-W. Lin, C.-H. Cheng, B.-C. Kung,
W.-Y. Chao, J.-Y. Yan, H.-C. Cheng*
ITRI, Taiwan

High performance nanocrystalline silicon thin film transistors are achieved with top gate staggered structure. The nc-Si is directly deposited by 13.56 MHz plasma enhanced chemical vapor deposition (PECVD) at 200°C. Good device performance, uniformity, and reliability make it possible to be integrated into active matrix organic light emitting diode (AMOLED) applications.

Author Interviews

18:00 – 19:00

Friday, December 3

9:00 - 10:10

Room 501

AMD6: Organic & Carbon TFT

Chair: P. Heremans, imec, Belgium
Co-Chair: K. Nomoto, Sony, Japan

**AMD6 - 1: *Invited* Organic Single Crystals with Band-Like
9:00 Transport in Field-Effect Transistors**

K. Tsukagoshi^{,**}, C. Liu^{*}, T. Minari^{*,**}*

^{}NIMS-MANA, Japan*

*^{**}CREST-JST, Japan*

We report organic single crystals transistor formed by solution process. A self-organized phase separations to form an amorphous semiconductor film on insulator-polymer by spin-coating the mixture of the semiconductor molecule and insulator-polymer realized the band-like transport with high mobility up to 9.1 cm²/Vs after annealing in solvent vapor.

**AMD6 - 2: *Invited* Field Effect Transistors Based on Organic
9:25 Semiconductors and Graphene**

*K. Tanigaki, S. Ikeda, X. Fan, R. Nouchi, Y. Wang,
N. Mitoma*

Tohoku Univ., Japan

Organic semiconductors and graphene are described as new field effect transistors (FETs). Graphene shows high mobility as well as long spin coherent length, because of the mass-less Dirac states and the small spin-orbit coupling, relevant in spintronics. Ambipolar carrier injection can be realized in organic semiconductors useful for future optoelectronics.

AMD6 - 3 **A Spin Coating Process for High Mobility of Organic Transistor**
9:50

P.-Y. Lo, J.-M. Ding, C.-W. Liu, C.-C. Chou, J.-P. Hu
ITRI, Taiwan

We reach device mobility of $2 \text{ cm}^2/\text{V}\cdot\text{s}$ in this study. The high mobility OTFT is integrated into a VGA display panel of OTFT-EPD with the Sipix electrophoretic medium for further demonstration.

----- Break -----

10:40 - 12:00	Room 501
AMD7: Oxide TFT (1)	

Chair: K. Tanigaki, Tohoku Univ., Japan
 Co-Chair: K. Azuma, Shimadzu, Japan

AMD7 - 1: *Invited* Characteristic of the Hysteresis on ZnO TFT with SiO₂ Gate Oxide
10:40

Z. Ye, M. Wong
Hong Kong Univ. of S&T, Hong Kong

AMD

Hysteresis in the current-voltage characteristic is observed in a ZnO TFT with silicon dioxide as the gate dielectric; and presently attributed to delay flipping of electric dipoles located at the interface between the dielectric and the channel. Potential application to the realization of an electronic memory element is also reported.

AMD7 - 2 **Improvements in the Characteristics of Solution-Processed Zinc-Tin Oxide Thin-Film Transistors by Adding H₂O in the ZTO Solution**
11:05

Y.-U. Lee, J.-S. Lee, Y.-J. Kim, S.-H. Cho, B. Kim,
Y.-H. Kim, M.-K. Han*
Seoul Nat. Univ., Korea
**KETI, Korea*

We fabricated solution-processed ZTO TFTs with various ZTO solutions in order to investigate the effect of H₂O on the electrical properties of TFTs. In the case of the ZTO TFT fabricated with H₂O added ZTO solution, the mobility and subthreshold slope were better than those of conventional ZTO TFTs.

**AMD7 - 3 A Novel Method of Low Contact Resistance
11:25 Treatment in Solution Metal Oxide TFT Fabrication**

*K.-H. Su, C.-C. Yu, Y.-C. Lai, C.-Y. Chien, L.-Y. Lin,
J. P. Tseng, F.-W. Chang
AU Optronics, Taiwan*

In our research, IZO ($\text{In}_2\text{O}_3\text{-ZnO}$) prepared by sol-gel method was applied to thin film transistor (TFT) fabrication as semiconductor layer. To protect channel region in a vacuum system and improve the contact interface between metal oxide semiconductor and S/D metal simultaneously, we introduced a half-tone method to IZO TFT device.

**AMD7 - 4L High Stability of Inkjet Printed Indium Zinc Oxide
11:45 Thin Film Transistors**

*K.-B. Park, M.-K. Ryu, J.-B. Seon, K.-H. Lee, S.-Y. Lee,
W. H. Jeong*, J. H. Bae*, H. J. Kim*
Samsung Advanced Inst. of Tech., Korea
Yonsei Univ., Korea

We report the fabrication of Indium zinc oxide transistors using inkjet printing. The compositions of dropped IZO films have high stoichiometric characteristics. The IZO field effect transistors were fabricated showing a field-effect mobility of $0.2 \text{ cm}^2/\text{Vs}$. An electrically and thermally biased stability showed a threshold voltage deviation of 0.66 V for 3 hours.

----- Lunch -----

13:20 - 14:40

Room 501

AMD8: Oxide TFT (2)

Chair: H.-H. Hsieh, AU Optronics, Taiwan
Co-Chair: H. Hamada, Sanyo Elec., Japan

**AMD8 - 1: Invited Impact of Density of States Near Valence
13:20 Band on Photo-Stability in InGaZnO TFTs**

*J.-W. Park, W.-G. Lee, G.-S. Youn, D.-H. Lee, S.-H. Cho
Samsung Elect., Korea*

From the photo-stability test for InGaZnO TFTs under gate bias, the relationship between threshold voltage shift and DOS near VBM was analyzed. The threshold voltage shift after 3 hours of gate bias stress with illumination decreases to less than 3.5 V due to the reduction of DOS near VBM.

**AMD8 - 2 Photo-Current Response and Negative Bias
13:45 Stability Under Light Irradiation in IGZO-TFT**

*M. Tsubuku, T. Inoue, M. Takahashi, S. Yoshitomi,
H. Kanemura, K. Akimoto, A. Miyanaga, S. Yamazaki
Semiconductor Energy Lab., Japan*

Photo-current response and negative bias stability under light irradiation become issues in using In-Ga-Zn-O thin film for TFT. We report the improved photo-characteristics seen by comparing three TFTs. A sample with good characteristics has small and fast photo-response, and it is expected traps within a band gap would become few.

**AMD8 - 3 Transportation Model Establishment of InGaZnO for
14:05 Thin Film Transistor Device Application**

*L.-F. Teng, P.-T. Liu, Y.-T. Chou, Y.-S. Fan
Nat. Chiao Tung Univ., Taiwan*

The transportation model of on electrical metastability of a-InGaZnO TFT is established. The generation of oxygen vacancies by the annealing in a vacuum led to an increased I_{off} and large V_{th} shifts, while N_2 and O_2 ambience effectively improve the device performance. A physical mechanism is also reasonably proposed.

AMD

**AMD8 - 4L Influence of TFT Structure & Process Condition on
14:25 the Extent of IGZO Stability & Mobility**

*Y.-C. Kao, C.-N. Lin, K.-Y. Tu, F. Wu, D. Tu, C. Shieh,
C. Wu, R. Lin, P. Lu, H.-M. Sung, W.-C. Tsai, C.-H. Chen
AU Optronics, Taiwan*

IGZO TFT with different structures and process conditions were studied. Structure of BCE type has higher mobility ($10 \text{ cm}^2/\text{Vs}$). The stability & IV uniformity of IGZO TFT is improved by surface modification of IGZO film. The T65/240Hz LCD display driven by IGZO TFT is also fabricated.

----- Break -----

15:00 - 16:05

Room 501

AMD9: Nanodevice & Oxide TFT

Chair: J.-W. Park, Samsung Elect., Korea
Co-Chair: H. Kumomi, Canon, Japan

AMD9 - 1: Invited Thin Film Transistors with Semiconductor Nanowires
15:00

D. Pribat

Sungkyunkwan Univ., Korea

Semiconductor nanowires are new nanomaterials, studied for thin film transistors and electronics applications. Although these nanomaterials are usually synthesised at moderate to high temperatures, they can be transferred to any kind of substrate after growth, paving the way for the fabrication of displays and large area electronics systems on plastic.

AMD9 - 2 Amorphous In-Ga-Zn-Oxide TFTs with High Stability Against Bias Temperature Stress
15:25

N. Saito, T. Ueda, S. Nakano, Y. Hara, K. Miura, H. Yamaguchi, I. Amemiya, A. Ishida, Y. Matsuura*, A. Sasaki*, J. Tonotani, M. Ikagawa*

Toshiba, Japan

**Toshiba Mobile Display, Japan*

Detailed investigations of amorphous In-Ga-Zn-Oxide (a-IGZO) TFT revealed that the degradation under bias-temperature stress (BTS) originated from hydrogen-diffusion phenomena. By optimizing the initial a-IGZO film and the intermediate annealing, and lowering hydrogen concentration in insulators, BTS stability was improved. A 3.0-in. OLED panel showed excellent luminance uniformity.

AMD9 - 3 The Instability of a-IGZO TFT Caused by the Drain Induced Barrier Lowering (DIBL) and Parasitical TFT
15:45

M.-C. Hung, C.-H. Tu, W.-T. Lin, J.-J. Chang, P.-L. Chen

AU Optronics, Taiwan

The instability of a-IGZO TFT—including oxygen and water and photosensitivity effect—has been studied widely, but no definitive mechanism was given so far. In this work, the instability caused by the drain induced barrier lowering (DIBL) as well as parasitical TFT was studied and a proposed model was provided.

Author Interviews

16:20 – 17:20

Supporting Organization:

Thin Film Materials & Devices Meeting

Workshop on FPD Manufacturing, Materials and Components

Wednesday, December 1

16:40 - 18:00

Room 409

FMC1: Optical Films

Chair: Y. Iimura, Tokyo Univ. of A&T, Japan

Co-Chair: M. Miyatake, Nitto Denko, Japan

FMC1 - 1: *Invited* Vacuum Particle Beam Methods for 16:40 Alignment of Reactive Mesogens

O. Yaroshchuk, R. Kravchuk, E. Telesh, A. Khokhlov**,
O. Parri****

NAS of Ukraine, Ukraine

**Belorussian State Univ. of Informatics & Elect.,
Belarus*

***Izovac, Belarus*

****Merck Chems., UK*

The vacuum particle beam processes of liquid crystal alignment are successfully extended to reactive mesogens (RMs). In this series, etching process is preferable for planar/tilted alignment, while deposition processes for homeotropic alignment. Combining these processes various laminated and patterned structures are realized showing attractive solutions for optical and electronic films.

FMC1 - 2 Negative Dispersion Retarder for 3D TV Applications 17:00

A. Geivandov, A. Lazarev, P. Lazarev, S. Palto**,***

Crysoptix, Japan

**Kontrakt, Russia*

***Inst. of Crystallography RAS, Russia*

Crysoptix has developed lyotropic liquid crystal (LLC) materials for manufacturing coatable LCD retarders. LLC coated on plastic substrates produces a negative dispersion TBF™ retarder that provides an efficient optical compensation of LCD and can be used for 3D LCD applications: circular polarizers for screens and goggles; patterned retarders for stereoscopic imaging.

FMC1 - 3 Low-Reflective Wire-Grid Polarizers Exhibiting High Performance in Visible Region

17:20

*A. Takada, T. Yamada, N. Hanashima, K. Sasaki,
E. Takahashi, M. Suzuki**

Sony Chem. & Info. Device, Japan

**Kyoto Univ., Japan*

We have developed low reflective wire-grid polarizers in visible region. The structure consists of absorptive layer/gap layer on wire-grid. Both the high transmittance and low reflectance in the desired wavelength range have been achieved by the selection of absorptive material and the optimization of the thickness of each layer.

FMC1 - 4 Adhesive Design of Transparent PSA Sheets for Multi-Function Mobile-Use Display

17:40

H. Fumoto, H. Kishioka

Nitto Denko, Japan

LUCIACS series is transparent PSA sheets. It is suitable for laminating of Multi-Function Mobile-Use display such as touch panels. The new adhesive could be designed without acid components and it is optimum for the capacitive type touch panel.

Author Interviews

18:00 – 19:00

Thursday, December 2

9:00 -12:00

Poster/A.I. Room

Poster FMCp: FPD Manufacturing, Materials & Components

FMCp - 1 Light Guide with Reverse-Cone Textures for Sheetless Backlight

9:00

*C. G. Son, S. K. Hwang, J. S. Gwag, J. H. Yi, J. H. Kwon,
G. Park*, W. T. Moon**, S. H. Kim**, B. K. Kim**,
S.-H. Kang**

Yeungnam Univ., Korea

**Sunlin Univ., Korea*

***LG Display, Korea*

A lightguide panel with reverse-cone array textures on the top surface is designed and fabricated to develop a sheetless edge-lit backlight. The optimum structure of reverse-cone texture was obtained by simulation and a lightguide without any prism sheet was fabricated by attaching the reverse-cone textures by using UV resin.

FMCp - 2 Brightness Enhancement in LCDs Using the High Color Temperature (HCT) of Panel

H. J. Wang, Y. J. Kim, S. W. Lee, I. C. Park, M. C. Jun, I. J. Jung

LG Display, Korea

Brightness improvement of LCD was achieved nearly 6% by means of high color temperature (HCT) of panel and lamp tuning. A new high transmittance property of blue resin was designed to achieve HCT of panel. For the compensation of panel color temperature down, high luminance lamp was used.

FMCp - 3 One Dimensional Coupler Lens for LED Collimation

W.-H. Yang, H.-H. Lin, C.-J. Hsu, Y.-N. Pao

ITRI, Taiwan

We have developed a one dimensional coupler lens for LCD Backlight. At the optimum curvature and size, the light out through the lens has a high-collimating emitting property, in which the simulation FWHM is smaller than 1.8° . The FWHM of the prototype is collimated to 5.07° .

FMCp - 4 Design of LED Illumination Devices Based on Reflectors

B.-W. Lee, J. H. Lee, J.-H. Ko, J. Wang, H. Kim**

Hallym Univ., Korea

**GLS, Korea*

LED illumination devices based on reflectors were designed to realize specific illuminating distributions and compared to those based on lenses. Both reflector-based and lens-based LED lighting devices showed the targeted distributions satisfactorily. However, reflector-based devices exhibited higher optical efficiencies compared to lens-based devices due to reduced light losses.

FMCp - 5 Withdrawn**FMCp - 6 7-in. Field Emission Backlight Unit Assembled for LCD Panel with TiO₂ Coated Spacer**

M.-T. Chian, W.-C. Shih, J.-M. Jeng*, Y.-L. Lee*, P.-T. Tai*, C.-H. Cheng*, J. Lo**

Chunghwa Picture Tubes, Taiwan

**Tatung Univ., Taiwan*

The field emission backlight unit for LCD panel was fabricated in this work. In order to avoid the space charge on the spacer, the spacer is coated with TiO₂ which acts as the charge-leakage layer. By introducing the TiO₂ coated spacers, the assembly of the FEBLU becomes very easy.

FMCp - 7 Withdrawn

FMCP - 8 Properties of Transparent Conducting IZTO Electrode Deposited at Room Temperature

Y. D. Ko, J. Y. Kim, H. C. Joung, D. J. Son^{}, D. G. Jung^{*},
B. H. Choi^{**}, Y. S. Kim^{***}*

Samsung Mobile Display, Korea

^{}Sungkyunkwan Univ., Korea*

*^{**}Korea Inst. of Ceramic Eng. & Tech., Korea*

*^{***}Seoul Nat. Univ. of Tech., Korea*

IZTO films have been deposited by pulsed DC magnetron sputtering onto glass substrate to investigate the effect of oxygen partial pressure. The structural, electrical, optical properties were analyzed. In addition, the grown IZTO films were used in fabrication of organic-emitting diodes (OLEDs) as anode to study the device performances.

FMCP - 9 Electrical Property Improvements by Inserting Buffer Layer for Impurity-Doped ZnO Transparent Electrodes Prepared by Magnetron Sputtering Depositions

J. Nomoto, T. Hirano, T. Miyata, T. Minami

Kanazawa Inst. of Tech., Japan

Improvements of obtainable resistivity in Al- or Ga-doped ZnO (AZO or GZO) thin films prepared by magnetron sputtering depositions were successfully achieved by inserting a very thin buffer layer. A resistivity of approximately $3 \times 10^{-4} \Omega\text{cm}$ was obtained in 150-nm-thick-GZO and -AZO thin films prepared on glass substrates at 200°C.

FMCP - 10 Effects of Superimposing RF Power on the Preparation of Impurity-Doped ZnO Transparent Electrodes by DC Magnetron Sputtering

J. Nomoto, T. Hirano, T. Miyata, T. Minami

Kanazawa Inst. of Tech., Japan

The effects of superimposing RF power on the preparation of transparent conducting impurity-doped ZnO films by d.c. magnetron sputtering depositions were investigated for transparent electrodes used in FPDs. Superimposing appropriate RF power produced a decrease in both deposition damage and obtainable resistivity as well as an increase of deposition rate.

FMCP - 11 Improving S/D Resistance in Zinc Tin Oxide TFT with Atmospheric Plasma Surface Treatment

*S. J. Oh^{**}, Y. H. Kim^{*}, J. W. Kang^{**}, M. S. Oh^{*}*

^{}KETI, Korea*

*^{**}Dankook Univ., Korea*

Atmospheric plasma treatment of zinc tin oxide (ZTO) surfaces has been studied and demonstrate to be efficient method in improving the performance of TFT characteristics. Our result suggest that atmospheric plasma treatment is a cheaper, more convenient, and more efficient method than low-pressure plasma treatment for improving device performance.

FMCP - 12 Optimisation of a Mass Analyzed Multiple Beamline for the Ion Implantation of Very Large FPD Substrates

D. Aitken

Superion, UK

Beam extraction from a large area source with an array of parallel long double extraction slots is optimized using magnetic fields to minimize plasma losses between these double slots. This paper also introduces a variable geometry analyzing magnet giving control of resolving power and the transmitted ion mass range.

FMCP - 13 Development of Dose Distribution Control as a Countermeasure against Pressure Variations Resulted from Photoresist Outgassing

*T. Matsumoto, K. Imai, M. Konushi, K. Orihira,
Y. Nakazawa, M. Onoda, K. Nakao, Y. Inouchi,
J. Tatemichi, M. Konishi, M. Naito*

Nissin Ion Equipment, Japan

An accurate dose distribution control system was developed for an ion implanter for LTPS-TFT to improve dose uniformity under photoresist outgassing. Excellent uniformity was exhibited even in a case of a gas pressure increase of one order of magnitude. The system does not have a negative impact on the throughput.

FMCP - 14 Organic Light-Emitting Diodes Fabrication by Electro Spray Deposition Process

W. T. Hwang, N. H. Kim, H. Y. Chae

Sungkyunkwan Univ., Korea

We have demonstrated organic light emitting diodes (OLED) fabrication with electro spray deposition (ESD) as a solution process alternative. OLED fabricated with ESD shows good performance in terms of surface smoothness and brightness. Current efficiency (cd/A) of device which is fabricated by ESD shows better performance than that of spincoated device.

FMCP - 15 Optimum Design of Single-Slit Mask Applied for High Performance TFT-LCDs

S.-J. Choi, Y.-S. Im, G.-B. Hui, F. Zhang, K.-Y. Kim,
W.-S. Yoon*, J.-S. Xue, J.-Y. Lee*

BOE Tech. Res. Inst., China

**Beijing BOE Display Tech., China*

Optimum single slit mask design applied by gray-tone photolithography had been established by simulation and experiments. We found out that transmittance of single slit was influenced by TFT channel length, size and shape. We obtained optimum design factor of single slit and achieved a fine channel to improve TFT characteristics.

FMCP - 16 Analysis and Fabrication of PSS Technology Applied in TFT-LCD Displays

C. W. Su, A. Mochizuki, J. T. Lien*

Chunghwa Picture Tubes, Taiwan

**Nano Loa, Japan*

We have succeeded to achieve 1.7 μm cell gap thickness and good liquid crystal alignment. In finally results, the response time (rising time and falling time) is less 1 ms. However, PSS technology is compatibility in an LC panel mfg with conventional mfg lines. Besides, we also have succeeded to develop 15.4-in. PSS-LCD.

FMCP - 17 New Structure of Transflective LCD without HMDS

Y. Wu, J. Ma, S. Huo, X. Luo, Z. Xia, Z. Ling

Shanghai Tianma Micro-Elect., China

An approach of coating organic material onto the silicon nitride insulate layer without HMDS process is invented, eliminating the peeling off phenomenon originated from the etching undercut. The panel process is simplified, and a fully function sample is fabricated.

FMCP - 18 Transparent Conductive Film Incorporating Silver Halide Photographic Technologies

T. Kuriki, A. Ichiki, K. Yokota

FUJIFILM, Japan

Fujifilm has developed "EXCLEAR", a new transparent conductive film based on silver-halide photography technologies, offering advanced transmittance, advanced flexural performance and wider sheet resistance ranging from ultra-low (0.2 ohm/sq) to high (several thousand ohm/sq) with the combination with inorganic / organic transparent conductive materials.

FMCP - 19 Wettability Improvement by Silica Nanoparticle for TIPS-Pentacene

K. Matsukawa, S. Yamazaki^{,**}, S. Tokai^{*}, M. Yoshikawa^{**},
T. Nagase^{**}, T. Kobayashi^{**}, Y. Michiwaki^{***}, S. Watase,
M. Watanabe, H. Naito^{**}*

Osaka Municipal Tech. Res. Inst., Japan

**Citizen Holdings, Japan*

***Osaka Pref. Univ., Japan*

****Fuso Chem., Japan*

It is essential to control the wettability of soluble organic semiconductors on gate dielectrics for organic field-effect transistors using solution processes. We found that the addition of a small amount of silica nanoparticles (SNPs) drastically improves the wettability of soluble organic semiconductor of 6,13-bis(triisopropylsilyl)ethynyl)pentacene onto the hydrophobic gate dielectric of poly(methylsiloxane).

FMCP - 20 Photo-Patternable Silicon-Organic Hybrid Glass with Silsesquioxane Derivatives

*T. Fuke, D. Yokoyama, Y. Tashiro, T. Sekito, T. Nonaka
AZ Elect. Materials, Japan*

We succeeded in development of photo-patternable Silicon-Organic Hybrid Glass with siloxane derivatives comprised of silsesquioxane incorporated with silica unit. The cured film has high optical transparency, thermal stability and chemical durability together with excellent photolithographic property. Here we demonstrate successful usage of photo-patternable silicon-organic hybrid glass materials and lithography patterning.

FMCP - 21 Interface Engineering with a Hole-Transporting SAM for Organic Electronics

*C.-L. Lin, W.-S. Hsieh, S.-M. Chang
Nat. Taipei Univ. of Tech., Taiwan*

A series of organic compounds based on triphenylamine were designed with two substitute groups and a carboxyl group, which was connected to TiO₂ surface by self-assembled monolayers (SAMs). The modified TiO₂ was applied in organic electronics and measured the optical properties to confirm the characteristic of light-harvesting.

FMCP - 22 Evaluation of TIMs on Thermal Dissipation Performance for Power LEDs

*P. F. Ji, B. H. Kim, W. K. Hong, C. H. Moon
Hoseo Univ., Korea*

This experiment evaluates the function of TIMs in thermal management by comparing the effects of TIMs and ceramic substrates on thermal dissipation performance for high power LEDs. It was demonstrated that ceramic substrate gave a bigger change than TIMs in thermal dissipation characteristic.

FMCP - 23 Properties of Transparent Conductive Ga-doped ZnO Films in Bending

K. Nagamoto, Y. Matsubayashi, T. Kondo, Y. Sato,
H. Makino*, N. Yamamoto*, T. Yamamoto*
LINTEC, Japan
Kochi Univ. of Tech., Japan

Transparent conducting polycrystalline Ga-doped ZnO (GZO) films were deposited on polyester substrates by ion-plating deposition with direct current arc-discharge at process temperature of less than 100°C. We evaluated the mechanical bending properties of GZO films and obtained the relationship between bending properties of GZO films and process temperature.

FMCP - 24 Passivation Effect of F+Y Monolayer on Yttria-Stabilized Zirconia (YSZ) Layers of LTPS*S. Horita**JAIST, Japan*

Crystallized Si films are obtained on glass substrates covered with poly-YSZ layers at temperature lower than without YSZ by over 100°C. From XPS analysis, we proposed F+Y monolayer formation on the chemically cleaned YSZ layer, which supports Si crystallization. Crystallization model with it can explain the results quantitatively.

FMCP - 25 Atmospheric Plasma and Process for Liquid Crystal Alignment*O. Yaroshchuk, R. Kravchuk, S. Pogulyai, V. Tsiolko**NAS of Ukraine, Ukraine*

The method of liquid crystal alignment is developed based on combination of atmospheric plasma and rubbing processes. In this tandem, rubbing insures uniformity, while plasma process provides tuning of anchoring parameters. High-quality alignment is realized with a pretilt angle controlled in the range 0°-90°. The samples demonstrate excellent electro-optic performance.

FMCP - 26 Effective Method for Electrode Pattern Positioning in Touch Screen Panel*S.-J. Seok, Y.-J. Park, S.-H. Park, O. Kim**Pohang Univ. of S&T, Korea*

We propose the effective way of internal electrode pattern positioning in projected capacitive touch screen panel. By changing the way of alignment, the distance, and height between two electrodes, we estimate capacitance values and the change of each value using a simulator. Finally we present a proper example of placement.

FMCP - 27L Enlargement of Polycrystalline Si Grain on Polycarbonate Substrate Prepared by Conventional Laser Annealing*N. Kawamoto, T. Imamura*, Y. Tomizawa*, K. Tadamoto**Yamaguchi Univ., Japan***Teijin, Japan*

In this paper, we discuss the crystal growth mechanism of polycrystalline Si grain by conventional laser annealing on polycarbonate substrate. We show the polycrystalline Si grain of diameter with over 150 nm by conventional laser annealing on polycarbonate substrate.

FMCP - 28L Display Performance of PSVA-LCD Using Reactive Mesogen Monomer Induced Alkyl Spacer

R. Kawakami, S. Niiyama, Y. Nakagawa, Y. Soda**

Asahi Glass, Japan

**Optrex, Japan*

We proposed a novel UV curable reactive mesogen (RM) monomer for Polymer-Stabilized Vertical Alignment (PSVA) LCD. The experimental results reveal that the PSVA by the novel RM monomer realizes less image sticking and better response time. In addition, the novel monomer needs less UV irradiation energy to be cured.

FMCP - 29L Dye Absorption Properties of the TiO₂ Electrodes Coated with Al₂O₃ for a Dye Sensitized Solar Cell(DSSC)

S.-C. Choi, H.-S. Lee, S.-H. Sohn

Kyungpook Nat. Univ., Korea

The surface of TiO₂ electrode in the DSSC was coated with Al₂O₃ nanoparticles by a sol-gel method. Because Al₂O₃-coated TiO₂ (pH9.48) is more basic than bare TiO₂(pH3.9), the higher basicity of Al₂O₃-coated TiO₂ surface favors dye attachment through its carboxylic acid groups. Thus dye absorption of Al₂O₃-coated TiO₂ is enhanced.

FMCP - 30L Surface Modification of the TiO₂ Electrode for Dye Sensitized Solar Cells (DSSCs)

H.-S. Lee, S.-C. Choi, S.-H. Sohn

Kyungpook Nat. Univ., Korea

The surface of TiO₂ electrode, photo-anode in DSSCs, was coated with SiO₂, Al₂O₃ nanoparticles in simple surface treatment way, a kind of the modified sol-gel method. It is found that the surface coating of TiO₂ electrode with nanoparticles is dependent on the concentrations of precursors and pH of TiO₂ suspensions.

FMCP - 31L The Investigation on the Relation between CD Bias and SD Layer Area on the Glass Substrate

Z. Weifeng, X. Jianshe, L. Xiang, H. Guanbao, Z. Feng

BOE Tech. Group, China

The relation between CD bias and SD layer area on the glass substrate has been investigated. It is found GTM and HTM's situation is different. HTM CD Bias has an increasing trend while SD layer area increases. But GTM CD bias doesn't change. The difference is caused by transmittance difference.

FMCP - 32L Spin-Coatable Gate Dielectric for Organic Thin Film Transistor

*Y. Isogai, T. Katoh, K. Sugitani, T. Hirano, M. Tada,
Y. Fujisaki*, Y. Nakajima*, T. Yamamoto*, T. Suzuki*

ZEON, Japan

**Japan Broadcasting, Japan*

We have developed spin-coatable gate dielectric for flexible organic thin film transistor. It is applicable to P-type and N-type organic semiconductor with stable TFT characteristics. Under long term bias stress to gate, little hysteresis and threshold shift was detected. It can meet the cost reduction of manufacturing flexible displays.

FMCP - 33L Quasi-Single-Crystal Si Thin Film for System on Panel Using SiGe Precursor and Laser Lateral Crystallization

A. Hara, K. Hirose, J. Suzuki*, K. Kondo, K. Kitahara**

Tohoku Gakuin Univ., Japan

**Shimane Univ., Japan*

We have fabricated a quasi-single-crystal (QSC) Si thin film on glass substrate with a SiGe film as a precursor using cw laser lateral crystallization. The fabricated QSC Si film is poly-Si; however, most of the grains, which have large and ribbon-like shape, have {111} surface orientation and <011> growth direction.

FMCP - 34L Low-Hydrogen-Content Transparent SiN_x Film Prepared at Low-Temperature by Surface-Wave-Plasma CVD

S. Ueno, M. Yomogida, M. Suzuki, Y. Konishi, K. Azuma*

Shimadzu, Japan

**Shimadzu Emit, Japan*

We have succeeded in obtaining transparent SiN_x films with a water vapor transmission rate (WVTR) of less than 1×10^{-6} g/m²/d. We developed a surface-wave-plasma CVD system and found that the WVTR of the SiN_x film could be controlled by changing the distance between the plasma and the substrate.

FMCP - 35L Highly Foldable Polarizer Film for Anti-Reflection of OLED Display

*H. S. Shim, H.-J. Kwon, S. Kim, Y.T. Chun, I. S. Kee,
S. Y. Lee, S. O. Hwang*, Y. W. Kim*, H.-R. Chung*,
C. S. Lee**

Samsung Elect., Korea

**Cheil Inds., Korea*

Development and evaluation of highly foldable polarization film for anti-reflection of AMOLED display is described. This film can be folded up to 100,000 times at about 1.6 mm radius while maintaining the 90% transparency and anti-reflectivity as the conventional one.

FMCp - 36L Improvement of Light Extraction Efficiency in Mercury-Free Flat Fluorescent Lamp(MFFL) using Sub-Wavelength Structures

*B. J. Oh, J. C. Jung, I. W. Seo, O. Kwon, K.-W. Whang
Seoul Nat. Univ., Korea*

Sub-wavelength structures and formed on the surface of mercury-free flat fluorescent lamp(MFFL) front glass plate using CF_4 and O_2 plasma etching. Transmittance and light extraction efficiency of MFFL improved through the sub-wavelength structures formed on the glass surface which effectively has gradient refractive index change.

FMCp - 37L An Edge-Lit Backlight Unit with a Newly Designed Asymmetric Pyramid Sheet

M. Lee, S.-T. Hur, S.-W. Choi*
Vinnosys, Korea
Kyung Hee Univ., Korea

An edge-lit backlight unit (BLU) for small size liquid crystal display (LCD) was suggested. In this BLU, a newly designed single pyramid sheet replaced the two orthogonally placed prism sheets used for collimating.

FMCp - 38L Effect of CuO Nanoparticles Mixed in PEDOT:PSS Buffer Layer on Organic Solar Cells

*Sang Hoon Oh, Jung Joohye, Hyun Jae Kim
Yonsei Univ., Korea*

In this research, the effect of poly(3,4-ethylenedioxythiophene): poly(styrenesulfonate) (PEDOT:PSS) buffer layer with CuO nanoparticles on organic solar cell was investigated. CuO nanoparticles mixed in PEDOT:PSS film can improve short circuit current density due to their low resistivity. This method can contribute to get high efficiency organic solar cells.

----- Lunch -----

15:00 - 16:00

Room 204

FLX7/FMC6: Materials & Components for Flexible Displays

Chair: T. Tomono, Toppan Printing, Japan

Co-Chair: T. Ogura, Nippon Steel, Japan

**FLX7/
FMC6 - 1** **Transparent High Barrier Coating on Flexible Film
Substrate by Roll to Roll PECVD System**

15:00

*H. Tamagaki, T. Okimoto, T. Segawa**Kobe Steel, Japan*

A new Roll to Roll PECVD System, which generates plasma between a pair of rollers, is developed for the deposition of SiO_x transparent high barrier coating on film. At SiO_x deposition, the deposition rate of 900 nm-m/min and barrier performance (WVTR) below 5x10⁻⁴ g/m²day is demonstrated.

FLX7/ **Robust Folding Structure for a Foldable Display****FMC6 - 2**

15:20

*H.-J. Kwon, H. S. Shim, S. K. Kim, Y. T. Chun, I. S. Kee,
S. Y. Lee**Samsung Advanced Inst. of Tech., Korea*

Design and analysis of folding structure applied hyperelastic material for foldable display are described. This structure allows to realize extendable and foldable large display using conventional glass panels. From Finite Element Method (FEM) analysis and mechanical and optical experimental results, we can confirm the design of more stable folding structure.

FLX7/ **Direct Connection of LSI Chips to Polyethylene
Naphthalate Using Au Cone Bump****FMC6 - 3**

15:40

T. Shuto, N. Watanabe, A. Ikeda, T. Higashimachi,
T. Asano**Kyushu Univ., Japan***Sojo Univ., Japan*

We show that the direct connection of LSI chip to PEN (polyethylene naphthalate) film can be realized by using Au cone bump for flexible display. More than 10,000 connections at 20 μm pitch with low resistance can be realized at 150 °C.

----- Break -----

Author Interviews

18:00 – 19:00

Friday, December 3

9:00 - 10:20

Room 409

FMC2: Manufacturing Technologies (1)

Chair: F. Pieralisi, Appl. Materials, Germany

Co-Chair: K. Miyazawa, Chisso, Japan

**FMC2 - 1 Split Sputter Mode - A Novel Deposition Method for
9:00 TFT Metallizations***F. Pieralisi, M. Hanika, E. Scheer, M. Bender
Appl. Materials, Germany*

The novel Split Sputter Mode (SSM) method, based on the superposition of two complementary film distributions, provides highly uniform and homogeneous metallization layers. An analytical model is presented and the critical deposition parameters are evaluated. Finally, the effectiveness of the SSM technique is demonstrated through aluminium-coated large area substrates.

**FMC2 - 2 Development of Sputtering Process for IGZO TFT on
9:20 Large Substrate***T. Yukawa, T. Kurata, M. Arai, J. Kiyota, S. Sato,
K. Takahashi, S. Ishibashi, K. Saito
ULVAC, Japan*

In recent years, In-Ga-Zn-O (IGZO) has been drawing attention as high mobility material for panel performance improvement. In this report, we discuss uniformity of IGZO deposited by vertical type AC Magnetron Sputtering Equipment that is most widely used in the panel production line of more than Gen. 6 size.

**FMC2 - 3 Microstructure Analysis and Electrical Properties of
9:40 Cu-Mn Electrode for Back-Channel Etching a-IGZO
TFT***P. Yun, J. Koike
Tohoku Univ., Japan*

Cu-Mn alloy was investigated as an electrode on a-IGZO film because of its good adhesion, a diffusion barrier and a wet etching selectivity of about 10:1 with IGZO film. Contact property showed non-linear behavior with Al and Cu, while Ohmic contact was obtained with Cu-Mn and Ti after annealing.

FMC2 - 4 Role of Oxygen Atoms in the Growth of Magnetron Sputter-Deposited ZnO Films
10:00

A. Morita, I. Watanabe, H. Shirai
Saitama Univ., Japan

Among various deposition methods of ZnO films, a magnetron sputtering has been most widely used for fabricating ZnO films in large area at low cost. However, the role of oxygen atoms in the growth is still controversial. We demonstrate the role of oxygen atoms in the growth of ZnO films.

----- Break -----

10:40 - 12:00

Room 409

FMC3: Manufacturing Technologies (2)

Chair: K. Miyazawa, Chisso, Japan
 Co-Chair: T. Takeda, Nagase ChemteX, Japan

FMC3 - 1 Electroless Cu Metallization for FPD Manufacturing
10:40

B. Beck, B. Dosse, F. Brüning, J. Etzkorn
Atotech Deutschland, Germany

The feasibility of using wet chemical copper deposition for Thin Film Transistor gate metallization was demonstrated. Environmentally friendly processes were then developed that produced adherent copper deposits on smooth molybdenum layers. The samples were characterized by means of Interference Microscopy, 4-Point Probe Measurement, FIB/SEM and Tape Test.

FMC3 - 2 Enhancement of Scribing Stability for Laminated TFT-LCD
11:00

C.-H. Tseng, Y.-C. Liu, M.-S. Chen, T. Huang
AU Optronics, Taiwan

Reducing the thickness of LCD panels enhance the aesthetic and ease use of portable devices. Laminated cells have a potential issue of unstable control during scribing process. In this study, we illustrated a new design which enhances the supportability and offers a reliable status during scribing for laminated cells.

FMC3 - 3 Novel Structure of Acoustic Inkjet Method for Dispensing Large Phosphor Particles
11:20

Y. Nomura, Y. Hosono, K. Higuchi, S. Enomoto, I. Amemiya
Toshiba, Japan

A novel acoustic inkjet method with a conveyed film has been investigated for stable ink supply and droplet ejection of ink containing large-phosphor-particles. High accuracy of ejected droplet volumes (5%) was proved in the case with water used as ink. Moreover, droplets containing 20-micrometer-phosphors were ejected by the novel method.

**FMC3 - 4 Layout and Process Optimization Using Proximity
11:40 Exposure Lithography Simulation**

*B. Meliorisz, U. Hofmann, N. Unal, J. Sachen
GenlSys, Germany*

This paper presents the benefits of using optical proximity lithography simulation for process and OPC development, layout optimization and verification. The simulation provides accurate optical, image formation and resist processing results. We show several examples that demonstrate how simulation can contribute to improving lithography processes when using proximity printing exposure.

----- Lunch -----

13:20 - 14:40

Room 409

FMC4: Materials (1)

Chair: Z. Liang, Corning Display Tech., USA
Co-Chair: R. Yamaguchi, Akita Univ. Japan

**FMC4 - 1: *Invited* Post-Modern FPD Manufacturing -
13:20 Environmentally Sustainable Facility Construction
 and Operation, and Lessons from Adjacent
 Industries**

*D. Carkner, M. O'Halloran, T. Johnson, A. Maule
CH2M HILL, USA*

A review of techniques for improved efficiency, environmental responsibility, and cost performance in FPD manufacturing, informed by examples of successful methods used in adjacent industries, such as semiconductors, solar PV, and data centers. Practical examples of energy, water, and materials savings achieved together with cost and schedule reductions are provided.

**FMC4 - 2: *Invited* Tunable Microwrinkles for Display Device
13:40 Elements**

*T. Ohzono, H. Monobe, Y. Shimizu
AIST, Japan*

Microwrinkles on a surface-modified soft elastomer form under lateral compression through surface Euler's buckling. The wavy microstructures are reversibly altered by adding strain. We briefly review the transformation of microwrinkles and the preliminary applications: liquid crystal alignment, liquid micromanipulation and microswitch array, which are applicable to the display device elements.

FMC4 - 3 LCD Performance and Evaluation on Substrate Surface

14:00

*Z. Liang, R. Greene, R. Schweiger, R. White, X. Zhang**
Corning, USA
**Dalian Maritime Univ., China*

TN mode LC cells with 4 μm cell gap were fabricated using glass samples with variety of SDs. The threshold cell gap variation for JND=1 is about 0.15 μm which is in good agreement with human eye direct inspection. JND reading is a good predictor to evaluate spots mura.

FMC4 - 4 Ultra Fine Pitch Anisotropic Conductive Film with Fixed Array of Conductive Particles

14:20

R.-C. Liang, Y. Morita, S. Tseng, S. Rokutanda,
J. Chung, J. McNamara, Z.-A. G. Wu,
Trillion Science, USA

Ultra fine pitch Anisotropic Conductive Adhesive Film with fixed array of conductive particles has been developed and manufactured. This novel ACF has demonstrated superb performance at less than 10 μm pitch in LCD driver IC bonding. Conductive particles are arranged in array pattern providing uniform contact resistance with reliable performance.

----- Break -----

15:00 - 16:20

Room 409

FMC5: Materials (2)

Chair: D. L. Schulz, North Dakota State Univ., USA

Co-Chair: T. Nonaka, AZ Elec. Mat., Japan

FMC5 - 1: *Invited* Development of Low Temperature Solution-Processed Metal-Oxide TFT Materials

15:00

J. Steiger, R. Anselmann, H. Thiem, A. Hoppe,
D.-V. Pham, A. Merkulov
Evonik Degussa, Germany

We will present recent developments at Evonik in regard to material synthesis and solution based processing techniques of metal oxides for the use in TFT applications. Mobilities of higher than 10 cm^2/Vs in bottom-gate devices at a processing temperature of 350°C will be demonstrated.

FMC5 - 2: Invited Electrospun a-Si using Liquid Silane/Polymer Inks

D. L. Schulz, J. M. Hoey, J. Smith, J. Lavaasen, C. Braun, X. Dai, K. Anderson, A. Elangovan, X. Wu, S. Payne, K. Pokhodnya, I. Akhatov, L. Pederson, P. Boudjouk
North Dakota State Univ., USA

Amorphous silicon nanowires (a-SiNWs) were prepared by electrospinning cyclohexasilane (Si_6H_{12}) admixed with polymethylmethacrylate (PMMA) in toluene. Raman spectroscopy characterization of these wires (d~50-2000 nm) shows 350 °C treatment yields a-SiNWs. Porous a-SiNWs are obtained using a volatile polymer.

FMC5 - 3 Characterization of New Silsesquioxane and Silsesquiazane Polymers

Y. Tashiro, T. Fuke, T. Sekito, D. Yokoyama, T. Nonaka
AZ Elect. Materials, Japan

We succeeded in development of new silsesquioxanes and silsesquiazanes by new synthesis method. New Silsesquioxanes (SQ) are low temperature curable and provide superb pencil hardness and high optical transparency. And new silsesquiazanes (SQAZ) provide high refractive index and high optical transparent film. Here we demonstrate properties as new coating material.

FMC5 - 4 Intrinsically Conductive Polymer Dispersions and Inks for Transparent Electrode

T. Isaji, M. Abe
Nissan Chem. Inds., Japan

Organic solvent dispersions and inks of intrinsically conductive polymer (polyaniline based) with high conductivity have the possibility to be used for transparent electrode.

Author Interviews

16:20 – 17:20

Supporting Organizations:

The Japan Society for Printing Science and Technology
 Japan Society of Colour Material
 The Technical Association of Photopolymers, Japan
 Society of Photographic Science and Technology of Japan
 The Society of Radtech, Japan
 The Japanese Research Association of Organic Electronics Materials
 Japan Electronics Packaging and Circuits Association

Workshop on Plasma Displays

Thursday, December 2

13:20 - 14:40

Room 501

PDP1: Panel Configuration

Chair: L. F. Weber, Consultant, USA

Co-Chair: R. Murai, Panasonic, Japan

PDP1 - 1: *Invited* Technology for 3D PDPs at LG Electronics

13:20

*S.-H. Moon, D.-H. Kim, J.-H. Lee, J.-M. Ra, M.-J. Jeon,
K.-R. Choi*

LG Elect., Korea

Recently, the market of 3D TVs has become larger. LGE has developed 3D PDP TV and released these models at July. Also, LGE has successfully developed a prototype 3D Multi-vision display of 180-in. screen which consists of 9 sub-modules of 60" PDP TV.

PDP1 - 2 50-in. Full HD Shadow Mask PDP

13:40

Z. Fan^{,**}, X. Zhang^{*,**}, Z. Wu^{*,**}, Y. Tu^{*}, L. L. Yang^{*},
B. P. Wang^{*,**}, Q. Zhang^{*}*

**Southeast Univ., China*

***Nanjing Huaxian High Tech., China*

The research of discharge performance of SMPDP with $0.19 \mu\text{m} \times \text{RGB} \times 0.57 \mu\text{m}$ pitch, rectangular cell and Delta arrangement is done on experimental platform. It proves high-resolution can be realized through optimization of cell structure and parameter, without affecting the performance. The 50-in. FHD SMPDP is developed.

PDP1 - 3 Study on the Discharge Characteristics of a Diagonal Discharge AC PDP with Facing Electrodes

14:00

*D.-H. Kim, J. Heo, J.-W. Ok, Y.-G. Kim, D.-H. Kim,
H. J. Lee, H.-J. Lee, C.-H. Park*

Pusan Nat. Univ., Korea

In order to improve electro-optical characteristics, the new facing discharge structure has been investigated. The proposed structure, which has a diagonal discharge path, make it possible to gain a low power consumption, a high luminance and a high luminous efficacy compared with those of conventional coplanar structure.

PDP1 - 4 Comparative Study on Discharge Characteristics of FHD and Quad-FHD PDPs
14:20

*Y.-S. Choi, J.-B. Lee, S.-Y. Cho, S.-B. Shim, C.-H. Park,
 D.-H. Kim, H. J. Lee, H.-J. Lee*
Pusan Nat. Univ., Korea

We have investigated the luminous efficacy of various cell resolution. The luminance and luminous efficacy decreased as the resolution increased from FHD to QFHD, because of higher plasma loss. Absolute efficacy of delta cell array QFHD PDP reaches about 1.03 lm/W.

----- Break -----

15:00 - 16:20	Room 501
PDP2: Picture Quality	

Chair: H. Tolner, Southeast Univ., China
 Co-Chair: M. Uchidoi, Panasonic, Japan

PDP2 - 1: *Invited* Advances in Moving Picture Quality of Recent PDPs
15:00

I. Kawahara^{}***
^{}Panasonic Plasma Display, Japan*
*^{**}APDC., Japan*

Image quality of PDP has been greatly improved in recent years, including native contrast and moving picture performance. Especially, moving picture resolution, through elaborate signal processing and fast phosphors developed for 3D plasma shows stunning superiority also in 2D mode over other devices. Comparison between latest models is also covered.

PDP2 - 2 Skin Color Enhancement Based on Preferred Skin Color in PDPs
15:20

J. Jiang, Z.-H. Liang, X.-N. Zhang, C.-L. Liu
Xi'an Jiaotong Univ., China

A skin detection method and the preferred skin color region are obtained via psychological experiment. Then the skin color is enhanced according to the distance between it and preferred skin color. The experiment results show that the enhanced skin colors are more natural and agree with human vision and psychology.

PDP

PDP2 - 3 Two-Stage Dither Combined with Minor Pixel Separation for Gray Scale Enhancement
15:40

J.-F. Huang, Y.-G. Wang, X.-N. Zhang, Z.-H. Liang
Xi'an Jiaotong Univ., China

Order dither combined with minor pixel separation (MPS) can improve the gray levels in the dark area. Random dither combined with MPS can bring back gray-level lost in the middle and high gray ranges. The experiment results show that the gray scale can be expressed smoothly without structural pattern noise.

PDP2 - 4L High Luminance Twin-path Discharge Cell with Auxiliary Pulses for Ultra-High-Resolution PDP
16:00

Y. Hirano, K. Ishii, T. Usui, Y. Murakami
NHK, Japan

We have proposed a new electrode structure that uses twin-path discharges for ultra-high-resolution PDP. When auxiliary pulses are applied to the address electrodes during the sustaining discharge period, the luminance is improved less than 60% and the luminous efficiency is also improved by 10% by using 3-D fluid simulation.

----- Break -----

17:00 - 18:00

Room 204

PDP5: Late News Session (Protective Layer)

Chair: K. C. Choi, KAIST, Korea
 Co-Chair: S. Mikoshiba, APDC., Japan

PDP5 - 1L: *Invited* Display and Lifetime Characteristics of AC PDPs with SrO-MgO Double Protecting Layer
17:00

K.-W. Whang, H.-W. Cheong, J.-C. Jung, T.-H. Lee, O. Kwon
Seoul Nat. Univ., Korea

We have reduced the long aging time of AC PDP with SrO-MgO double protecting layer by introducing a special process to the front dielectric layer and achieved high luminous efficacy. It is essential to study the address discharge and lifetime characteristic of AC PDP with SrO-MgO double protecting layer.

PDP5 - 2L An AC PDP with an Air-Stable CaMgO Protective Layer
17:20

Y. Motoyama, D. Kato, M. Seki
NHK, Japan

We have successfully reproduced video images on a PDP that was air-sealed at 450°C and had a $\text{Ca}_{0.36}\text{Mg}_{0.64}\text{O}$ protective layer. The sustain pulse was obtained at 135 V, which was lower than the 170 V required when the conventional MgO protective layer is used.

PDP5 - 3L Inverse Relationship between Exo-Electron Currents and Statistical Delay of AC PDPs

17:40

Y. Kuang, K.-H. Choi^{}, Y.-S. Kim**Hongik Univ., Korea**^{*}Southeast Univ., China*

A relationship between exo-electron current and statistical relationship was examined on AC PDP test panels with or without MgO nano-crystals sprayed on MgO layer. The results indicated that the statistical delay is inversely proportional to exo-electron currents, but its proportional constant varies significantly, depending on the presence of MgO nano-crystals.

Author Interviews

18:00 – 19:00

Friday, December 3

9:00 - 12:00

Poster/A.I. Room

Poster PDPp: Plasma Displays**PDPp - 1 Characterization of Protective Layer Materials for PDPs by the EUPS Observation***T. Nakayama^{*}, M. Terauchi^{**,*}, K. Yoshino^{*,**}, T. Tsujita^{*,**},
M. Nishitani^{*,**}, T. Ishituka^{***}, T. Tomie^{***}, Y. Morita^{*,**}**^{*}Panasonic, Japan**^{**}Osaka Univ., Japan**^{***}AIST, Japan*

We applied EUPS (EUV photoelectron spectroscopy) to the characterization of protective layer materials. EUPS has a higher sensitivity than XPS to detect the outermost surface conditions. We found that hydroxide and carbon absorption on CaO progressed deeper from the surface and that they are more stable than on MgO.

PDPp - 2 Electron Energy Band Structure of Sprayed Functional Layer on MgO Measured by Secondary Electron Emission Using γ -FIB System*J. H. Choi, C. G. Son, Y. J. Hong, K. A. Lee, H. S. Uhm,
E. H. Choi**Kwangwoon Univ., Korea*

We have studied the electron energy band structure of MgO single crystal based on the Auger neutralization theory using by gamma-focused ion beam (γ -FIB) system. We measured secondary electron emission characteristics of MgO single crystals which have different crystal orientation. We measured the energy band structure $f_e(\alpha)$ function in valence band from secondary electron emission characteristics with He ion source (24.58 eV) in the three kinds of MgO single crystal with respective (100), (110), (111) orientations.

PDPp - 3 Electro-Optical Characteristics of Degraded Functional Layer in AC PDPs

*K. A. Lee, C. G. Son, J. H. Choi, Y. J. Hong, E. H. Choi
Kwangwoon Univ., Korea*

We have studied electro-optical characteristics of different kinds of the MgO layer during the continuous discharge in AC-PDP. For observation of each degraded MgO layer characteristics, we measured the surface morphology, cathodoluminescence (CL) spectrum and the discharge characteristics after 500 hours discharge.

PDPp - 4 Adaptive Unsymmetrical Dither Region to Improve Dynamic False Contour of PDPs

*Y.-G. Wang, J.-F. Huang, Z.-H. Liang, X.-N. Zhang
Xi'an Jiaotong Univ., China*

Dynamic false contour (DFC) can be improved with less gray scales in PDPs, the others gray scales are realized by dither. Adaptive unsymmetrical dither region is computed and changed according to the DFC. So the dither region can be kept the minimum and PSNR is better than other methods.

PDPp - 5 Study of Jitter Characteristics Depending on Wall Charge Status on an Emissive Layer

*S. J. Lee, S. M. Kim, J. Kang
Dankook Univ., Korea*

We investigated the jitter characteristics depending on wall charge amount and polarity on different emissive layers, such as MgO and CEL MgO. The accumulation of negative wall charges on pulse-applied electrode and negative applied voltage were important to decrease the operation voltage and time delay.

PDPp - 6 Electro-Optical and Exoemission Properties of Fe-Doped MgO for AC PDPs

*S. Y. Cho, J. W. Ok, C. H. Park, D. H. Kim, H. J. Lee,
H. J. Lee
Pusan Nat. Univ., Korea*

In this paper, to improve the electro-optical characteristic in AC-PDP, we suggest the new analysis system to measurement exo-electron emission directly method and examine a relationship between the exo-electron emission (EEE) and SEE coefficient of Fe-doping MgO films or between characteristics of electro-optical properties of test panel.

PDPp - 7 Improvement of Luminous Efficiency Using New Reflective Layer in AC PDPs

T.-J. Kweon, J.-C. Ahn, E.-Y. Jung, B.-J. Kim, S.-J. Cho, H.-S. Jung, Y.-J. Park

Samsung SDI, Korea

In this paper, new reflective layer between barrier rib and phosphor was adopted to increase luminance. New reflective layer has the characteristics which high reflectance and low permittivity. By using this material, the luminous efficiency was improved by about 22%.

PDPp - 8 Effect of the Cell Structure on the Luminous Efficiency of PDPs

H. K. Kwon, M. S. Lee, C. H. Moon

Hoseo Univ., Korea

To investigate the possibility of increasing the luminous efficiency of the PDP, ITO electrode structure and barrier rib structure were changed. Conclusively, 4.23 lm/W of luminous efficiency was obtained in a proposed structure under 220 V with Ne-20% Xe, 400 torr gas mixture.

PDPp - 9 Effect of Deuterium on the Xe Excitation Efficiency in PDP

*A. Khorami, S. Ghanbari**

IRIB Univ., Iran

**Univ. of Essex, UK*

Different gas compositions affect the efficiency of ultraviolet light. In this paper, in order to improve luminous efficiency of plasma display panels, a small quantity of Deuterium is added to Ne-Xe gas mixture. Furthermore, the performance of the SrCaO protective layer is shown to be significant in enhancing cell efficiency.

PDPp - 10 Improvement of Luminous Efficiency via Nanoparticle Phosphors in PDP

A. Khorami, S. Ghanbari, M. Mofidi***

IRIB Univ., Iran

**Univ. of Essex, UK*

***Univ. of Azad, Iran*

The luminous efficiency of plasma display panels can be enhanced through the type of phosphor and nano sized phosphor. The photoluminescence characteristics of PbS nanoparticle phosphors is simulated in order to exhibit the advantages of more excitons and higher band gap, and results show a 14% improvement on cell efficiency.

PDPp - 11L Addressing Delay Time vs. Initial Number of Electrons in AC-PDP

*T. Sakai, K. Tachibana**

Display Res. Labs., Japan

**Ehime Univ., Japan*

We analyzed the addressing delay T vs. initial number of electrons n_0 with a cell using Ne and MgO. A variation $\Delta T / T$ is mainly caused by γ action. If $n_0 \geq 16$, T and ΔT is very small and a miss addressing rate $\leq 10^{-10}$. This condition is possible by a field emission.

PDPp - 12L Negative Sustain Waveform for Reducing Temporal Image Sticking in AC Plasma Display Panel

S.-Y. Kim, C.-S. Park, H.-S. Tae

Kyungpook Nat. Univ., Korea

The temporal image sticking characteristics produced by a negative sustain waveform were examined in comparison with those produced by a positive sustain waveform. It was observed that the temporal image sticking when applying the negative sustain waveform was reduced in comparison with the positive sustain waveform.

PDPp - 13L Effects of Overlap Sustain Waveform on Panel-Aging and Temporal Image Sticking Characteristics in AC Plasma Display Panel

C.-S. Park, S.-Y. Kim, H.-S. Tae

Kyungpook Nat. Univ., Korea

The panel-aging and the temporal image sticking characteristics were investigated with the non-overlap and overlap sustain waveforms in the 7-in. test panel. It is concluded that the overlap sustain waveform can induce the stable discharge very quickly and reduce the problem of temporal image sticking in plasma displays.

PDPp - 14L A Study on the Optical Properties of PDP Cells Using 3D Optical Code

H. Park, J. Kang

Dankook Univ., Korea

The optical properties of PDP were analyzed with 3D optical code. The reference model shows 16.6% and 10.2% higher reflectance than the test 1 and 2 models respectively. The calculated reflective properties are compared to the measured data. The relative difference is less than 4.9%.

PDPp - 15L Discharge Cell Designs for Large-Sized Transparent AC PDPs*H.-N. Choi, Y.-S. Kim**Hongik Univ., Korea*

A new design of transparent AC PDP for large area information displays was attempted in this study. The discharge cells with large fraction of non-discharge area was designed and its potential as the transparent display was examined. The results indicated that it can achieve optical transmittance while displaying images as well as while not-displaying images.

----- Lunch -----

13:00 - 14:40**Room 412****PDP3: High Efficiency**

Chair: Y.-S. Kim, Hongik Univ., Korea

Co-Chair: Y. Murakami, NHK, Japan

PDP3 - 5L: *Invited* Application of Localized Surface Plasmon Phenomena to an AC Plasma Display Panel**13:00***K. C. Choi, S. M. Lee, W. H. Kim**KAIST, Korea*

Gold and silver metal nanoparticles are applied to phosphor and protective layer in an ACPDP in order to induce localized surface plasmon phenomena. The localized surface plasmon resonance induces a very strong localized electric field. It is believed that the strong localized field affects the display characteristics of the ACPDP.

PDP3 - 1: *Invited* PDP Research and Development in China**13:20***Q. Yan**Shichuan COC Display Devices, China*

Low cost, high luminous efficiency PDP, low power consumption, high image quality are key factors to have a sustainable PDP business in China. Newly established PDP consortium in China is working closely with PDP manufacture to solve those challenges. The future direction of PDP development will be discussed.

PDP3 - 2 Withdrawn

PDP3 - 6L Improvement of Excitation Efficiency by a Localized High Capacitance Region in Micro-Discharge Cell and Its Mechanism
13:40

*M. Konishi, M. Miura, M. Murata, R. Murai, M. Kitagawa
 Panasonic, Japan*

We performed an experimental and simulation study on the relation between the distribution of capacitance in micro discharge cell and excitation efficiency for AC PDP. Introduction of localized high capacitance region in front dielectric layer near barrier rib is found to be effective for the improvement of the excitation efficiency.

PDP3 - 3 Efficacy Improvement of PDP Discharge Using Energy Stored in Panel Capacitance
14:00

*Y. Tanaka, T. Shiga
 Univ. of Electro-Commun., Japan*

Sustain voltage waveform using high impedance is introduced to improve the luminous efficacy of PDPs. When the discharge is ignited, the panel capacitance voltage drops during the high impedance period, resulting in low and narrow discharge current. Efficacy increases by 60% and luminance is almost identical to the conventional technique.

PDP3 - 4 Development of Degradation Resistant Red, Green and Blue Silica Encapsulated Phosphors for PDPs
14:20

*R. S. Yadav, A. F. Khan, A. Yadav, H. Chander,
 V. Shanker, S. Chawla
 Nat. Physical Lab., India*

PDPs performance is greatly dependent on phosphors. Towards this goal, highly efficient phosphors $Y_4Al_2O_9:Eu^{3+}$ (Red), $BaMgAl_{10}O_{17}:Eu^{2+}$ (Blue) and $YBO_3:Tb^{3+}$ (green) have been developed. Degradation resistance, enhancement in luminescence intensity by 30-35% and uniform particle size distribution (1-2 μm) could be achieved by encapsulating the phosphor grains by a thin silica layer.

----- Break -----

15:00 - 16:20

Room 412

PDP4: Protective Layer

Chair: Q. Yan, Shichuan COC Display Devices, China
 Co-Chair: H. Kajiyama, Hiroshima Univ., Japan, Korea

PDP4 - 1: Invited Investigation of Panel Design Parameters for Low Power Consumption PDPs

H.-B. Park, J.-H. Kim, W.-S. Yoon, Y.-S. Seo, S.-B. Song, W.-J. Chung, E.-G. Heo, Y.-J. Park, C.-I. Chung
Samsung SDI, Korea

To reduce the power consumption of PDP, a panel should be carefully designed for high luminous efficiency and low reactive power consumption. Effects of barrier rib structure, dielectric layer property, and gas mixture on efficacy and especially on reactive power are investigated.

PDP4 - 2 Discharge Characteristics of SrCaO-PDP with MgO: α Powder Manufactured by Using All-in-Vacuum Process

T. Yano^{,**}, K. Uchida^{*}, K. Suesada^{**}, S. Miyamoto^{**}, T. Shinoda^{**}, H. Kajiyama^{**}*
^{*}*ULVAC, Japan*
^{**}*Hiroshima Univ., Japan*

The SrCaO-PDP with MgO: α powder are manufactured by using the all-in-vacuum process. By coating MgO: α powder on SrCaO protective layer surface in vacuum, it is possible to keep low discharge voltage of SrCaO protective layer and to shorten the discharge time lag within about 1 μ s.

PDP4 - 3 Discharge Diagnosis of High- γ PDPs with Various Xe Contents

D. Zhu^{,**}, T. Izumi^{***}, T. Akiyama^{***}, K. Suesada^{*}, S. Miyamoto^{*}, X. Zhang^{**}, H. Kajiyama^{*}*
^{*}*Hiroshima Univ., Japan*
^{**}*Southeast Univ., China*
^{***}*APDC, Japan*

The 4-in. test plasma display panels which have high γ protective layer SrCaO have been investigated by experiments. The xenon content in the discharge gas ranges from 4% to 80%, respectively. The panel parameters that have been measured include firing voltage, luminance, efficacy, infra-red emission, etc.

PDP4 - 4 Analysis of Discharge Characteristics for High Luminous Efficacy with High γ Protective Layer

T. Izumi, T. Akiyama, S. Uchida^{}, M. Kitagawa*
APDC, Japan
^{*}*Tokyo Metropolitan Univ., Japan*

VUV production efficiencies were simulated by a one-dimensional fluid discharge model. By examining the electron and ion densities, it has been revealed that an increase in the electron heating efficiency originated from the high γ characteristics played a major contribution to the improvement of the VUV production efficiency.

Author Interviews

16:20 – 17:20

Sponsor:

Plasma Display Technical Meeting

IDW Outstanding Poster Paper Award

This award will go to the most outstanding paper selected from those presented at IDW '10 poster presentation.

The 2010 award winners will be announced on the IDW website: <http://www.idw.ne.jp/award.html>

BANQUET

Wednesday, December 1, 2010

19:30 – 21:30

Crowne Grand Ball Room (2F)

ANA Crowne Plaza Fukuoka

See page 9 for details

EXHIBITION

12:00 – 18:00 Wednesday, Dec. 1, 2010

10:00 – 18:00 Thursday, Dec. 2, 2010

10:00 – 14:00 Friday, Dec. 3, 2010

2F Lobby, 4F Lobby

Fukuoka International Congress Center

Free admission with your registration name tag

Workshop on EL Displays and Phosphors

Wednesday, December 1

15:00 -16:40

Room 413

PH1: Phosphors in General

Chair: T. -M. Chen, Nat. Chaio Tung Univ., Taiwan

Co-Chair: S. Okamoto, NHK, Japan

PH1 - 1: *Invited* The Luminescence of Divalent Europium (Eu²⁺) for Display Applications

15:00

A. M. Srivastava

GE Global Res., USA

The Eu²⁺ luminescence finds use in several lighting and display devices. This paper explores several aspects of Eu²⁺ luminescence and point to the need of fundamental studies that are needed to resolve interpretations of the experimental data. Such investigations can lead to the development of commercially important phosphors.

PH1 - 2: *Invited* R&D for Reducing Tb and Eu Usage in Phosphors for Fluorescent Lamp for Sustainable Development

15:30

T. Akai

AIST, Japan

The future, there may be an imbalanced supply and demand of Tb and Eu, which are used in fluorescent lamps. An outline of an R&D project to reduce the usage of Tb and Eu is presented with a review of their demand and supply.

PH1 - 3 **A Computational Chemistry Study on Relationship between Crystal Structure and Emission Property of Eu²⁺-Doped Phosphors**

16:00

*H. Onuma, I. Yamashita, R. Nagumo, R. Miura,
A. Suzuki, H. Tsuboi, N. Hatakeyama, A. Endou,
H. Takaba, M. Kubo, A. Miyamoto*

Tohoku Univ., Japan

In this paper, we reported a computational study on emission property of Eu²⁺-doped phosphors. Multi-regression analyses were carried out and prediction equations for emission/excitation wavelength of Eu²⁺-doped phosphors were obtained. We found that Ca/Sr/Ba and Si/O/S atoms around Eu atoms make emission/excitation wavelength long and short, respectively.

PH1 - 4 **The Improvement in Photoluminescence Property of
16:20** **CaYAlO₄:Eu³⁺ Phosphor by the Post-Annealing
Process**

*M. Bartic, H. Kominami, Y. Nakanishi, K. Hara
Shizuoka Univ., Japan*

This paper describes the synthesis and characterization of the novel CaYAlO₄:Eu³⁺ phosphor, which emits red photoluminescence (PL) with the main emission peak located at 611.5 nm under a VUV irradiation at room temperature. The experimental data showed that the post-annealing process has improved significantly the PL property of this phosphor.

----- Break -----

Author Interviews

18:00 – 19:00

Thursday, December 2

9:00 - 10:10

Room 413

PH2: Phosphors for LEDs

Chair: A. M. Srivastava, GE Global Res., USA
Co-Chair: S. Oshio, Panasonic, Japan

PH2 - 1: ***Invited* Synthesis and Luminescence Properties of
9:00** **Lanthanide Ion-Doped Nitride Phosphors**

*K. Machida
Osaka Univ., Japan*

Novel techniques were applied to synthesize nitride phosphors for white LED illumination. Without using alkaline earth metal nitrides, M₂Si₅N₈:Eu²⁺ (M=Ca, Sr, and Ba) are produced by nitriding the corresponding oxides with carbonaceous reductants. Meanwhile, direct nitriding of the component metals or hydrides such as M, Si, and/or Al are effective to produce Ba₂Si₅N₈:Eu²⁺ and CaAlSiN₃:Eu²⁺ as high-quality phosphors.

PH2 - 2 **Eu²⁺-Doped AlN-SiC Solid Solutions: Synthesis,
9:30** **Cathodoluminescence and Potential Applications**

*R.-J. Xie, N. Hirotsuki, B. Dierre, T. Takeda, T. Sekiguchi
NIMS, Japan*

Eu²⁺-doped AlN-SiC phosphors were prepared by firing the powder mixture at 2050°C for 2 h under 1 MPa N₂. A solid solution between AlN and SiC was formed, promoting the solution of Eu²⁺ in AlN. The phosphors showed intense blue emissions under electron beam excitation, indicative of potential phosphors for FEDs.

PH2 - 3 **A New Synthesis Route for Nitride Phosphors:
9:50** **Sr₂Si₅N₈:Eu²⁺ Orange Red-Emitting Phosphors
Synthesized at Relatively Low Temperature for LED
Application**

*A. Kirakosyan, D. Y. Jeon
KAIST, Korea*

Eu²⁺ activated Sr₂Si₅N₈ nitridosilicate phosphors was prepared by a new synthesis method allowed to synthesize it at relatively low temperature and atmospheric pressure of nitrogen. The method has several advantages compared to commonly used processes and shows high reaction yield. The phosphor synthesized might be used in WLED application.

----- Break -----

13:20 - 16:20

Poster/A.I. Room

Poster PHp: Phosphors

PHp - 1 **Structural and Luminescent Properties of Y_{6+x/3}
Si_{11-y}Al_yN_{20+x-y}O_{1-x+y}:Ce³⁺ Phosphors**

*W. B. Park, S. P. Singh, K.-S. Sohn
Sunchon Nat. Univ., Korea*

A two-step high throughput screening was implemented in YN-AlN-SiN_{4/3} ternary system based on random choices. We pinpointed a host structure Y_{6+x/3}Si_{11-y}Al_yN_{20+x-y}O_{1-x+y} (x= 0~3, y=0~3), the refined structure of which was the trigonal (P31c) with lattice parameters a = b = 9.81513 Å, c = 10.6305 Å, α = β = 90°, γ = 120°.

PHp - 2 **Luminescence Properties of Eu²⁺-doped β-SiAlON
Phosphors Synthesized by Spark Plasma Sintering**

*S.-W. Choi, S.-H. Hong
Seoul Nat. Univ., Korea*

Eu_xSi_{6-z}Al₂O₂N_{8-z} phosphors were successfully prepared by spark plasma sintering (SPS). The obtained β-SiAlON:Eu²⁺ phosphor was excited over a broad spectral range in a UV-visible region, and showed a green emission band centered at 535 nm. The Eu²⁺-doped β-SiAlON phosphor showed superior thermal stability (25°C-200°C) compared to commercial green phosphor.

PHp - 3 Luminescence Properties of $\text{Ca}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$ Synthesized by Spark Plasma Sintering

Y.-S. Kim, S.-W. Choi, S.-H. Hong

Seoul Nat. Univ., Korea

Eu^{2+} -doped $\text{Ca}_2\text{Si}_5\text{N}_8$ phosphors were synthesized by Spark Plasma Sintering. The emission spectra of $\text{Ca}_2\text{Si}_5\text{N}_8:\text{Eu}^{2+}$ exhibited a single broad band centered at 600 nm under the excitation of 460nm. The influence of the synthesis temperature and the doping concentration on the crystalline phase and luminescence properties had been characterized.

PHp - 4 Photoluminescence Behavior of $\text{MgAlSiN}_3:\text{Eu}^{2+}$ Phosphors

B. Y. Han, K.-S. Sohn

Sunchon Nat. Univ., Korea

The effect of Eu^{2+} concentration in $\text{MgAlSiN}_3:\text{Eu}^{2+}$ Phosphors is studied. $\text{MgAlSiN}_3:\text{Eu}^{2+}$ Phosphors with low Eu^{2+} concentration emits red light and is suitable for white light emitting diodes, however, higher Eu^{2+} concentration emit deep red light around 710 nm is useful for energy down converting material for use in crystalline Silicon cells.

PHp - 5 The Effect of Al Inclusion on the Photoluminescence of $\text{LaSi}_3\text{N}_5:\text{Ce}^{3+}$ Phosphors

J. W. Park, S. P. Singh, K.-S. Sohn

Sunchon Nat. Univ., Korea

Blue emitting $\text{LaSi}_3\text{N}_5:\text{Ce}^{3+}$ phosphor has been modified by Al substitution to enhance the color rendering index of white light emitting diodes (WLED) by shifting the excitation band towards desirable wavelength region. The crystal structure remains unaltered with Al substitution and orthorhombic structure in the $P2_12_12_1$ space group is maintained.

PHp - 6 Photoluminescence Properties of $\text{CaTiO}_3:\text{Bi}$

T. Kyomen, K. Hirozumi, M. Hanaya

Gunma Univ., Japan

$\text{CaTiO}_3:\text{Bi}$ phosphor showed yellowish white photoluminescence by irradiation of light in the wavelength range of 400-300 nm. It was suggested that the photoluminescence is occurred by not only s-p transition excitation of Bi^{3+} but also band-gap excitation of CaTiO_3 and successive energy transfer to Bi^{3+} .

PHp - 7 Growth of Silicate Phosphors from the Vapor Phase

*T. Ishigaki, K. Toda, T. Sakamoto, K. Umeatsu, M. Sato
Niigata Univ., Japan*

Well-crystalline $\text{Ba}_2\text{SiO}_4:\text{Eu}^{2+}$ powders were grown on a substrate by new vapor phase reaction between mixed powder and SiO gas. The emission intensity of the $\text{Ba}_2\text{SiO}_4:\text{Eu}^{2+}$ phosphor synthesized by new vapor phase technique is about 2.6 times higher than that of a conventional solid state reaction sample.

PHp - 8 Study on Intermediate State of YAG:Ce Prepared by Coprecipitation Method

T. Murakawa, H. Okura**, T. Honma***, Y. Miyamoto*,
K. Ohmi**

**Tottori Univ., Japan*

***Merck, Japan*

****Japan Synchrotron Radiation Res. Inst., Japan*

Intermediate states of $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}$ prepared by liquid phase reaction has been studied. Relationships between precursors, intermediate products and completed phosphors are systematically investigated by analyzing the valence and local structure around Ce. It has been found that most of Ce is segregated as amorphous tetravalent cerium oxide by oxidized fire.

PHp - 9 Optical Properties of $\text{Sr}_{1.9}\text{Ba}_{0.1}\text{SiO}_4 : \text{Eu}^{2+}$ Thin Film Phosphors According to Thickness

*J. H. Moon, K. N. Lee, Y. R. Do
Kookmin Univ., Korea*

This study investigates yellow emitting Eu^{2+} doped $\text{Sr}_{1.9}\text{Ba}_{0.1}\text{SiO}_4$ Thin Film Phosphors (TFPs). $\text{Sr}_{1.9}\text{Ba}_{0.1}\text{SiO}_4:\text{Eu}^{2+}$ TFPs were deposited on a $2 \times 2 \text{ cm}^2$ quartz substrate using electron beam evaporation. The brightness and luminescence efficiency of the thin films improved as the deposition temperature and thickness of the $\text{Sr}_{1.9}\text{Ba}_{0.1}\text{SiO}_4:\text{Eu}^{2+}$ TFPs were increased.

PHp - 10 Structural and Cathodoluminescent Properties of ZnAl_2O_4 Phosphor for UV Emission

*T. Iguchi, H. Kominami, Y. Nakanishi, K. Hara,
A. Ohnishi*, M. Kitaura**

Shizuoka Univ., Japan

**Yamagata Univ., Japan*

ZnAl_2O_4 which shows UV emission under the EB excitation has been investigated for the UV emitting devices. The luminescent properties were drastically changed by the synthesis temperature and Zn/Al ratio. From PLE and CL measurement, it is thought that the UV emission is caused from oxygen vacancy.

PHp - 11 Valence Estimation of Eu Luminescent Centers of BAM Phosphors by Conversion Electron Yield and Fluorescence Yield XAFS Measurements

T. Honma, T. Kunimoto, T. Koshiba**, Y. Yamashita**, K. Ohmi***

Japan Synchrotron Radiation Res. Inst., Japan

**Tokushima Bunri Univ., Japan*

***Tottori Univ., Japan*

Conversion electron yield (CEY)- and X-ray fluorescence yield (XFY)-XAFS measurements have been performed for Eu luminescent centers in BAM phosphors baked in various conditions. The valence states of Eu ions near the surface and the internal bulk of BAM crystal are evaluated from Eu-L₃ edge CEY- and XFY-XANES spectra, respectively.

PHp - 12 Synthesis and Characterization of Lithium Aluminate Red Phosphor

K. Inoue, T. Sago, Y. Amano, Y. Iwamoto**

Mie Ind. Res. Inst., Japan

**Nagoya Inst. of Tech., Japan*

The sol-gel-derived lithium aluminate composition with Li:Al=1:1 yielded α -LiAlO₂ at 600°C. Then α/γ phase transformation at 800 to 1200°C, and subsequent decomposition lead to the formation of LiAl₅O₈ above 1200°C. At 1600°C, the red emission band is observed with the maximum around 685 nm.

PHp - 13 Synthesis of Ce³⁺-Tb³⁺ Co-activated Phosphate Phosphor in Air Condition

N. Sato, K. Uematsu, T. Ishigaki, K. Toda, M. Sato

Niigata Univ., Japan

β -SrP₂O₆:Ce³⁺, Tb³⁺ phosphor was synthesized by solid state reaction in air condition. Ce and Tb could be easily reduced without reduction gases. The phosphor emit strong green light under UV excitation. Therefore, β -SrP₂O₆:Ce³⁺, Tb³⁺ can be expected as a green phosphor for the CCFL backlight.

PHp - 14 Synthesis of Eu³⁺ Doped Novel Borotungstate and Borosilicate Phosphors for White LEDs

M. Inoue, S. Seki, K. Uematsu, T. Ishigaki, K. Toda, M. Sato

Niigata Univ., Japan

Eu₃BWO₉ and Gd₃BSi₂O₁₀:Eu³⁺ as novel red emission phosphors were prepared by solid-state reaction. These phosphors have the main excitation band located at 395 nm, and dominated emission peak at 588 nm and 614 nm. Eu₃BWO₉ and Gd₃BSi₂O₁₀:Eu³⁺ were suitable for the tri-color phosphors based white LED.

PHp - 15 Effect of Organic Dye in Inorganic-Organic Hybrid Electroluminescence Devices

*Y. Noguchi, Y. Hoshino, T. Tamura, T. Uchida, T. Satoh
Tokyo Polytechnic Univ., Japan*

By using organic dyes to dope the phosphor layers of powder EL devices, high luminosity and uniform luminescence can be realized. In hybrid EL device, the excitation energy of the phosphor is transferred to the organic dyes. The introduction of the organic dye results in increased luminosity and uniform brightness.

PHp - 16 Current-Voltage Characteristics of Top-Emission Printed EL Devices Using Solution-Processed ZnO Nanocrystals

*H. Kawasaki, K. Itatani, T. Toyama, H. Okamoto
Osaka Univ., Japan*

Current-voltage (J-V) measurements were performed on the top-emission EL devices with a printed emission layer involving solution-processed ZnO nanocrystals. The temperature dependence of J-V characteristics suggested the deposition method and the deposition conditions of top anodes play a crucial role in determining UV emission intensity.

PHp - 17 Inorganic Electroluminescent Devices with Carbon Nano Tube

K.-M. Yu^{}, H.-S. Song^{*}, H.-K. Yi^{*}, H.-S. Choi^{*}, H.-R. Oh^{*},
H.-J. Moon^{**}, D.-S. Moon^{***}, B. S. Bae^{***}
^{*}Univ. of New IT Eng., Korea
^{**}Univ. of Semiconductor, Korea
^{***}CCO Display Tech., Korea*

The EL devices were investigated with CNT. We investigated EL with a phosphor paste mixed with CNT by impeller and ball mill. The luminance of EL devices depends on how to mix the CNT. We investigated EL devices according to amount of CNT, and the position of the CNT layer.

PHp - 18 Preparation of Rare-Earth Doped SrGa₂S₄ Thin Film Phosphors by Two Electron Beams Evaporation and 355 nm Laser-Annealing

T. Yamasaki, T. Seino^{}, H. Kominami, Y. Nakanishi,
Y. Hatanaka^{**}, K. Hara
Shizuoka Univ., Japan
^{*}Japan Steel Works, Japan
^{**}Aichi Univ. of Tech., Japan*

The crystallization mechanism of SrGa₂S₄:Eu²⁺ thin-film phosphors by 355nm laser-annealing was examined. From simulation of thermal distribution by laser irradiation on SrS and Ga₂S₃ films, the laser energy was mainly absorbed by Ga₂S₃ and heated. It was expected that laser energy absorption in Ga₂S₃ contributed to formation of SrGa₂S₄ greatly.

PHp - 19 Thin-Film Electroluminescent Devices Fabricated Using La₂O₃-Based Multi-Component Oxide Phosphors

J. Ishino, Y. Nishi, T. Miyata, T. Minami

Kanazawa Inst. of Tech., Japan

Multicolor PL and EL emissions were observed from newly developed La₂O₃-based oxide phosphors using BaLa₂O₄, CaLa₂O₄ or SrLa₂O₄ as the host material. The use of Bi-activated oxide phosphors co-doped with Eu made it possible to control the EL and PL emission color over a wide range.

PHp - 20 EL and PL Characteristics in Various Bi-Activated Vanadate-Based Phosphor Thin Films

J. Ishino, T. Miyata, T. Minami

Kanazawa Inst. of Tech., Japan

Multicolor PL and EL emissions were obtained in Bi-activated YVO₄ and GdVO₄ as well as YVO₄:Bi,Eu, GdVO₄:Bi,Eu and LaVO₄:Bi,Eu phosphor thin films. Color changes from green to red in PL and EL emissions were obtained. A maximum luminance of 24 cd/m² was obtained in a red-emitting GdVO₄:Bi, Eu TFEL device.

PHp - 21 Influence of Organic Solvent on Optical Degradation Characteristics of Sol-Gel Glass Coated Eu-Complex

*T. Fukuda, S. Akiyama, S. Kato, Z. Honda, N. Kamata, N. Kijima**

Saitama Univ., Japan

**Mitsubishi Chem. Group, Sci. Tech. Res. Ctr., Japan*

We investigated the influence of organic solvent on the optical degradation of Eu-complex encapsulated by sol-gel derived glass networks. The most important finding is that the dielectric constant of the organic solvent affects the optical degradation characteristics of the encapsulated sample and PL quantum efficiency of the sol-gel starting solution.

PHp - 22 Improved Stability of Glass-Coated Eu-Complex Using Solvothermal Synthesis

*S. Kato, S. Akiyama, T. Fukuda, Z. Honda, N. Kamata, N. Kijima**

Saitama Univ., Japan

**Mitsubishi Chem. Group, Sci. Tech. Res. Ctr., Japan*

We achieved an improved optical degradation characteristic of Eu-complex encapsulated by the silica glass network via a solvothermal synthesis. By optimizing the concentration of the organic solvent, a maximum half brightness time of more than 360 min was achieved, and it was 5.4-times longer than that of the reference sample.

PHp - 23 Fabrication of a Transparent Thin Film Using $Y_3Al_5O_{12}:Ce^{3+}$ Nanophosphor with a Poly (methyl methacrylate) Matrix

B. K. Park, J. H. Oh, Y. R. Do

Kookmin Univ., Korea

$Y_3Al_5O_{12}:Ce^{3+}$ (YAG:Ce³⁺) nanophosphor was synthesized by a glycothermal method, where a reaction between aluminum isopropoxide and acetates of yttrium and cerium(III) was induced in 1,4-butylene glycol in an autoclave. A PMMA matrix transparent thin film dispersed YAG:Ce³⁺ nanophosphor was fabricated on glass substrates by a spin-coating method.

PHp - 24 Enhanced Photoluminescence of Transparent Polymer Films Dispersed Fluorescent Dye with Light-Recycling Filters

H. K. Park, J. R. Oh, Y. R. Do

Kookmin Univ., Korea

We exploit the effects of light-recycling filters (LRFs) to enhance the photoluminescence of transparent polymer films incorporating dispersed fluorescent dye. Fluorescent dye (Lumogen yellow) was dispersed in a transparent polymer consisting of polymethyl methacrylate (PMMA) and toluene. Transparent films were spin-coated on glass substrates with and without LRFs, respectively.

PHp - 25 Preparation of Perovskite-Type Alkaline-Earth Stannates Thin Films Using a Unilamellar Nanosheets Seed Layer

H. Takashima, K. Ueda, K. Ikegami*

AIST, Japan

**KIT, Japan*

We have obtained green photoluminescence in rare-earth-doped perovskite-type alkaline-earth stannate thin films. On a glass substrate with a seed layer prepared by the Langmuir-Blodgett method, uniaxially oriented thin films of $[(Ca_{0.97}Mg_{0.03})_{0.98}Tb_{0.02}]SnO_3$ with sharp and intense emission and transmittance > 75% have been successfully obtained.

PHp - 26 A Novel Synthesis of Spherical Silica Phosphors

W. Pan, N. Wang, Y. Wu, G. Li, J. Li, G. Ning, Z. Mu, Y. Lin**

Dalian Univ. of Tech., China

**Liaoning Zhongda Superconducting Material, China*

The novelty of the current work lies in the simple synthesis of a class of silica phosphors produced upon calcination of hybrid-functionalized silica spheres which to the best of our knowledge are the first known the role of en on the morphology and luminescence properties of the resultant silica spheres.

PHp - 27 High Throughput Synthesis "Melt-Synthesis Technique" for Photoluminescence Materials Using by Arc Imaging Furnace

*T. Ishigaki, K. Uematsu, K. Toda, M. Sato, M. Yoshimura**

Niigata Univ., Japan

**Tokyo Inst. of Tech., Japan*

To synthesize photoluminescence materials, we applied a novel "melt-synthesis technique". Rapid synthesis methods to develop those double oxides have been strongly anticipated. During melt synthesis, the mixture of oxides or their precursors is melted rapidly (1–60 s) in an arc-imaging furnace using strong light radiation.

PHp - 28L Computational Screening of Host Crystal for Phosphors: Correlation of Eu^{2+} Emission Wavelength with Stoichiometry

H. Onuma, D. Yoshihara, I. Yamashita, R. Nagumo, R. Miura, A. Suzuki, H. Tsuboi, N. Hatakeyama, A. Endou, H. Takaba, M. Kubo, A. Miyamoto

Tohoku Univ., Japan

We reported a decision tree analysis to explore a host material of Eu^{2+} -doped phosphors focusing on their emission wavelength. The emission wavelengths of investigated phosphors correlated well with a simple function of their stoichiometry. Our proposed rule would be useful for a first screening of host materials for Eu^{2+} -doped phosphors.

PHp - 29L Crystallographic and Luminescent Characteristics of $\text{CuAlS}_2\text{:Mn}$ Phosphor Thin Films Prepared by Multi Source Deposition Using $\text{Al}_2\text{S}_3\text{:Mn}$ and Cu Evaporation Sources

T. Koshiba, Y. Miyamoto, K. Ohmi

Tottori Univ., Japan

$\text{CuAlS}_2\text{:Mn}$ phosphor thin films have been prepared by multi-source deposition method using $\text{Al}_2\text{S}_3\text{:Mn}$ and Cu as electron-beam evaporation sources. The prepared films are crystallized as CuAlS_2 by annealing at 650°C , and are singly oriented to the $\langle 112 \rangle$ axis. The films show an efficient reddish-orange photoluminescence under UV light irradiation.

PHp - 30L Eu, Mn Coactivated Calcium Silicate Phosphors for Near-UV Excitation Synthesized by Microreaction Method

H. Okura^{,**}, T. Murakawa^{**}, Y. Miyamoto^{**}, K. Ohmi^{**}*

^{}Merck, Japan*

*^{**}Tottori Univ., Japan*

Novel orange phosphors ($\text{Ca}_{1-x-y}\text{Eu}_x\text{Mn}_y\text{SiO}_3\cdot(\text{SiO}_2)_n$) have been developed by combinatorial synthesis, which is an effective method for searching for new phosphors. Synthesized phosphors have acicular particles and show an orange luminescence with a peak wavelength at 600 nm under near-UV excitation. The phosphors are suitable for high-color rendering white LEDs.

PHp - 31L Surface Modification of the LED phosphor by Al_2O_3 -coating and NaOH Treatment

J. H. Seo, S. H. Sohn

Kyungpook Nat. Univ., Korea

The surface of Eu doped silicate phosphor was coated with Al_2O_3 -nanoparticles in a simple surface treatment way, a kind of the modified sol-gel method. Surface modification was caused by NaOH-treatment. It was found that the surface coating and the NaOH-treatment do not affect to the luminance intensity of the phosphors.

PHp - 32L The Nitridation of Europium Doped Strontium Silicate Phosphors

S. J. Lee, J. S. Lee, W. H. Jung^{}, K. Lee, Y. J. Kim*

Kyonggi Univ., Korea

^{}Cerakor, Korea*

Eu^{2+} doped Sr_2SiO_4 powders were nitrided and then the structural and optical properties were investigated. The nitridation was performed by firing the mixture of $\text{SrCO}_3\text{-Si}_3\text{N}_4\text{-Eu}_2\text{O}_3$ under N_2 atmosphere. The emission wavelength ranged from green to red under 466 nm excitation, depending on the firing parameters.

PHp - 33L Broad Band- $\text{SrSi}_2\text{O}_2\text{N}_2$: Eu^{2+} Phosphor for Solid-State Lighting and Photovoltaic Cell

Y.-C. Fang^{}, S.-Y. Chu^{*,**}*

Nat. Cheng Kung Univ., Taiwan

$\text{SrSi}_2\text{O}_2\text{N}_2$: Eu^{2+} green phosphors are prepared using a solid-state reaction. The luminescence properties are investigated using PLE/PL spectra, and this concentration quenching mechanism may be exchange interaction. Results show that $\text{SrSi}_2\text{O}_2\text{N}_2$: Eu^{2+} phosphors with a broad excitation band have potential for use in solid-state lighting and solar cells.

----- Break -----

16:40 - 17:50

Room 502

PH3: Emissive Displays and Phosphors

Chair: D. Jeon, KAIST, Korea

Co-Chair: K. Wani, Tazmo, Japan

PH3 - 1: Invited Challenges to Full-Color Quantum Dot Display

16:40

B. L. Choi, T.-H. Kim, K.-S. Cho, E. K. Lee, S. J. Lee, J. Chae, J. W. Kim, D. H. Kim, S. Y. Lee, Y. Kuk*, J. M. Kim*

*Samsung Elect., Korea
Seoul Nat. Univ., Korea

Colloidal quantum-dot (QD) display has recently received considerable attention due to their many strengths of QD property. In this talk, the status of QD-EL and the embodiment of full-color QD display with a noble, scalable approach for fine patterning of QD will be presented.

PH3 - 2 Optical Simulation of Light Conversion Process in Emissive LCDs Consisting of Phosphor Layers and Near-UV LEDs

17:10

*T. Yata***, Y. Miyamoto*, K. Ohmi**

**Tottori Univ., Japan
**Sony Mobile Display, Japan*

A light conversion process in emissive LCDs consisting of phosphor layers and near-UV light has been simulated using a Monte Carlo ray tracing method. It enables to optimize parameters of phosphor layer by only using measured luminescent and optical characteristics of phosphors and optical filters.

PH3 - 3 Effect of Annealing on the Structural and Photoluminescence Properties of ZnO/Zn_{0.9}Mg_{0.1}O Heterostructures

17:30

C. Li, D. Wang, T. Kawaharamura, T. Matsuda, T. Hiramatsu, H. Furuta, M. Furuta, T. Hirao

Kochi Univ. of Tech., Japan

ZnO/Zn_{0.9}Mg_{0.1}O thin films were prepared by radio frequency magnetron sputtering. Thermal-annealing was carried out in different ambient gases at a low temperature of 430°C. Bamboo-like nano-rods were only formed after annealing in a reducing gas, accompanying with an enhancement in both visible and UV region emissions.

Author Interviews

18:00 – 19:00

Supporting Organizations:

The 125th Research Committee on Mutual Conversion between Light and Electricity, Japan Society for Promotion of Science
Phosphor Research Society, The Electrochemical Society of Japan

IDW '11

The 18th International Display Workshops

December 7-9, 2011

Nagoya Congress Center
Nagoya, Japan

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Workshop on Field Emission Display and CRT

Friday, December 3

9:00 - 9:10

Room 402

Opening

Opening Remarks

9:00

M. Takai, Osaka Univ., Japan

9:10 - 10:00

Room 402

FED1: FEDs & BLUs

Chair: H. Mimura, Shizuoka Univ., Japan

Co-Chair: H. Shimawaki, Hachinohe Inst. of Tech., Japan

FED1 - 1: 9:10 ***Invited* Development of Carbon Nanotube Backlight for LC Television; Reliability of Printed Carbon Nanotube Field Emitters**

*Y. C. Kim, I. H. Kim, J. N. Hur, J. W. Bae, S. H. Park,
H. J. Kim, I. T. Han, J. M. Kim, Y. H. Kim*

Samsung Advanced Inst. of Tech., Korea

LCD TV lit by CNT BLU has been developed. We present development and optimization on the CNT paste for the application in BLU. Emission current density $\sim 1 \text{ mA/cm}^2$ under DC bias was stably obtained through the CNT paste with high concentration of CNTs up to 10 wt%.

FED1 - 2 9:40 **High Speed Lightening of CNT Field Emission Backlight for LCD by Enhanced Turn-off Current Driving Method**

J.-W. Jeong, J.-W. Kim**, J.-T. Kang***, Y.-H. Song***

**Elect. & Telecommun. Res. Inst., Korea*

***Univ. of Sci. & Tech., Korea*

****Kyungpook Nat. Univ., Korea*

The advanced current driving method was adopted for a high speed operation of CNT field emission backlight. The enhanced turn-off method shortens the response time of field emission switching in the FE-BLU, under 1ms, which is applicable to an impulsive or a color-sequential BLU for premium LCD.

FED1 - 3 Withdrawn

----- Break -----

10:40 - 12:10

Room 402

FED2: Field Emitters (1)

Chair: Y. Gotoh , Kyoto Univ., Japan
 Co-Chair: F. Wakaya, Osaka Univ., Japan

FED2 - 1: *Invited* Field Emission Characteristics of Carbon Nanotube Emitters Fabricated by a Filtration-Transfer Method

*D. H. Shin, Y. Song, Y. Sun, J. Y. Lee, J. H. Shin, C. J. Lee
 Korea Univ., Korea*

FED

We demonstrated CNT field emitters made by a filtration-transfer method. They showed low turn-on and threshold electric fields and very stable emission stability for long operation time at the acceleration condition. The new fabrication method can promise high-performance CNT emitters with organic binder free at room temperature.

FED2 - 2 Robust Carbon Nanotube Cathode with Various CNT Diameters and Post Treatments

11:10

*M. Takai, T. Takikawa, H. Oki, K. Murakami, S. Abo,
 F. Wakaya
 Osaka Univ., Japan*

Carbon nanotube (CNT) cathodes with high emission current and long lifetime have been realized using various surface treatments and pulsed aging, resulting in the field emission lifetimes exceeded 100 hours in dc operation, corresponding to 100,000 hours at a duty ratio of 1/1000.

FED2 - 3 Performance of Hafnium Nitride Field Emitter Array in Tough Circumstance

11:30

*W. Ohue, K. Ikeda, K. Endo, Y. Gotoh, H. Tsuji
 Kyoto Univ., Japan*

Gated Hafnium Nitride field emitter arrays (HfN-FEAs) which possess approximately 10,000 emission tips were fabricated, and their performance was evaluated both at room temperature and at 200°C. HfN-FEAs could be operated even at 200°C.

**FED2 - 4 Enhanced Electron Emission from nc-Si MOS
11:50 Cathode by Laser Irradiation**

H. Shimawaki, Y. Neo^{}, H. Mimura^{*}, F. Wakaya^{**},
M. Takai^{**}*

Hachinohe Inst. of Tech., Japan

^{}Shizuoka Univ., Japan*

*^{**}Osaka Univ., Japan*

Enhancement of electron emission by laser irradiation of a metal-oxide-semiconductor (MOS)-type cathode based on nanocrystalline silicon has been studied. The emission current was enhanced under irradiation and quickly responded to on-off of the laser. In addition, the threshold voltage for the electron emission became lower than that without irradiation.

----- Lunch -----

13:20 - 14:40

Room 402

FED3: Field Emitters (2)

Chair: M. Takai, Osaka Univ., Japan

Co-Chair: Y. Neo, Shizuoka Univ., Japan

**FED3 - 1 FEA Technologies for Display and Imaging Sensor
13:20 Application**

M. Nagao, T. Yoshida, T. Shimizu, S. Kanemaru, Y. Neo^{},
H. Mimura^{*}*

AIST, Japan

^{}Shizuoka Univ., Japan*

Several FEA technologies for display and imaging device application that we have developed will be overviewed. A vertical-thin-film FEA for material saving fabrication, an integration of FEAs on TFT substrate for precise emission control, a volcano-structured multi-gate FEA for beam focusing, and HfC coating for lifetime improvement will be presented.

**FED3 - 2 Observation of Field Emission Current Fluctuation
13:40 with In Situ Analyzer of Field Emission Devices**

Y. Gotoh, M. Kawasaki, H. Tsuji

Kyoto Univ., Japan

Current fluctuation of field emission current was observed with in situ analyzer of field emitters. Current-voltage characteristics obtained by superimposing ac voltage, we obtained Seppen-Katamuki plots of the emitter. Detailed analysis revealed that the change in emission current could be detected by the present method.

FED3 - 3 **Enhancement of Electron Field Emission from Titanium-Oxide Nanostructure by Ultraviolet Light Irradiation**
14:00

F. Wakaya, T. Tatsumi, K. Murakami, S. Abo, T. Takimoto, Y. Takaoka*, M. Takai*

Osaka Univ., Japan

**Ishihara Sangyo Kaisha, Japan*

Effect of ultraviolet light irradiation on electron field emission from titanium-oxide nanostructure is investigated. The field-emission current was increased by the irradiation. The enhancement in the field-emission current by UV light with a wavelength $\lambda = 365$ nm is larger than that with $\lambda = 405$ nm.

FED3 - 4 **A New Method for Improving the Surface Conduction Electron Emission**
14:20

X. Siliang, L. Lu, Z. Lingguo, W. Shengli

Xi'an Jiaotong Univ., China

Surface-conduction electron emitters (SCEs) are normally fabricated from PdO conductive film. In this paper, we propose a method to increase the emission current of SCE. The experiment result shows the emission current can be increased from 5.32 μ A to 7.58 μ A by changing the voltage polarity exerted to the nano-scale gaps.

----- Break -----

FED

15:00 - 15:40

Room 402

FED4: Field Emitters (3)

Chair: M. Sasaki, Univ. of Tsukuba, Japan

Co-Chair: M. Nagao, AIST, Japan

FED4 - 1 **The Characteristics of Suppressor to Control an Emission Angle for Micro-Column Built in Field Emitter**
15:00

Y. Neo, A. Koike, Y. Takagi, T. Fujino, M. Nagao, T. Yoshida*, H. Murata**, K. Sakai**, T. Aoki, H. Mimura*

Shizuoka Univ., Japan

**Nat. Inst. of Advanced Ind. S&T, Japan*

***Meijo Univ., Japan*

The Micro-column was proposed as electron beam application, such as microscope and lithography. According with the basic principle of reduction law, the structure was redesigned and the beam spot diameters were estimated correctly. In this time, the new functioned electrode, named suppressor, was introduced to the initial emission angle.

FED4 - 2 **Work Function Measurement of Y-Oxide/W(100)
15:20** **Surface by Using of Photoemission Electron
Microscope**

*T. Kitaguchi, K. Furuta, H. Nakane
Muroran Inst. of Tech., Japan*

A cathode material of a low work function is needed to achieve a high performance electron source. We measured the work function of W(100) surface modified with Y_2O_3 by using of photoemission electron microscope. The work function of Y-oxide/W(100) surface is measured to be 2.7 eV.

Author Interviews

16:20 – 17:20

Sponsor:

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Asia Display 2011

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SID 2011

International Symposium, Seminar and Exhibition

May 15-20, 2011

Los Angeles, California, U.S.A.

Workshop on Organic LED Displays

Wednesday, December 1

13:20 - 14:50

Main Hall

OLED1: OLED Keynote & Materials

Chair: Y. Kijima, Sony, Japan

Co-Chair: T. Inoue, TDK, Japan

OLED1 - 1: *Invited* Challenges Towards the Next-Generation 13:20 OLED Materials and Devices

T. Tsutsui

Kyushu Univ., Japan

Progresses in materials and devices in OLEDs in these twenty years have been summarized, and present attainments of research and development in OLEDs are discussed. Then issues needed for further studies for the progress in science and technology on OLEDs are discussed.

OLED1 - 2: *Invited* Highly Efficient Fluorescent Blue OLED 13:55 Based on New Electron Transport Materials with High Electron Mobility

S. Kusano, M. Nagaoka, E. Takahashi, S. Fukuchi,

T. Fukuchi, N. Yokoyama

Hodogaya Chem., Japan

A series of new electron transporters showing high electron mobility and high T_g has been developed. I-V-L characteristics of blue OLED were measured in temperature range of 28-80°C. Material with higher mobility showed minor temperature dependence of driving voltage, and evident temperature dependence of current efficiency is discussed.

OLED1 - 3 Optimization of Carrier Balance in Phosphorescent 14:20 Polymers for Highly Efficient OLED Devices

*G. Motomura, M. Suzuki, T. Shimizu, S. Tokito**

NHK, Japan

**Yamagata Univ., Japan*

We have evaluated the carrier transport properties in phosphorescent polymers having carrier transport and phosphorescent units. The mobility observed by Time-of-Flight measurements depended on the concentration ratio of carrier transport units. An external quantum efficiency of 14.5% in OLEDs using phosphorescent polymers was achieved by optimizing the carrier balance.

**OLED1 - 4 Study of Carrier Injection in PDOF/Ca Interface by
14:35 Using Carrier Transfer Simulation Method**

*I. Yamashita, H. Onuma, R. Nagumo, R. Miura,
A. Suzuki, H. Tsuboi, N. Hatakeyama, A. Endou,
H. Takaba, M. Kubo, A. Miyamoto*

Tohoku Univ., Japan

We analyzed the carrier injections in PDOF/Ca interfaces by using carrier transfer simulation method based on a quantum chemistry calculation and Monte Carlo methods. We investigated the relationship between the interface structures and carrier injection properties.

----- Break -----

15:00 - 16:10

Main Hall

OLED2: OLED Soluble Technologies

Chair: K. Nakayama, Yamagata Univ., Japan

Co-Chair: T. Wakimoto, Merck, Japan

**OLED2 - 1: *Invited* Soluble Hole Injection Materials Applicable
15:00 to Hybrid and Printed OLED Devices**

K. Monzen, N. Nakaie, T. Yamada

Nissan Chem. Inds., Japan

We are developing the inks for wet coating, named *ELsource* that can be used as hole injection layer in OLED devices. The luminance of hybrid OLED device using the latest ink has increased two times more than that using conventional ink.

**OLED2 - 2 A High-Performance Hybrid OLED Device Assisted
15:25 by Evaporated Common Organic Layers**

*T. Higo, T. Matsumoto, T. Imai, T. Yoshinaga, Y. Obana,
T. Hirano, T. Sasaoka, T. Urabe*

Sony, Japan

We propose a novel OLED structure named "Super Hybrid OLED", which is consisted of polymer and small molecule layers. The Super Hybrid OLED has excellent performance in the blue device (0.14, 0.09) of current efficiency of 6.1 cd/A. Both red and green Super Hybrid devices showed equivalent performances to all-polymer devices.

OLED2 - 3 **A Novel Solution Processable Hole-Transport Polymer and Its Applications on Organic Electroluminescent Devices**
15:40

J.-H. Li, A. Raju, P. Almar, T. Hirai, M. Bown, K. Ueno

Commonwealth Scientific & Ind. Res. Org., Australia

A new solution processable hole-transport material (HTL) and the according devices of fluorescence and phosphorescence are demonstrated in this presentation. Results showed that the device performances based on this HTL are comparable with the ones with traditional HTL, NPD.

OLED2 - 4 **Highly Efficient Solution-Processed Phosphorescent Organic Light Emitting Diode Using Polymer Host**
15:55

*T. Sawabe, I. Takasu, Y. Mizuno, T. Sugizaki, A. Wada, T. Ono, J. Yoshida, S. Enomoto, A. Hirao, I. Amemiya, C. Adachi**

Toshiba, Japan

**Kyushu Univ., Japan*

We report a highly efficient solution-processed blue phosphorescent organic light-emitting diode (OLED) with maximum external quantum efficiency (EQE) of 20.9% and the maximum power efficiency of 40 lm/W. Our results show that solution-processed OLEDs can achieve high efficiency close to the theoretical limit.

----- Break -----

OLED

16:40 - 18:05

Main Hall

OLED3: OLED Display Applications

Chair: S. Aratani, Hitachi, Japan

Co-Chair: A. Mikami, Kanazawa Inst. of Tech., Japan

OLED3 - 1: *Invited* 15-in. RGBW Panel Using Two-Stacked White OLED and Color Filter for TV Applications
16:40

C.-W. Han, S.-H. Pieh, H.-S. Pang, J.-M. Lee, H.-S. Choi, S.-J. Bae, H.-W. Kim, W.-S. Ha, Y.-H. Tak, B.-C. Ahn

LG Display, Korea

We fabricated 15-in. HD panel employing the two-stacked WOLEDs and color filter, of which color gamut is up to 101.2% (CIE1976). The WOLEDs exhibit a current efficiency of 61.3 cd/A and a power efficiency of 30 lm/W at 1000 nit and their CIE coordinate is (0.340, 0.334).

OLED3 - 2 High Efficient Top Emitting OLED Micro Display for Personal Display Application
17:05

C. Y. Park, S. Lee, C.-H. Hyun, S. K. Kang, B.-C. Kwak, H.-S. Lim*, O.-K. Kwon*, H. K. Chung*

Samsung Mobile Display, Korea

**Hanyang Univ., Korea*

A 0.4-in. VGA OLED Micro Display composed of Si wafer backplane and white OLED was demonstrated. A high current efficiency of 18.4 cd/A (conversion white efficiency 4 cd/A) for single optical path length top emitting white OLED was achieved. A HMD using OLED Micro Display was demonstrated for personal display application.

OLED3 - 3 Design of the LTPS Process Compatible High Performance Distributed Bragg Reflector (DBR) Using High k Dielectrics
17:20

D. Kwon, J. Yoon, C. Im, I. Lee, J. Lee, S. Kim

Samsung Mobile Display, Korea

The high performance DBR consisted of multi SiO₂/high k dielectric layers was developed. For low temperature poly-Si (LTPS) process compatibility, we designed it as a gate dielectric also. We achieved color gamut over 100% and improved light efficiency over 80% without degradation of thin film transistor (TFT) property.

OLED3 - 4 Rapid Thermal Annealing (RTA) Skipped Bottom Emission 5 Mask AMOLED Displays with a Low k Organic Interlayer
17:35

I. Lee, C. Im, D. Kwon, J. Yeo, J. Yoon, J. Kim, Y. Kim, J. Lee, S. Kim

Samsung Mobile Display, Korea

The world first LTPS 5 mask AMOLED panel was designed by placing the gate and the pixel on the same plane. With RTA process skipped, we achieved mobility of 81 cm²/Vs for the TFT with an organic interlayer. Finally, LTPS 5 mask 12.1-in. WXGA AMOLED panel was fabricated without RTA process.

OLED3 - 5L OLED-on-CMOS Based Single Chip Microdisplay and Image Sensor Device
17:50

R. Herold, U. Vogel, B. Richter

COMEDD, Fraunhofer Inst. for Photonic MicroSys., Germany

After first reports of the principle of a single chip microdisplay and camera device, this paper presents the first characterization results of a chip with active matrix camera. Operation will be explained by block-schematic. A second part shows the characterization results of the camera and the display.

Author Interviews

18:00 – 19:00

Thursday, December 2

9:00 - 10:15

Room 204

FLX4/OLED4: Flexible OLED

Chair: T. Kamata, AIST, Japan
 Co-Chair: S. Naka, Univ. of Toyama, Japan

**FLX4/
 OLED4 - 1 Solution-Processed Organic Films of Multiple Small-
 Molecules and White Light-Emitting Diodes**

9:00

*W. Dongdong, W. Zhaoxin, Z. Xinwen, J. Bo, L. Shixiong,
 W. Dawei*, H. Xun*

Xi'an Jiaotong Univ., China

**Univ. of Arkansas, USA*

We found that the spin-coated films of NPB, and blends of NPB and DPVBi, though having lower densities, were more uniform than their vacuum-deposited counterparts. Using the spin-coated films of NPB:DPVBi as mixed host, doped with blue and yellow dyes, new white organic light-emitting devices (WOLEDs) were demonstrated.

**FLX4/
 OLED4 - 2 Flexible OLED Encapsulation by Glass Base
 Technology**

9:20

*G. Chen, S.-T. Yeh, P.-I Shih, J.-L. Wu, K.-Y. Cheng,
 L.-Y. Jiang, Y.-Y. Chang*

ITRI, Taiwan

A flexible OLED encapsulation process was successfully developed with glass base OLED mass production equipment. These flexible encapsulation OLED devices have good flexibility and environment reliability. We expected this approach will be the important way to manufacture the flexible OLED devices using currently most OLED equipment facility.

**FLX4/
 OLED4 - 3 Graphene Sheet Synthesized with Microwave
 Eradiation and Interlinked by Carbon Nanotubes for
 High-Performance Transparent Flexible Electrodes**

9:40

G. Xin, W. Hwang, N. Kim, H. Chae

Sungkyunkwan Univ., Korea

High quality graphene was obtained though microwave irradiating expansion following a solution process. By combining Carbon Nanotubes (CNTs) as bridges between graphene flakes, allowed the fabrication of high performance conductive films with conductivities and optical properties: $181 \Omega\text{sq}^{-1}$ at 82.2% transmittance after chemical treatment and doping.

FLX4/ OLED4 - 4L Fabrication of QVGA Flexible Phosphorescent AM-OLED Display using Ink-jet Printing

10:00

M. Suzuki, H. Fukagawa, G. Motomura, Y. Nakajima, M. Nakata, H. Sato, T. Shimizu, Y. Fujisaki, T. Takei, S. Tokito, T. Yamamoto, H. Fujikake*

NHK, Japan

**Yamagata Univ., Japan*

We demonstrated a 5-in. QVGA flexible phosphorescent AM-OLED display driven by OTFTs on a plastic substrate. Cross-linked olefin polymer was used as the gate insulator. Phosphorescent polymer materials were used for emitting layer of OLEDs, which were patterned by ink-jet printing. Color moving images were achieved by the display panel.

----- Break -----

10:40 - 11:50

Room 501

OLED5: OLED Device Technologies

Chair: K. Monzen, Nissan Chem. Inds., Japan

Co-Chair: H. Kuma, Idemitsu Kosan, Japan

OLED5 - 1: *Invited* Surface-Light-Emitting Transistors Based on Vertical-Type Metal-Base Organic Transistors

10:40

K. Nakayama, Y.-J. Pu, J. Kido

Yamagata Univ., Japan

The metal-base organic transistor (MBOT) is a promising vertical-type organic transistor composed of simple layered structure and it can drive large current with low voltage. MBOT also can be applied for surface-light-emitting transistors by combining with OLED materials that realize both functions of OLED and OTFT.

OLED5 - 2 Performance Improvement of White Phosphorescent Organic Light-Emitting Diodes by Using Composite Host Structure to Enhance the Carrier Injection

11:05

F.-S. Juang, L.-A. Hong, C.-Y. Chen, S.-H. Wang, Y.-S. Tsai, Y. Chi, H.-P. Shieh***

Nat. Formosa Univ., Taiwan

**Nat. Tsing Hua Univ., Taiwan*

***Nat. Chiao-Tung Univ., Taiwan*

Device characteristics of phosphorescent OLEDs with composite host structure were investigated by co-doping hole and electron transport-type hosts in emitting layer. The improved of charge carrier injection and confined of exciton within recombination zone were achieved. White OLED shows the efficiencies of 34.5 cd/A and 24 lm/W at 1000 cd/m².

OLED5 - 3 Withdrawn

OLED5 - 5L High-Efficient White Organic Light-Emitting Diodes with a Three-stack Multi-Photon Emission Structure

11:20

*Shingo Ishihara**Hitachi, Japan*

We have investigated 3-stack MPE WOLEDs with all phosphorescent emitters. The current efficiency and the power efficiencies obtained were 129 cd/A and 27 lm/W at 0.1 mA/cm², respectively.

OLED5 - 4 Low Temperature Color Filter on Thin Film Encapsulation AMOLED for Flexible Top Emission

11:35

*S. Kim, H. S. Shim, H.-J. Kwon, Y. T. Chun, I. Kee,**S. Y. Lee, S. Lee*, J. H. Kwack*, D. Han*, M. S. Song*,**S. Kim***Samsung Elect., Korea***Samsung Mobile Display, Korea*

We developed low temperature color filter on thin film encapsulation AMOLED panel for flexible display, which are performed under 90°C to be compatible to OLED device. Here, new optical system composed of LTCF and OLED micro cavity, can demonstrate high outdoor readability, low power consumption, and a wide viewing ability.

----- Lunch -----

OLED

13:20 - 16:20

Poster/A.I. Room

Poster OLEDp: OLED Technologies

OLEDp - 1 UV-Influence Suppressed on the Device Characteristic of a-IGZO Thin-Film Transistors Using Solution Based TiOx

*C.-W. Chou, H.-H. Lu, H.-C. Ting, T.-H. Shih, C.-Y. Chen, Y.-S. Lin**AU Optronics, Taiwan*

The TiO_x film was proposed to lower the ultra-violet (UV) influence on the device characteristics of amorphous indium gallium zinc oxide (a-IGZO) thin-film transistors (TFTs). After UV treatment, a-IGZO TFTs passivated with TiO_x film showed less shift and degradation on electrical characteristics.

OLEDp - 2 High Transparency Organic Light-Emitting Diodes Based on Multilayer Transparent Electrodes

*J. Choi, H. Cho, S. Yoo**KAIST, Korea*

We present organic light-emitting diodes (OLEDs) based on multilayer transparent electrodes (MTEs) which exhibit luminance over 8000cd/m² and turn-on voltage of 2.7 V. The MTEs consist of Ag/Cs₂CO₃ cathode with a ZnS capping layer. Our OLEDs show 82% of peak transmittance (at 600 nm) and 73% average transmittance in the visible region.

OLEDp - 3 Optimization of Micro Lens Array (MLA) Pattern for the Improvement of Light Extraction Efficiency in OLED Devices

H. J. Lee, H. K. Bae, B.-S. Kim, C. S. Oh, C.-G. Son,
L. S. Park*

Kyungpook Nat. Univ., Korea

**Yeungnam Univ., Korea*

In this paper we discussed the effect of micro lens array (MLA) pattern fabricated on the glass substrate of organic light emitting diode (OLED) for improvement of light extraction efficiency. The effect of MLA on light extraction efficiency from OLED was examined by the fabrication of various MLA on the devices.

OLEDp - 4 Highly Polarized Electroluminescence from OLEDs with a Quarter-Wave Retardation Plate Films and a Reflective Polarizer

B. Park, Y. H. Huh, Y. I. Lee, J. C. Shin, H. G. Jeon

Kwangwoon Univ., Korea

We present a highly polarized OLED using a quarter-wave plate film and a reflective polarizer, which exhibited emissions of 13,400 cd/m² with peak efficiency of 10.3 cd/A and degree of polarization over 40. These are almost two times higher than those of the polarized OLED using only a reflective polarizer.

OLEDp - 5 Improvement of Luminance Distribution in Transparent OLED by Using ITO/APC/ITO Top Electrode

*T. Uchida, M. Yahata, K. Sakurai, K. Yamada, T. Satoh,
T. Tamura*

Tokyo Polytechnic Univ., Japan

We fabricated films with both high electrical conductivity and high optical transparency by using Zn-doped In oxides (IZO) with an inserted thin Ag-Pd-Cu (APC) film. Transparent organic light-emitting diodes (OLEDs) with an IZO/APC/ IZO top electrode indicated better luminance uniformity than the device with a single IZO cathode.

OLEDp - 6 High Hole Conduction Technology for OLEDs

*J. H. Yu, W. S. Jeon, J. S. Park, D. C. Lim, Y. J. Doh,
J. W. Choi, Y. H. Son, J. H. Kwon*

Kyung Hee Univ., Korea

An interesting high hole conduction configuration with extremely low driving voltage characteristics in phosphorescent green OLEDs is reported. The configuration of a hole transporting layer (HTL)/ electron extraction layer (EEL)/ HTL results in 1.1×10^{-2} cm²/Vs hole mobility at electric field of 0.1 MV/cm².

OLEDp - 7 Properties of Organic Light Emitting Diodes with Very Thin MoO₃ Layer and Characterization of the MoO₃ Layer Deposited on ITO Anode

S. Yoshida, M. Kawamura, Y. Abe

Kitami Inst. of Tech., Japan

With a MoO₃ hole injection layer, device performance of prepared OLEDs was improved significantly. The results showed optimum thickness of the MoO₃ to be 1.0 nm. Coverage of ITO surface was not complete with MoO₃ of that thickness by AFM observation. It became complete with the MoO₃ of 2.0 nm.

OLEDp - 8 Fluorescence Analysis of ITO-Sputtering Damage of an Organic Film

*N. Takada, S. Hoshino, K. Suemori, T. Kamata,
N. Ibaraki, S. Suenaga*, B. Tanaka*, N. Hamanaga*,
K. Aoe*, E. Tao**

AIST, Japan

**Choshu Ind., Japan*

The fluorescence damage analysis technique taking account of the optical interference effect and exciton diffusion/quenching mechanism was developed and ITO (Indium-tin-oxide) sputtering damage to an Alq₃ (tris(8-hydroxyquinoline) aluminum) film was evaluated. Using the model that sputtered ITO particles scrape off Alq₃ surface, we elucidated Alq₃ film damage of about 5nm.

OLEDp - 9 Pre-Metered Horizontal Dipping Method for Simple Fabricating Large OLEDs

B. C. Park, H. G. Jeon, K. H. Choi

Kwangwoon Univ., Korea

Pre-metered horizontal dipping (H-dipping) was studied for fabricating OLEDs by using concave meniscus of used solutions. H-dipped OLEDs were fabricated with high performance; maximum efficiency of 19.3 cd/A with 40,600 cd/m². Patterned OLEDs on 5.6-in. substrates were successfully fabricated, implying that H-dipping holds great potential for large-area OLEDs.

OLEDp - 10 Withdrawn

OLEDp - 11 New Small Molecule Host System for Solution-Processed Red Phosphorescent OLEDs

*Y. H. Son, K. H. Kim, W. S. Jeon, J. S. Park, D. C. Lim,
Y. J. Doh, J. W. Choi, J. H. Kwon*

Kyung Hee Univ., Korea

High efficiency solution-processed red phosphorescent OLEDs with new small molecule mixed host systems are reported. This fabricated red phosphorescent OLED with $(\text{Ir}(\text{phq})_2\text{acac})$ dopant and 2-TNATA: TPBI mixed host has a driving voltage of 5.2 V and maximum current and power efficiencies of 17.8 cd/A and 11.3 lm/W, respectively.

OLEDp - 12 Combination of Inorganic Hole Injection Layer and Organic Hole Transport Layer in OLED Technology

Z. Hotra^{,**}, P. Stakhira^{*}, V. Cherpak^{*}, D. Volyniuk^{*},
L. Voznyak^{*}, N. V. Kostiv^{*}*

^{}Lviv Polytechnic Nat. Univ., Ukraine*

*^{**}Rzeszow Univ. of Tech., Poland*

In this work we proposed OLED structure with inorganic copper iodide (CuI) as hole injection layer combine with organic nickel phthalocyanine (NiPc) as hole transport layer. It was shown that combine inorganic CuI hole injection layer and organic NiPc as hole transport layer reduced operating voltage and improved OLED performance.

OLEDp - 13 Novel and High Efficient Yellow Phosphorescent Iridium Emitters

H.-L. Huang, T.-C. Chao, M.-R. Tseng

ITRI, Taiwan

We investigated and synthesized different orientation and substituted group of the thieno-pyridine framework organo-iridium yellow complexes (PO-01, PO-01-TB). The electroluminescent current efficiencies of the devices were from 62.8 cd/A to 64.8 cd/A under the brightness of 1000 cd/m² and EQE were all above 18.5% to 20.4%.

OLEDp - 14 Highly Operational Color Stability of Blue Organic Light-Emitting Diode

T.-L. Chiu, P.-Y. Lee, C.-H. Hsiao^{}, J.-H. Lee^{*},
C.-Y. Chen^{*}, M.-K. Leung^{*}*

Yuan Ze Univ., Taiwan

^{}Nat. Taiwan Univ., Taiwan*

A color stability blue organic light-emitting device (B-OLED) with blue phosphorescent dopant iridium(III)bis(4,6-difluorophenyl-pyridinato-N,C²)picolate (Flrpic) was demonstrated in this paper by fine-tuning its doping concentration. Under continuous operation, the maximum color coordinate variation of B-OLEDs with Flrpic concentration 3~15% is $\Delta x=0.008$ and $\Delta y=0.02$ as applied voltage from 4.5 to 11V.

OLEDp - 15 Fabrication of Thin Film by Plasma Polymerization and Application to Organic Light Emitting Device

S. Ojiro, R. Koyama, S. Hikita, Y. Sato, S. Yoshikado
Doshisha Univ., Japan

Thin film applicable to light emitting device was deposited using plasma polymerization of benzene monomer by discharge at 13.56 MHz. The effects of discharge power and electrode distance on the quality were investigated. Sharp infra-red absorption peak caused by C=C expansion and contraction of benzene ring was observed around 133 Pa.

OLEDp - 16 Fabrication of 4-Wavelength White Organic Light-Emitting Diodes Including Two Emissive Layers and Three Primary Colors

Y.-H. Kim, S. Y. Lee, W. Song, M. Meng, H. J. Yang,
K. W. Kim, W. Y. Kim
Hoseo Univ., Korea

4-wavelength white organic light-emitting diode concluding three primary colors was fabricated using two emissive layers. White emission characteristics of the OLED such as CIE coordinates, efficiency, and max luminescence were (0.32,0.37) at 6 V, 7.1 cd/A at 199 cd/m², and 10659 cd/m² at 8 V, respectively.

OLEDp - 17 High Color-Stability for White Organic Light Emitting Devices by Using Phosphorescent Sensitizer Fluorescent

F.-S. Juang, L.-A. Hong, C.-J. Hsiao, S.-H. Wang,
M.-H. Ho, C.-H. Chen**
Nat. Formosa Univ., Taiwan
**Nat. Chiao Tung Univ., Taiwan*

High color-stability white-OLED was achieved by using a yellow dopant in phosphor-sensitized emitter and optimizing the interlayer thickness. Device shows the E.Q.E. of 8.2%, and the efficiency of 21.5 cd/A with CIE (0.40, 0.46) at 20 mA/cm². The shift of CIE_{x,y} down to (-0.001, -0.001) from 20 to 200 mA/cm².

OLEDp - 18 Inorganic Nanolaminates on Polymer Substrates as Gas-Diffusion Barriers in Flexible Electronics Structures

J. -H. Choi, Y. -W. Park, J. W. Jeong, T. H. Park, H. J. Choi,
E. H. Song, D.-J. Ham, J.-W. Lee, C.-H. Kim*, B.-K. Ju*
Korea Univ., Korea
**Cheil Inds., Korea*

A SiO₂/Al₂O₃ nanolaminate gas-diffusion barrier film on a plastic substrate was proposed. The Ca-test indicates that such laminate films can effectively suppress the void defects of an inorganic layer, and are significantly less sensitive against moisture permeation. This nanostructure is verified as being useful in highly water-sensitive flexible organic electronics.

OLEDp - 19 Improved Lifetime of Highly Flexible OLEDs Based on Multilayer Transparent Electrodes with Enhanced Barrier Performance

*S. Park, K. H. Jung, C. Yun, H. Cho, B.-S. Bae, S. Yoo
KAIST, Korea*

We present multilayer transparent electrodes (MTEs) fabricated on polyethylene naphthalate (PEN) substrates coated with organic-inorganic hybridizers that lead to improved barrier characteristics. Lifetime measurement shows that flexible organic light-emitting diodes (OLEDs) with these MTEs have a reliability that is far superior to ITO-based counterparts under repeated bending.

OLEDp - 20 Evaluation Technology to Verify Flexible Gas Barrier Property Based on Electrical Calcium Degradation for Electronics Application

*E. H. Song, Y. W. Park, J. W. Jeong, J. H. Choi,
T. H. Park, H. J. Choi, B. K. Ju
Korea Univ., Korea*

Ca-test was designed to evaluate barriers property by checking current changing through the tested calcium cell. We introduce newly designed Ca-test model which can measure about two times faster than formal model. Moreover this structure can be bent, so we can analyze barrier property degradation by forcing bending stress.

OLEDp - 21 Transfer-Printed Integrated Circuits for Display Backplanes

*C. A. Bower, D. Gomez, K. Lucht, B. Cox, D. Kneeburg
Sempruis, USA*

Conventional thin-film transistor (TFT) backplanes do not exhibit the performance required for current-driven active-matrix OLED (AMOLED) displays. Here, we report on the latest results of fabricating active-matrix display backplanes using transfer-printed high-performance integrated circuits. We will present the print yield and print accuracy, as well as strategies for backplane fabrication.

OLEDp - 22 The Electrical Characteristics of Organic Light Emitting Diodes Applied Organic Photo Sensor for Emotional Lighting Applications

*J. W. Jeong, Y. W. Park, T. H. Park, J. H. Choi, H. J. Choi,
E. H. Song, J. I. Lee*, H. Y. Chu*, B. K. Ju*

*Korea Univ., Korea
Elect. & Telecommun. Res. Inst., Korea

This paper reports on a study of the emission properties of organic light emitting diodes (OLEDs) controlled by an organic photo sensor (OPS) for emotional lighting applications. The luminance of the OLED increased from 283.4 cd/m² to 1134 cd/m² when the OPS was exposed to different illumination levels.

OLEDp - 23 The Influence of Operating Temperature on the Electrical Characteristics of Pentacene Thin-Film Transistors

*L.-Y. Chiu, C.-C. Tai, W.-Y. Chou, F.-C. Tang,
H.-L. Cheng*

Nat. Cheng Kung Univ., Taiwan

The effect of temperature on the electrical characteristics of pentacene-based organic thin-film transistors (OTFTs), including mobility, threshold voltage and hysteresis behaviors, was investigated. Increased charge mobility and enlarged hysteresis were observed at higher temperature, suggesting that the environmental thermal energy plays an important role to device performance of PEN-based OTFTs.

OLEDp - 24 Withdrawn**OLEDp - 25 The Study of the Performance of Organic Solar Cells by the Electrode and Characteristics of Interfacial Layers**

*N. S. Knag^{**}, J.-W. Yu^{***}, I.-D. Kim^{**}, J.-M. Hong^{**},
B.-K. Ju^{*}*

^{}Korea Univ., Korea*

*^{**}Korea Inst. of S&T, Korea*

*^{***}Kyung Hee Univ., Korea*

We reported on the effect of organic photovoltaics by conductivity of interlayer such as PEDOT:PSS and TCO (Transparent conducting oxide) such as ITO, which is used P3HT and PCBM. And, we have measured with exactly defined shadow mask to study effect of solar cell efficiency according to conductivity of hole transfer layer.

OLEDp - 26L Electroluminescence Properties of Novel Hyper-Branched Light-Emitting Polymers Based Devices

R.-H. Lee, W.-S. Chen, Y.-Y. Wang

Nat. Chung Hsing Univ., Taiwan

A series of hyper-branched polyalkylfluorenes (HBPFs) with an electron-conducting group, triazine and a hole-conducting group, triphenylamine as molecular cores were synthesized by the Suzuki coupling reaction. This series of HBPFs with different conjugated lengths were end-capped with a hole-conducting group, triphenylamine, and a rigid moiety, tetraphenylsilane.

OLEDp - 27L Surface Plasmon Enhanced Optoelectronic Performance of a Conjugated Polymer Using Ag Dot Arrays

J. Y. Kim, K. H. Cho, Y. Yeo, K. C. Choi

KAIST, Korea

In this work, the optoelectronic performance of a conjugated polymer with silver dot arrays was investigated. The silver dot fabrication based on the imprint method resulted in a 2.7-fold enhancement of the integrated PL intensity by successfully coupling between the surface plasmon and excitons in the emitting layer.

OLEDp - 28L Solution Processed White Light Emitting Devices Using a Novel Orange Triplet Emitter

J.-Y. Liao, T.-C. Chao, J.-S. Lin, M.-R. Tseng

Material & Chem. Res. Labs. Ind. Tech. Res. Inst. (ITRI), Taiwan

The solution processed white light emitting devices composed of a novel orange emitter, PO-01-TB, and the blue emitter, Flrpic, are studied. Devices with efficiencies of 22 cd/A and 10 lm/W are reported by mixing the orange and blue emitters into PVK/OXD-7 matrix.

OLEDp - 29L The Other Crucial Factor Dominates the Holes Injection Efficiency of Ultra-thin Anode Buffer Layer on Organic Light Emitting Devices

*S.-Y. Chu, Y.-C. Chen, H.-H. Huang, P.-C. Kao**

Nat. Cheng Kung Univ., Taiwan

**Nat. Chiayi Univ., Taiwan*

In this study, we have investigated surface energy of ITO substrates modified by ultra-thin buffer layers plays crucial factor as important as energy barrier. With larger surface energy, organic light emitting devices could get superior performance even there exist larger barrier between ultra-thin buffer layer modified ITO and organic layer.

OLEDp - 30L Synthesis and Characterization of Novel Blue-Light-Emitting Fluorene-Carbazole Copolymers with Boryl Substitutions

Y.-H. Chen, Y.-Y. Lin, Y.-C. Chen, J. T. Lin*, R.-H. Lee, R.-J. Jeng*

Nat. Chung Hsing Univ., Taiwan

**Academia Sinica, Taiwan*

Novel carbazole/fluorene-Based copolymers with dimethylboron pendants were synthesized by Suzuki polymerization for blue light-emitting diodes. Different energy levels and electroluminescence performances were observed for the copolymers via tuning the conjugation length of the side chain.

OLEDp - 31L Metal Mask Printing Method for Organic Light-Emitting Diodes Fabrication*H. Ishiguro, S. Naka, H. Okada**Univ. of Toyama, Japan*

We have investigated "metal mask printing method" for organic light emitting diodes, which is simple technique for short-tact time, large-area and high-resolution device fabrication. Maximum luminance of 270 cd/m² was obtained for self-aligned single layer device.

OLEDp - 32L Enhanced Electron Injection into Alq₃ Based OLEDs Using a Thin Potassium Carbonate Buffer Layer*P.-C. Kao, C.-C. Chang, S.-I. Lin**Nat. Chiayi Univ., Taiwan*

A cathode buffer layer of potassium carbonate (K₂CO₃) was used to improve the electro-optical properties of organic light-emitting diodes (OLEDs). The improvement can be attributed that the electron-injection efficiency was enhanced due to a lower electron injection barrier, which improves the charge carrier balance in OLEDs.

----- Break -----

OLED

16:40 - 18:05

Room 501

AMD5/OLED6: AM-OLED

Chair: D. Pribat, SungKyunKwan Univ., Korea

Co-Chair: Y. Fujisaki, NHK, Japan

AMD5/OLED6 - 1: Invited Process Development of Amorphous Indium-Gallium-Zinc-Oxide Thin-Film Transistors for Large Size AMOLED Applications

16:40

*H.-C. Ting, H.-H. Lu, T.-H. Shih, L.-C. Lee, C.-W. Chou, L.-P. Shin, S.-S. Wang, T.-C. Wan, C.-Y. Chen, Y.-H. Lin**AU Optronics, Taiwan*

In this paper, we will show how to approach a-IGZO TFTs AMOLED in Gen 6 Fab currently. We evaluated the TFTs structure from bottom gate coplanar to BCE type with Mo/Al/Ti as S/D electrode. Using photosensitive organic passivation layer and TiO_x coating to improved the device performance and stability.

**AMD5/
OLED6 - 2** **High Mobility Oxide Semiconductor TFT for Circuit
Integration of AM-OLED**

17:05

*E. Fukumoto, T. Arai, N. Morosawa, K. Tokunaga,
Y. Terai, T. Fujimori, T. Sasaoka*

Sony, Japan

We have developed a high mobility and high reliability oxide semiconductor TFT which used ITZO as a channel material. Its mobility and ΔV_{th} after 20,000sec of BTS test were 30.9 cm²/Vs and 0.1 V. We have achieved a stable enhancement type TFT, which realizes circuit integration for AM-OLED.

**AMD5/
OLED6 - 3** **A New Simple Pixel Circuit Compensating the
Threshold Voltage for AMOLED Displays**

17:25

*Y.-I. Hwang, Y.-S. Park, K.-N. Kim, B.-H. Kim,
B. H. Berkeley, S.-S. Kim, B.-D. Choi**

Samsung Mobile Display, Korea

**Sungkyunkwan Univ., Korea*

We propose new simple pixel compensation circuits with three or four thin film transistors (TFTs) and one capacitor. In addition to compensating the deviation of the threshold voltage of the driving TFTs, we can compensate IR-drops and reduce the number of components in compensation circuits with these novel circuits.

**AMD5/
OLED6 - 4** **4.1-in. Full Color AMOLED Driving by Top Gate
Nanocrystalline Silicon Thin Film Transistor Array**

17:45

*K.-Y. Ho, H.-C. Lin, H.-S. Dai, P.-F. Lee, C.-C. Hsu,
S.-Y. Peng, C.-W. Lin, C.-H. Cheng, B.-C. Kung,
W.-Y. Chao, J.-Y. Yan, H.-C. Cheng*

ITRI, Taiwan

High performance nanocrystalline silicon thin film transistors are achieved with top gate staggered structure. The nc-Si is directly deposited by 13.56 MHz plasma enhanced chemical vapor deposition (PECVD) at 200°C. Good device performance, uniformity, and reliability make it possible to be integrated into active matrix organic light emitting diode (AMOLED) applications.

Author Interviews

18:00 – 19:00

Workshop on 3D/Hyper-Realistic Displays and Systems

Thursday, December 2

9:00 - 10:20

Room 412

3D1: Holography and 3D Display

Chair: T. Horikoshi, NTT DoCoMo, Japan

Co-Chair: K. Yamamoto, NICT, Japan

3D1 - 1: *Invited* Spatial Imaging Based on Extremely High-Definition Computational Holography — Wave-Field Oriented 3D Imaging —

9:00

K. Matsushima

Kansai Univ., Japan

Extremely high-definition displays beyond Super Hi-Vision give us a new horizon in the field of 3D imaging. This paper introduces spatial 3D imaging brought by computational holography and techniques for numerical propagation of wave-fields that make it possible to create the spatial 3D images.

3D1 - 2 **24 Mega Pixels Phase Electroholography**

9:20

T. Shimobaba, H. Nakayama, N. Masuda, N. Takada, T. Ito*

Chiba Univ., Japan

**Shohoku College, Japan*

We report a phase-type electroholography that can reconstruct 3D objects from 24-mega pixels phase-type CGHs, with large and wide-viewing angle. To solve the problems of the size and viewing angle, we used 12 phase modulated LCDs. For real-time calculation, we used a GPU cluster and the wave-recording plane method.

3D1 - 3 **Simplified Novel Look-Up Table Method Using Compute Unified Device Architecture**

9:40

Z. Ali, J.-H. Park, N. Kim

Chungbuk Nat. Univ., Korea

In this study, we have exploited the parallel nature of the computations involved in the process of digital holography using novel look-up table method. We utilize CUDA enabled GPU to accelerate each step of the digital holography. Our simulation results confirm that the GPU implementation is much faster than CPU.

- 3D1 - 4L** **Imaging Characteristics of Array of Dihedral Corner Reflectors by Use of Gaussian Beam Decomposition**
10:00 *S. Yokoyama^{*,**}, K. Nitta^{*}, O. Matoba^{*}, S. Maekawa^{**}*
^{}Kobe Univ., Japan*
*^{**}NICT, Japan*

A methodology to analyze an imaging optics with dihedral corner reflector array is reported. This methodology is based on the Gaussian beam decomposition and achieves results of analysis with simple operation for beam propagation. Usefulness of the methodology is verified and novel characteristics obtained by the methodology are reported.

- 3D1 - 5L** **A Real-Time Color Electroholographic Reconstruction System Using a Multi Graphics Processing Unit**
10:10 *N. Takada, H. Nakayama^{*}, S. Awazu^{*}, Y. Ichihashi^{**}, T. Shimobaba^{*}, N. Masuda^{*}, T. Ito^{*}*
Shohoku College, Japan
^{}Chiba Univ., Japan*
*^{**}NICT, Japan*

Electroholography is a technique for realizing three-dimensional (3-D) television. We developed a color electroholographic system consisting of three liquid-crystal display panels and three graphics processing units. The system succeeded in animating 3-D images composed of about 1,500 points in each light's primary color at nearly video-rate.

----- Break -----

10:40 - 12:00	Room 412
3D2: 3D Display (1)	

Chair: K. Matsushima, Kansai Univ., Japan
 Co-Chair: S. Yano, NHK, Japan

- 3D2 - 1:** **Invited 3-D Display Interaction**
10:40 *M.-C. Park, H.-D. Lee, J.-Y. Son^{*}*
Korea Inst. of S&T, Korea
^{}Daegu Univ., Korea*

Interactions take place as two or more objects and/or beings effect upon one another. 3-D display enhances visual presence and enriches personal experience. 3-D display interaction is effective to exchange and share of thoughts, feelings, experiences and ideas. Our researches are introduced in the aspect of 3-D display interaction.

3D2 - 2: Invited 3D Volumetric Scanned Light Display with Multiple Fiber Optic Light Sources
11:00

*B. T. Schowengerdt, E. J. Seibel
Univ. of Washington, USA*

A custom array of 16 singlemode optical fibers positions the end of each fiber a different distance from a collimating lens, placing light from each fiber at a different focus level. The superimposed multifocal beams are raster-scanned to generate a volumetric display, with each fiber writing to a different layer.

3D2 - 3 LC Grin Lens for a Multi-View 3D Display
11:20

*P. W. Wu, W. L. Chen, C. H. Shih, W. M. Huang
AU Optronics, Taiwan*

A 5-view 2.83-in. 2D/3D switchable displays with low crosstalk and low driving voltages were fabricated. By changing different applying voltages, suitable LC orientations are configured to obtain good 3D performance for displays of different optimal viewing distance design.

3D2 - 4 Moiré Pattern Reduction by Using Special Designed Parallax Barrier in an Autostereoscopic Display
11:40

*W.-T. Yen, C.-L. Wu, C.-L. Wu, C.-H. Tsai, C.-J. Chou
ITRI, Taiwan*

To minimize the moiré effect, we simulate the relationship of brightness distribution and various design parameters of the parallax barrier. According to the simulation results, a combination of multiple parameters was chose to obtain a moiré free autostereoscopic display based on the concept of mutual compensation among the design parameters.

----- Lunch -----

13:20 - 16:20

Poster/A.I. Room

Poster 3Dp: 3D/Hyper-Realistic Displays and Systems

3Dp - 1 An Evaluation Method of Cross-Talk on Stereoscopic LCD with Frame Sequential Method and a Directional Backlight System

*A. Sakai, A. Hayashi, T. Kometani, H. Ito
Eizo Nanao, Japan*

There are two types of cross-talk on stereoscopic LCD based frame sequential method with a directional backlight system. One is optical cross-talk in a directional backlight system, and the other is caused by slow response of LC panel. This paper considers about a method for evaluating them overall.

3Dp - 2 Perceived Depth Change between Real Objects with Different Visual Acuties of Both Eyes

*K. Sadakuni, T. Inoue, H. Yamamoto, S. Suyama
Univ. of Tokushima, Japan*

In stereoscopic display, the amount of perceived depth change is quickly decreased when both eyes have different visual acuties. On the contrary, in real object, the amount of perceived depth change is gradually decreased when both eyes have different visual acuties.

3Dp - 3 Study of 3D-Image Influence on Visual Region by EEG Analysis

*C.-Y. Chen, M.-D. Ke, Y.-R. Pan, C.-P. Chen,
S.-W. Cheng**
Nat. Yunlin Univ. of S&T, Taiwan

The electroencephalograms (EEG) of visual region from 60 volunteers were measured during watching a 3D movie. While the volunteers viewing a movie, α wave decreased but β wave increased in the occipital zone (visual region). Besides, there was no difference between viewing 2D and 3D movies.

3Dp - 4 Evaluation of Gray to Gray Performance in Stereoscopic Displays

*W.-C. Tsai, M.-H. Yang, H.-S. Ruan, C.-W. Chen,
K.-C. Chang, K.-S. Wang*
AU Optronics, Taiwan

Methods of analyzing crosstalk in stereoscopic displays with arbitrary gray level are demonstrated. We proposed novel viewpoints which are based on gray to gray look-up table to quantify ghosting artifact and are applicable to all types of stereoscopic displays.

3Dp - 5 The Fabrication of Autostereoscopic Panel Used Four-Level Diffractive Splitter on a Quartz Substrate

C.-Y. Chen, W.-C. Hung, Q.-L. Deng, Y.-R. Chang
Nat. Yunlin Univ. of S&T, Taiwan

In this paper, a new autostereoscopic panel used diffractive splitter is fabricated on a transparent quartz substrate. The diffractive efficiency of the quartz four-level blaze grating can reach 55.3%, that the device can replace the lenticular type or barrier type autostereoscopic panel, and make the brightness of panel much increased.

3Dp - 6 Three-Dimensional Display Using a Roof Mirror Grid Array and a Prism Sheet

Y. Maeda^{}, D. Miyazaki^{*,**}, N. Hirano^{*}, S. Maekawa^{**}*

^{}Osaka City Univ., Japan*

*^{**}NICT, Japan*

We developed a three-dimensional display using a roof mirror grid array, which is an optical imaging element that forms a real image, and a rotating prism sheet. The use of the rotating prism sheet can reduce a blur caused by diffraction at the roof mirror grid array.

3Dp - 7 Reflective 3D LC Display with Patterned Retarder

K.-S. Bae, U. Cha, Y.-H. Kim, J.-H. Kim, C.-J. Yu

Hanyang Univ., Korea

We report a stereoscopic 3D liquid crystal display in a reflective type. Using the cholesteric liquid crystal with a patterned retarder, two orthogonal polarization states are obtained and thus the stereoscopic images are constructed.

3Dp - 8 A New Basis Representation for Multiview Image Using Directional Sampling

T. Yamada, T. Fujii

Tokyo Inst. of Tech., Japan

To compress or interpolate the multiview image efficiently, we propose a new basis representation. By using directional sampling, we apply directional 3D-DCT and directional 3D-DWT to three dimensional data. In the experimental results, the proposed method showed better quality than previous method, not only in the objective/ subjective evaluation.

3Dp - 9 Development of a Novel Virtual Reality 3D Display: the "J-Display"

W. J. Tam, C. Vázquez

Commun. Res. Ctr., Canada

A novel type of stereoscopic 3D display to improve sense of virtual reality is proposed. The display has a curvilinear surface that allows stereoscopic objects to be viewed as being naturally "grounded" and not cut off as with standard displays. A tabletop prototype is described and future development is discussed.

3Dp - 10 A Scent-Emitting Thin Type LED Display Device with a Porous Screen, and It's Application

A. Tomono, H. Katsuyama, K. Tomono^{}*

Tokai Univ., Japan

^{}Wartburg College, USA*

We propose a new method where scents are ejected through the display in order to enhance the reality of the visual images. A thin LED panel filled with tiny pores was made for this experiment, and an air control system using a blower was placed behind the display screen.

3Dp - 11 Holographic Optical Elements for Stereoscopic Vision on LCD Panel*W.-C. Su, C.-Y. Chen*, Y.-F. Wang*, H.-W. Ho***Nat. Changhua Univ. of Education, Taiwan***Nat. Yunlin Univ. of S&T, Taiwan*

A holographic image splitter for stereoscopic effect on liquid crystal display panel is developed in this study. We designed and generated a special holographic optical element to replace the traditional image splitter in a stereoscopic display panel. Experimental results support the idea well.

3Dp - 12 Full Color Rewritable Photorefractive Large Area Display Material*M. Yamamoto, P. Wang, T. Gu, W. Lin, H. Wanyun, O. Siddiqui, A. Bablumyan*, A. Ordyan*, P. Blanche*, R. Voorakaranam*, N. Peyghambarian***NITTO DENKO Tech., USA***Univ. of Arizona, USA*

Organic polymer-based photorefractive materials which have both better diffraction efficiency and longer grating persistency have been improved. The materials were succeeded in principle-proving concept of highly image-persistent and rewritable holographic display systems. By using materials, we are aiming for developments of holographic display devices such as medical imaging devices.

3Dp - 13L 3D Display with No Physical Constraints Force Feedback Function*M. Tsuboi, S. Kimura, M. Fukumoto, T. Horikoshi**NTT DoCoMo, Japan*

A 3D display with force feedback function is proposed. In proposed system, neither physical connections to outer point, actuators, nor batteries are needed to pen-type device. Also, horizontal motion parallax is achieved and no conflicts between the position of 3D images and pen-type device.

3Dp - 14L Variable Parallax 3D Display for Mobile Application*H. Song, Y.-S. Choi, K.-H. Choi, J.-M. Bae, H.-S. Lee, S.-Y. Lee**Samsung Elect., Korea*

A variable parallax 3D display with a backlight unit having partitions in which a direction of light extraction angle can be regulated are proposed. Such concept was implemented in a prototype and verified that it could switch 3D parallax images between a landscape mode and portrait mode.

3Dp - 15L Turn-type Color 3-D Display System Using Arrays of LEDs

*T. Shimizu, Y. Sakamoto, I. Fukuda
Kanazawa Inst. of Tech., Japan*

We developed a depth sampling type 3-D display system. The system is designed to be capable of displaying a three-dimensional image by turning LEDs (Light Emitting Diodes) arrays. Recently, we successfully improved the brightness of the 3D display system. This report provides a detailed description of this improvement.

3Dp - 16L Impact of Spatial 3D Imaging by Extremely High-Definition Computational Holography

*K. Matsushima, H. Nishi, Y. Arima, K. Higashi,
M. Nakamura, S. Nakahara
Kansai Univ., Japan*

Spatial 3D images created by high-definition computational holography are actually demonstrated. The demonstrated 3D images are static images at this stage. However, these presage the great future of 3D displays beyond the Super Hi-Vision because of its strong sensation of depth, which never has been caused by conventional 3D systems.

----- Break -----

3D

16:40 - 18:00

Room 413

3D3/DES3: 3D System and Content

Chair: J.-Y. Son, Daegu Univ., Korea

Co-Chair: T. Fujine, Sharp, Japan

3D3/DES3 - 1: Invited Full HD and Super-High Image Quality 3D Plasma TV Technology

16:40

*K. Tasaka, M. Kawashima, K. Suetsugi, M. Ishizuka,
T. Yamashita, Y. Sugio
Panasonic, Japan*

This paper introduces the basic concept of Full HD and High Image Quality 3D Plasma Theater System and the key technology of Full HD and Super-High Image Quality 3D Plasma TV which was realized by the newly developed technology of Plasma panel improvement and new 3D system technology of both Plasma panel and 3D eyewear.

**3D3/
DES3 - 2:** *Invited* **Real-Time 2D-to-3D Conversion: Basic
Concepts and Practical Use**
17:00 *K. Yamada, Y. Suzuki*
JVC Kenwood Holdings, Japan

This paper describes the algorithm for our original 2D-to-3D conversion technology, which is beginning to be used for both consumer and professional apparatuses to fulfill the growing need for high quality 3D contents. The algorithm has advantages in quality, numerical complexity, no need of frame memory and very low latency.

**3D3/
DES3 - 3:** *Invited* **From 3D technology to New Styles of Visual
Images**
17:20 *M. Ikeo, A. Saito, Y. Nishida*
NHK Media Tech., Japan

The desire to visualize our imagination in new ways has encouraged the evolution of the media, while technical innovation has inspired our imagination. However, recent rapid advances in digital technology are leading the media not to represent human imagination but to mirror the actual world with ever greater reality. Can filmmakers' imagination catch up with the hyperrealism of the visual media? Content creators must shed the bonds of 3D images and develop new styles of visual images.

**3D3/
DES3 - 4:** *Invited* **3D Video Formats and Compression for
Content Distributions**
17:40 *H. Kimata*
NTT, Japan

Usage of 3D video would increase as the growth of 3D content production. The suitable 3D video format depends on the purpose in applications. This paper summarizes 3D video formats and compression technologies distinguished by purposes and it addresses the trends of stereoscopic video and multi-view video formats.

Author Interviews

18:00 – 19:00

Friday, December 3

10:40 - 12:10	Room 502
VHF8/3D4: 3D Human Factors	

Chair: S. Clippingdale, NHK, Japan
Co-Chair: H. Yamamoto, Univ. of Tokushima, Japan

**VHF8/
3D4 - 1:** **Invited Safety in 3D Broadcast, and Study in 3D
Channel Starting Service**

10:40 *Y. Imai, K. Imanishi, T. Okunaga*
SKY Perfect JSAT, Japan

SKY Perfect TV started broadcasting 3D channel from June 2010 and carried out the test shooting and the examination for a safe and easy-to-watch 3D broadcast. We studied the cause of fatigue and discomfort in watching 3D image by using images of soccer game and that of a woman.

**VHF8/
3D4 - 2** **Evaluation of Viewability to Hyper-Realistic Picture**

11:10 *N. Suzuki^{*}, S. Yano^{*,**}*
^{}NICT, Japan*
*^{**}NHK, Japan*

This paper provides a subjective and objective evaluation of the viewability of hyper-realistic images. First, we examined the preferable viewing distance for images of different sizes, including monoscopic and stereoscopic images. Second, we measured the eye movements of participants in a previous experiment comparing preferable with non-preferable viewing distance.

**VHF8/
3D4 - 3** **Measurement of Accommodation and Vergence
Responses while Viewing Two-View and Multi-View
3D Displays**

11:30 *H. Mizushina, I. Negishi, H. Ando^{*}, S. Masaki*
Advanced TeleCommun. Res. Inst. Int., Japan
^{}NICT, Japan*

We measured accommodation and vergence responses simultaneously while viewing two-view 3D display based on polarized glasses and multi-view 3D display based on parallax barrier. Difference between two-view and multi-view conditions was observed in the vergence response, but not in the accommodation response.

**VHF8/
3D4 - 4** **Influence of Luminance Gradient on Three
Dimensional Perception for Real Object and Digital
Image**

11:50 *K. Iwauchi^{*,**}, T. Takahashi^{**}, T. Eda^{**}, T. Ishikawa^{**},
M. Ayama^{**}*
^{}Sharp, Japan*
*^{**}Utsunomiya Univ., Japan*

We investigated 3D perception using real objects and digital images. The results indicate that the absolute luminance value of the brightest area and the luminance gradient are the two most important factors for 3D perception of real objects, whereas a degree of gradient enhancement is needed for digital images.

13:20 - 14:40

Room 502

3D5: 3D Image Quality

Chair: M.-C. Park, Korea Inst. of S&T, Korea

Co-Chair: T. Mishina, NHK, Japan

3D5 - 1: Invited Crosstalk in 3D-TV: Modeling, Adaptive Cancellation Algorithms and Perceptual Validation**13:20***L. Kerofsky, Y. Yoshida*, S. Deshpande, I. Sezan**Sharp Labs. of America, USA***Sharp, Japan*

Reduction of crosstalk for active glasses 3D-TV is analyzed. Crosstalk is characterized defining in-range and out-of-range pixel pairs. A distance minimizing algorithm cancels in-range crosstalk. Subjective quality improvement is validated. An adaptive algorithm reduces crosstalk due to out-of-range values while preserving image quality.

3D5 - 2 Human Factor for 3D Angular Uniformity Intensity Tolerance**13:40***R.-W. Liao, C.-S. Cheng, C.-H. Shih, W.-M. Huang**AU Optronics, Taiwan*

We propose a simple human factor experiment to know the threshold 3D AIU (angular uniformity intensity) of human eyes. We design different patterns corresponding to 3D AIU% to simulate the real case of human eyes. According to results, we can define the threshold 3D AIU is 98.82%.

3D5 - 3 A New Method for Quality Control of Shutter Glasses 3D Displays**14:00***P. Boher, T. Leroux, V. C. Patton**ELDIM, France*

We use a videoluminance meter to check the quality of shutter glasses 3D displays rapidly and easily. A dedicated pattern is applied to check simultaneously the effect of the grey level on the other eye and of the temporal synchronization. The visual impact of grey level instabilities is precisely quantified.

3D5 - 4
14:20**Effects of Overlapping Images on Image Flipping in Autostereoscopic Displays**

H. Ujike^{*,*2}, S. Uehara^{*,*3}, G. Hamagishi^{*,*4}, K. Taira^{*,*3},
 T. Koike^{*,*5}, C. Kato^{*,*5}, T. Nomura^{*,*6}, T. Horikoshi^{*,*7},
 K. Mashitani^{*,*8}, A. Yuuki^{*,*9}, K. Izumi^{*,*10},
 Y. Hisatake^{*,*11}, N. Watanabe^{*}, Y. Nakano^{*,*12}

^{*}Japanese Ergonomics Nat. Committee, Japan

^{*2}AIST, Japan

^{*3}Toshiba, Japan

^{*4}Sony Mobile Display, Japan

^{*5}Hitachi, Japan

^{*6}Sharp, Japan

^{*7}NTT DoCoMo, Japan

^{*8}Sanyo Elec., Japan

^{*9}Mitsubishi Elec., Japan

^{*10}3D Consortium, Japan

^{*11}Toshiba Mobile Display, Japan

^{*12}YOSH Consultancy, Japan

The factors affecting image flipping along different views in multi-view autostereoscopic displays were experimentally investigated. Our results indicated that (i) overlapping images reduce image flipping and also image sharpness, (ii) those effects of overlapping images weaken with larger number of views per IOD.

3D

----- Break -----

15:00 - 16:20

Room 502

3D6: 3D Display (2)

Chair: T. Fujii, Tokyo Inst. of Tech., Japan

Co-Chair: T. Koike, Hitachi, Japan

3D6 - 1: Invited Advantages of 3D Displays in Mobile Devices

15:00

T. Horikoshi

NTT DoCoMo, Japan

Small portable displays offer several advantages over large 3D-TVs. This paper describes the mobile environment, and shows that portable displays well suit the realization of multi-view 3D service. A head tracking system is also introduced that can effectively widen the stereoscopic viewing space of portable 3D displays.

3D6 - 2 3D Viewing Experience in Mobile Contexts**15:20***M. Salmimaa, T. Jävenpää, M. Pölöen**Nokia Res. Ctr., Finland*

User opinions on viewing angles and display size of handheld (auto) stereoscopic display in different contexts were studied. The optical characteristics of the display were determined. Results indicated that users preferred larger displays, especially with longer viewing durations. The viewing freedom was thought to be appropriate for all the contexts.

3D6 - 3 Effects of an Extra Diffuser between VZFO and Display Panel in a Multiview 3-D Imaging Systems**15:40***J.-Y. Son, Y. Vaspanov*, M.-C. Park**, H. Lee, S. Yeon**Daegu Univ., Korea***Hanyang Univ., Korea****Korea Inst. of S&T, Korea*

The crosstalk value changes by diffusers between VZFO and image display panel are measured in the multiview 3-D imaging geometry. The experiment informs that most diffusers can decrease moirés appearing in the system but increase crosstalk, however, a certain diffuser can be used to reduce moirés without the crosstalk problem.

3D6 - 4 Multi-View Image Capture for Glasses Free Multi-view 3D Displays**16:00***S. Gurbuz, S. Yano*, S. Iwasawa, H. Ando**NICT, Japan***NHK, Japan*

In this paper, we provide an overview of our multi-view image capture system. More specifically, we propose scene content based novel image alignment method for multi-camera image capture systems that are necessary to achieve good 3D image quality.

Author Interviews

16:20 – 17:20

Workshop on Applied Vision and Human Factors

Wednesday, December 1

13:20 - 14:50

Room 412

VHF1: Lightness Perception

Chair: Y. Shimodaira, Shizuoka Univ., Japan

Co-Chair: T. Matsumoto, Sony, Japan

VHF1 - 1 **Border Detection between Two Stimuli in Various Surround Luminance Conditions**

13:20

T. Ishikawa, T. Suzuki, T. Suzuki, T. Kawai, O. Koyama*, T. Eda**, M. Ayama*

Utsunomiya Univ., Japan

**Canon, Japan*

***Int. Univ. of Health & Welfare, Japan*

Border detection between two stimuli was investigated over a wide range of reference luminance conditions for various surround luminance levels. Results indicated that luminance contrasts for border detection exhibit a U-shaped curve against the reference luminance, and are discussed in relation to physiological properties of human visual system.

VHF1 - 2 **Informational Representation for Image Quality Degradation Activating Accommodation Mechanism in Subjective Evaluation Process**

13:40

T. Matsui

Gunma Univ., Japan

We measure accommodative responses to three kinds of compound drifting waves composed of drifting sine, square and missing fundamental square waves with an infrared optometer, and clarify which information representation (accommodative cue) for image degradation, i.e., spatial frequency structures or spatial features, activates the accommodation mechanism in subjective evaluation process.

VHF1 - 3 **Impact of Ambient Illumination Levels and Viewing Angles to Perceptual Contrast Ratio of Display**

14:00

*W. Lv, H. Xu, M. R. Luo**

Zhejiang Univ., China

**Univ. of Leeds, UK*

A visual experiment was performed to find the just noticeable difference (JND) of lightness under different viewing conditions on an LCD display. The impact of ambient illumination and viewing angles to the perceptual contrast ratio was revealed. The present results can be used to verify and develop perceptual contrast models.

VHF1 - 4L Purity Discrimination for Spectrally Mixed Light in the Mesopic Condition
14:20*Y. Ikegaya, G. Ohashi, Y. Shimodaira, Y. Shibata*, H. Serizawa***Univ. of Shizuoka, Japan***Koito Manufacturing, Japan*

Purity discrimination on monochromatic light and mixed light was studied in the mesopic condition. With correction on luminance ratio of pure color light of dominant wavelength to white light for colored light, thresholds of purity discrimination for monochromatic light and mixed light can be expressed in a unified manner.

VHF1 - 5L Influence of Multi-colored Unevenness on White Uniformity Evaluation of an LED Backlight
14:35*K. Nagamine, S. Tomioka, Y. Masakura**, T. Tamura*, Y. Shimpuku**Sony, Japan***Tokyo Polytechnic Univ., Japan****Tokyo Univ. of Tech., Japan*

We analyzed the relationship between viewer perception of the degree of the white uniformity of an LED backlight and photometric data measured by a 2D colorimeter and found that multi-colored uneven evaluation stimuli had a stronger influence on the results than similarly colored uneven stimuli.

----- Break -----

15:00 - 16:20**Room 412****VHF2: Color Perception**

Chair: T. Matsumoto, Sony, Japan

Co-Chair: K. Masaoka, NHK, Japan

VHF2 - 1 Artificial Hue Adaptation: Novel Technique to Help Easy Color Discrimination for Dichromatic Vision Preserving Color Saturation
15:00*S. Ohtsuka, S. Suzuki, S. Oishi, S. Oka, S. Fukumoto
Kagoshima Univ., Japan*

A novel technique for helping color vision deficiency is proposed. The features of this technique are, (a) utilization of a pair of original and hue-rotated color images, and (b) paired images enable color vision deficiency observers to distinguish between both B-Y and R-G opponent colors by alternating these images arbitrarily.

VHF2 - 2 **KANSEI Evaluation of Color Images Corrected for Color Anomalies Assessed by Deuteranomalous and Normal Observers**

*Y.-C. Chen, I. Takahashi** , Y. Guan, T. Ishikawa, H. Eto* , T. Nakatsue* , J. Chao** , M. Ayama*

Utsunomiya Univ., Japan

**Sony, Japan*

***Chuo Univ., Japan*

To investigate effectiveness of 'color-weak correction' to the KANSEI evaluation for color deficient observers, test images corrected with 5 levels of color-weakness were assessed by normal and anomalous trichromat. In some images, corrected image showed the best performance for deuteranomalous indicating the effectiveness of color-weak correction.

VHF2 - 3 **Skin-Color Palette Applying to Visual Assessment and Color Measurement of FPD**

*S.-H. Chen, H.-S. Chen, Y.-H. Chao, M. R. Luo**

Nat. Taiwan Univ. of S&T, Taiwan

**Univ. of Leeds, UK*

Visual assessment and physical color measurement methods have been widely used for evaluating color quality of Flat Panel Displays. In this study, a color selection method is proposed including a skin-color palette surrounding a reference image. The method is useful to analyze skin color quality on displays.

VHF2 - 4 **Low Color Gamut Application in Netbook and E-Book**

H. Zhang, L. Mao, J. Chen, S. Zhang, Y.-W. Chiu, T.-C. Chung, T.-S. Jen

InfoVision Optoelect., China

A new concept of integrating low color gamut of the color filter (CF) with color engine (CE) technology to improve the performance of the TFT LCD has been developed in this paper. An 11.6-in. module was fabricated for evaluation. By using the photo resistance with special specifications, it could achieve 33% NTSC standard with all the thickness of R, G, and B photo resistance equal to 1.39 μm , and Transmittance increase 23%. The insufficiency of chromaticity issue can be suppressed by color engine technology.

----- Break -----

16:40 - 18:10

Room 412

VHF3: Color Reproduction

Chair: K. Masaoka, NHK, Japan

Co-Chair: T. Kurita, NICT, Japan

**VHF3 - 1: Invited High-Fidelity, Wide-Gamut, High-Functionality
16:40 Color Imaging Technology: Natural Vision and Its
Future**

M. Yamaguchi

Tokyo Inst. of Tech., Japan

This paper reports the image and video technology that breaks through the limitation of RGB-based color, called Natural Vision, which incorporates the multispectral and multiprimary color imaging technologies for high-fidelity, wide-gamut, high-functionality color imaging and display.

**VHF3 - 2 Is CIE Matching Mandatory for Color Accuracy
17:10 Using Filter Based Colorimeters?**

P. Boher, T. Leroux, V. C. Patton

ELDIM, France

We demonstrate that CIE matching is mandatory to achieve good color accuracy using a color filter system. When tristimulus calibration is applied, CIE matching ensures excellent color stability even if spectral fluctuations take place. In addition, small deviations from the CIE curves can be measured and used to improve color accuracy during the measurements.

**VHF3 - 3 Development of High-Reproduction Color Index and
17:30 Evaluation of Viewing Angle**

T. Matsumoto, S. Haga, T. Nakatsue, H. Eto, Y. Akiyama

Sony, Japan

We developed a High-reproduction Color index (HR) to evaluate the accuracy of color reproduction on TV and report viewing angle measurement by using HR scores, which can evaluate color reproduction performance not only by color shifts caused by off-center viewing angles but also by the color reproduction in front view.

**VHF3 - 4 Accurate Estimation Method of XYZ for Colors of
17:50 Images on an LCD**

K. Ono, Y. Simodaira

Shizuoka Univ., Japan

An accurate estimation of tri-stimulus value of XYZ for colors of images displayed on an LCD is proposed even if it doesn't satisfy the additive color mixture. The method enables us to estimate XYZ with the average color difference of less than unity.

Author Interviews

18:00 – 19:00

Thursday, December 2

9:00 - 12:00

Poster/A.I. Room

Poster VHFp: Applied Vision and Human Factors**VHFp - 1 Boys and Girls Perceived Subjective Color Reproduction in Global LCD Brands***W. Mphöpö^{*,**}, M. Wang^{**}, J. Zhou^{**}, D. Gao^{**}, Z. Tang^{**}***Nat. Chiao Tung Univ., Sweden****Beijing 2nd High School Attached to Beijing Normal Univ., China*

What is the highest average subjective color reproduction capability users in the largest market today can expect to get from some of the major brands like Apple, Toshiba, HP, Sony, IBM/Lenovo etc? The answer is no where near 100% and some barely break 50% in important demographics.

VHFp - 2 Relationship of Legibility, Border Contrast in Colors and Visual Fatigue*H.-Y. Hsiao, H.-S. Chen**Nat. Taiwan Univ. of S&T, Taiwan*

4 experiments were designed on LCD monitors to explore the relationships of legibility, border contrast and visual fatigue. The result hints adjacent color pairs in the combinations aren't recommended. And using the stronger border contrast aren't suggested, which may make text reading not smoothly, and bring visual fatigue easily.

VHFp - 3 Psychophysical Analysis of Paint Colors for Wide Color Gamut Display*J. W. Jang, J. J. Yoo, H. Hong, H.-H. Shin**LG Display, Korea*

A series of physical measurements and psychophysical experiments using commercially available 1279 paint samples was performed in order to visually confirm the necessity of wide-gamut displays. Through the physical measurements, 3.8% of the samples were located out of BT.709 gamut. It was also 2.2% of the samples were visually perceivable.

VHFp - 4 Measuring Method of Viewing Angle Range Using Color Difference

Y. Fukai, K. Arata, N. Komine, T. Li, T. Arai, T. Igarashi, Y. Sano

Toyo Univ., Japan

We propose measuring method of viewing angle range using color difference. As a result of evaluation of image quality factors such as maximum luminance, gamma value and others as well as conventional contrast ratio, correlation of the color difference with subjective evaluation turned out to be the highest.

VHFp - 5 Color Differences Formulae for High Dynamic Range Projectors

P.-L. Sun, C.-P. Chueh, H.-S. Chen

Nat. Taiwan Univ. of S&T, Taiwan

CIE color-difference formula CIEDE2000 is important for image quality assessment but it does not take background luminance level, dynamic range, simultaneous contrast and crispening effect into account. The study presents a color difference formula to deal with these factors for assessing color fidelity of high dynamic range projectors.

VHFp - 6 Visually and Quantitatively Evaluating Rendering Image Performance for Vertical Stripe RGB Pixel with Various Repeated Units on the LCD

Y.-C. Wang, C.-R. Sheu

Nat. Cheng Kung Univ., Taiwan

We demonstrate the evaluation of rendering image performance with respect to visual perception and numerical comparisons. Using FFT analysis, it is easily observed the difference with various units. Three typical repeated units with vertical stripe RGB sub-pixel are studied in this paper, which are Stripe, Mosaic and Pentile1 repeated units.

VHFp - 7 Contrast Ratio Analysis for Back-Lit Dimming LCD

S.-Y. Pan, K.-C. Chang, C.-W. Chen, K.-S. Wang

AU Optronics, Taiwan

CR value will affect image quality, but may not be said that it is better for human perception with higher CR. The CR is dependent on measurement methods. This paper will discuss the effectiveness of different CR measurement methods. And provide some comments on human perception sensitivity for CR index.

VHFp - 8 Spot Mura Quantification Analysis for LED Edge-Lit Display

H.-S. Ruan, S.-Y. Pan, C.-W. Chen, K.-S. Wang
AU Optronics, Taiwan

We use CCD camera system instead of human inspectors' eyes to judge the Spot Mura level for Edge-lit LED Backlight and furthermore more objectively obtain an appreciate value. Therefore we develop a suitable analysis algorithm to quantify it by connecting CCD camera system measurement values with human inspectors' experience.

VHFp - 9 Robustness of Image Quality Factors in Different Environment Illumination

S. Mori, G. Ohashi, Y. Shimodaira
Shizuoka Univ., Japan

The purpose of this study is to examine the robustness of image quality factors in various environment illuminations using the parameter design in the field of quality engineering. Experimental results showed that image quality factors are or are not liable to be influenced by various environment illuminations.

VHFp - 10 Measurement of Cerebral Blood Flow Volume While Viewing 2D and 3D Images

H. Isono
Nippon Inst. of Tech., Japan

We measured cerebral blood flow volume while subjects viewed a 3D image immediately after viewing a 2D image. The results indicated that cerebral blood flow volume in the occipital lobe of the cerebrum is larger and there is greater brain activity while viewing 3D images than while viewing 2D images.

VHFp - 11 Effects of Image Quality Attributes on Stereoscopic 3D TV

K. T. Kim, Y.-H. Kim, Y. G. Lee, Y. J. Kang, H. E. Kim,
G. H. Kim, C.-W. Kim
Inha Univ., Korea

In this paper, human visual experiments are performed to verify effects of five image attributes on the stereoscopic 3D LCD TVs. Experimental results indicate that degree of cross talk is one of the most important factors affecting the image quality on the stereoscopic 3D LCD TVs.

VHFp - 12L Accurate Color Conversion for Multi-primary Displays with Three-primary Color Conversion and Linear Programming

*M. Takaya, T. Mori, Y. Shimodaira**

Numazu Nat. College of Tech., Japan

**Shizuoka Univ., Japan*

We propose a method to improve the accuracy of multi-primary-color conversion, which is based on linear programming. Existing accurate conversion methods for three-primaries and linear programming were combined to reduce color difference caused by color-tracking. The accuracy of the proposed method was 30 times higher than that of linear programming.

VHFp - 13L Color Conversion Method for Multi-Primary Display to Reduce False Contours

T. Mori, M. Takaya, Y. Amano, Y. Shimodaira**

Numazu Nat. College of Tech., Japan

**Shizuoka Univ., Japan*

This paper proposes a color conversion method for a multi-primary display to reduce false contours. Color conversion was adapted to mathematical programming. The color signals were obtained by SUMT and Newton's method. As a result, false contours have been reduced with a small color difference.

VHFp - 14L Research on Acquiring Color Signal for High Fidelity Color Camera

Y. Kandori, Y. Shimodaira

Shizuoka Univ., Japan

On a prototype camera intending to satisfy Luther condition, color acquisition accuracy of less than unity is achieved when it adopts a color conversion matrix of 3x4 with an invariable term under light sources of D65, Cool White, Horizon, TL84 and A.

----- Lunch -----

13:20 - 14:50

Room 412

VHF4/DES1: Multi Primary (1)

Chair: K. Sekiya, Tohoku Univ., Japan

Co-Chair: T. Matsumoto, Sony, Japan

**VHF4/
DES1 - 1: Invited Measuring Light and Color: An Introductory
Talk to Colorimetry**

13:20

*N. Ohta**Rochester Inst. of Tech., USA*

Colorimetry is quantifying colors, that is, an art of expressing colors by numbers. There are two classes of quantification: color appearance system and color mixing system. The gist of the two methods will be introduced.

**VHF4/
DES1 - 2: A New Evaluation Method of Color Reproductive
Performance and Evaluation of Multi-Primary Color
Display**

13:50

*M. Teragawa, T. Kanda, T. Fujine, M. Sugino,
Y. Miyanaga***Sharp, Japan***Hokkaido Univ., Japan*

This paper proposed new evaluation of color reproductive performance, and evaluated MPC display. We used coverage ratio against object color for evaluation of outer frame structure, and CDI for evaluation of inner structure. We clarified MPC display was suitable for expressing object colors and had advantage of smooth color reproduction.

**VHF4/
DES1 - 3: Color Reproduction of Multi-Primary Color Display:
Numerical Analysis Method and Application to
Lower Power Consumption**

14:10

*T. Fujine, M. Teragawa, N. Ohta***Sharp, Japan***Rochester Inst. of Tech., USA*

We analyze color reproduction of multi primary color (MPC) display, and propose to calculate primary amount of color mixing for MPC in minimum power consumption by linear programming. As an example, we analyze characteristics of RGB+Y four primary color system in comparison with RGB system.

**VHF4/
DES1 - 4 A Numerical Evaluation across Multi-Primary Color
Systems****14:30***A. Yoshida, K. Yoshiyama, K. Tomizawa, K. Nakamura,
Y. Yoshida, M. Teragawa, Y. Yamamoto*, N. Ohta****Sharp, Japan***CIS Labs., Japan****Rochester Inst. of Tech., USA*

We conducted a numerical analysis over several Multi-Primary Color (MPC) display systems consisting of RGB + Cyan primaries. We compared the results with our previous results (RGB + Yellow and RGB + White) for indicating characteristics of different MPC systems in terms of luminance reproduction and power consumption.

----- Break -----

15:00 - 16:20**Room 412****VHF5/DES2: Multi Primary (2)**

Chair: N. Ohta, Rochester Inst. of Tech., USA

Co-Chair: T. Matsumoto, Sony, Japan

**VHF5/
DES2 - 1: Invited Four Primary Color (RGB+Y) Displays: The
Latest Technologies and Advantages****15:00***M. Teragawa**Sharp, Japan*

This paper reviews the latest RGB+Y four primary color LCD technologies and the advantages. RGB+Y LCD has advantages for not only color reproducibility but also power consumption, in addition, higher resolution. RGB+Y LCD along with UV2A can make LCD-TV improved in all ways.

**VHF5/
DES2 - 2 High Resolution Reproducibility of Multi-Primary
Color Displays****15:40***K. Yoshiyama, H. Furukawa, N. Kondoh, S. Nakagawa,
Y. Yoshida**Sharp, Japan*

In this paper, we focus on high resolution characteristic of Multi-Primary Color (MPC) display, and show that horizontal resolution can be approximately twice for stripe-patterned four-primary color display by the combination with advanced sub pixel signal processing.

**VHF5/
DES2 - 3** **Advanced RGBW Display Image Process Using
Sub-pixel Rendering**
16:00 *M.-C. A. Kao, P.-L. Hsieh, H.-T. Lin*
 Chunghwa Picture Tubes, Taiwan

A novel image process has been developed to transform RGB into RGBW. It comprise the "RGBW mapping algorithm" is used to adjust color of image. And the "Virtual resolution scaling" is used to increase the apparent resolution. And the "W signal controlling" is used to increase sunlight readability.

----- Break -----

16:40 - 18:00 **Room 412**
VHF6: Moving Image Quality and Backlight System

Chair: T. Kurita, NICT, Japan
Co-Chair: K. Masaoka, NHK, Japan

VHF6 - 1 **Image Quality for Motion Pictures by Using Eye-
Tracking Technology**
16:40 *Y.-Y. Chang, H.-S. Chen, R. M. Luo**
 Nat. Taiwan Univ. of S&T, Taiwan
 **Univ. of Leeds, UK*

The purpose of this study is to find the relation between the psychophysical quantities (i.e., colorfulness, naturalness, visual comfort, preference, shadow / highlight detail) and image quality for motion pictures. Eye-tracking technology is introduced to collect the gazing areas which are attractive to the observers.

VHF6 - 2 **Investigation of Color Breakup Measurement
Method Using a Moving Camera System**
17:00 *Y.-Y. Lai, K.-N. Wu, M.-L. Tai**
 ITRI, Taiwan
 **Chunghwa Picture Tubes, Taiwan*

Field-sequential display is an eco-friendly production but color-breakup (CBU) is the significant problem. A novel CBU detects and analysis technique using the moving camera and the image processing method had proposed to evaluate the degree of CBU. This method could present a useful index to recognize the CBU phenomenon.

VHF

VHF6 - 3 **Study and Experiment of Color Breakup in a 6-in. Color Sequential Display**
17:20

C.-C. Tsai, S.-H. Yu, Y.-H. Cheng, W.-C. Tai
Chunghwa Picture Tubes, Taiwan

A 6-in. Color Sequential Display prototype has been developed. Some solutions of reducing color breakup has been discussed and experimented on the provided prototype. Color breakup has been roughly specified into static one and dynamic one. The proposed combination driving method can effectively reduce the color breakup.

VHF6 - 4 **Effect of Backlight Dimming Methods on the Perceived Contrast of Complex Images**
17:40

H.-I. Baek, J.-W. Kwon, S.-H. Kim, M.-J. Lim, H.-H. Shin
LG Display, Korea

Effect of different backlight dimming methods on the perceived contrast of complex images on the LCDs was subjectively compared and a good dependency on the image types was found. In some extreme cases, several times higher native contrast ratio was found to be required to compensate the perceived contrast difference.

Author Interviews

18:00 – 19:00

Friday, December 3

9:00 - 10:15	Room 502
VHF7: Display Human Factors	

Chair: T. Wake, Kanagawa Univ., Japan

Co-Chair: S. Clippingdale, NHK, Japan

VHF7 - 1 **Sociological Factors and LCD Subjective Image Quality (SIQ)**
9:00

W. Mphöpö^{,**}, J. Bingrui^{**}, L. Mi^{**}, W. Yimeng^{**}*

^{}Nat. Chiao Tung Univ., Sweden*

*^{**}Beijing 2nd High School Attached to Beijing Normal Univ., China*

Do sociological factors - cultural & ethnic background, gender, age, education level etc. have impacts on LCD Subjective Image Quality [SIQ] perception? Experiment with 750 Chinese and Korean individuals reveal sociological impacts of 40% or higher. And last but not least, Apple displays are not always best.

VHF7 - 2 Secure Display with Head-Tracking Viewing Zone

9:20

*H. Yamamoto, K. Kajimoto, S. Suyama**Univ. of Tokushima, Japan*

We propose a new type of secure display that employs face-detection with a camera. Optical encryption prevents eavesdropping of display signal and limits the viewing zone three-dimensionally. The viewing zone is moved to track the viewer's face. The experimental results shows the effectiveness of the proposed head-tracking secure display.

VHF7 - 3 Visual Cryptography on Color Video Displays

9:40

*C.-H. Wen**Nat. Taiwan Univ. of S&T, Taiwan*

Visual cryptography can encrypt the visual information by computer and decrypt the information via human eyes. This paper proposed a new scheme and decrypted the secret image by the way of video sequence. By showing the encrypted images frame-by-frame in front of visual display terminal, the decrypted information is noticeable.

VHF7 - 4L New HMI Solutions for Automotive Night Vision Systems

10:00

*P. Knoll**Karlsruhe Inst. of Tech., Germany*

First and second generation Night Vision Enhancement Systems with image presentation in the dashboard present a Camera-picture in the dashboard, in the center console area or on the windscreen. Results of ergonomic investigations with different HMI solutions are presented. Conclusions for a possible third generation are made.

VHE

----- Break -----

10:40 - 12:10

Room 502

VHF8/3D4: 3D Human Factors

Chair: S. Clippingdale, NHK, Japan

Co-Chair: H. Yamamoto, Univ. of Tokushima, Japan

**VHF8/
3D4 - 1: Invited Safety in 3D Broadcast, and Study in 3D
Channel Starting Service**

10:40

*Y. Imai, K. Imanishi, T. Okunaga**SKY Perfect JSAT, Japan*

SKY Perfect TV started broadcasting 3D channel from June 2010 and carried out the test shooting and the examination for a safe and easy-to-watch 3D broadcast. We studied the cause of fatigue and discomfort in watching 3D image by using images of soccer game and that of a woman.

**VHF8/
3D4 - 2
11:10** **Evaluation of Viewability to Hyper-Realistic Picture**
N. Suzuki^{}, S. Yano^{*,**}*
^{*}*NICT, Japan*
^{**}*NHK, Japan*

This paper provides a subjective and objective evaluation of the viewability of hyper-realistic images. First, we examined the preferable viewing distance for images of different sizes, including monoscopic and stereoscopic images. Second, we measured the eye movements of participants in a previous experiment comparing preferable with non-preferable viewing distance.

**VHF8/
3D4 - 3
11:30** **Measurement of Accommodation and Vergence Responses while Viewing Two-View and Multi-View 3D Displays**
H. Mizushima, I. Negishi, H. Ando^{}, S. Masaki*
Advanced TeleComm. Res. Inst. Int., Japan
^{*}*NICT, Japan*

We measured accommodation and vergence responses simultaneously while viewing two-view 3D display based on polarized glasses and multi-view 3D display based on parallax barrier. Difference between two-view and multi-view conditions was observed in the vergence response, but not in the accommodation response.

**VHF8/
3D4 - 4
11:50** **Influence of Luminance Gradient on Three Dimensional Perception for Real Object and Digital Image**
K. Iwauchi^{,**}, T. Takahashi^{**}, T. Eda^{**}, T. Ishikawa^{**},
M. Ayama^{**}*
^{*}*Sharp, Japan*
^{**}*Utsunomiya Univ., Japan*

We investigated 3D perception using real objects and digital images. The results indicate that the absolute luminance value of the brightest area and the luminance gradient are the two most important factors for 3D perception of real objects, whereas a degree of gradient enhancement is needed for digital images.

Author Interviews

16:20 – 17:20

Supporting Organizations:

Technical Group on Information Display, ITE

Technical Committee on Electronic Information Displays, Electronics Society, IEICE

Workshop on Projection and Large-Area Displays and Their Components

Wednesday, December 1

13:20 - 16:20

Poster/A.I. Room

Poster PRJp: Projection

PRJp - 1 A LCoS Microdisplay with Low Voltage Driving

G.-J. Lee, J.-H. Kim, K.-J. Yang, H.-K. Lyu, Y.-H. Lee,
H.-J. Chung*, B.-D. Choi*

*Daegu Gyeongbuk Inst. of S&T, Korea
Kumoh Nat. Inst. of Tech., Korea

A 0.28-in. SVGA LCoS panel with low power consumption was proposed for portable applications. For low operation voltage, a transmission gate was used for pixel switch in the proposed pixel structure so that any video signal within the power supply range can be stored in pixel capacitor.

15:00 - 16:25

Room 402

PRJ1: Illumination Systems

Chair: K. Li, Wavien, USA

Co-Chair: H. Nakano, Barco, Japan

PRJ1 - 1: *Invited* Full HD 3D Projector with Dual Engine and Single Projection Lens

15:00

*S.-G. Lee, S.-O. Yeo, W.-W. Park, S.-Y. Park, S.-H. Park,
J.-W. Kim, J.-K. Lee, S.-H. Kim*

LG Elect., Korea

The full HD 3D projector using passive polarization glasses has been developed to give a brighter 3D image on screen for the user. The dual engine and single projection lens system, the MHCM technology and digital processing & auto calibration technology provide a high quality 3D image for the user.

PRJ1 - 2 Development of a High Brightness Dual-Lamp Projector

15:25

*A. Yamada, K. Kojima, H. Kida, K. Samejima, J. Someya,
H. Sugiura*

Mitsubishi Elec., Japan

A projector has been developed that can display distinct pictures even in spacious and bright places. Two lamps are provided in a unique optical system to assure the brightness of 7,000 lumens and the high contrast ratio of 2,000 to 1, which are both the highest in the class.

**PRJ1 - 3 Increased LED Brightness with Recycling for
15:45 Projection Applications***K. Li**Wavien, USA*

This paper describes different approaches using LED recycling to increase the outputs at with separate recycled RGB LEDs for high power, recycled white LEDs for medium power, and single packaged RGB LEDs with recycling for low power. Gain ranges from 50% to over 100% have been achieved.

**PRJ1 - 4L Long Life Dual Paraboloid Reflector Lamp
16:05 Optimized for 3LCD and LCOS Projection Systems***K. Li**Wavien, USA*

Dual Paraboloid Reflector (DPR) has been demonstrated to extend lifetime of lamps by a factor of up to 5X. The DPR lamps have also been used with tapered light pipes suitable for DLP projectors. In this paper, a DPR system designed for used with 3LCD and LCOS system is shown.

Author Interviews

18:00 – 19:00

Thursday, December 2**9:00 - 10:20****Room 409****PRJ2: New Projection Applications**

Chair: B. Schowengerdt, Univ. of Washington, USA

Co-Chair: H. Kikuchi, NHK, Japan

**PRJ2 - 1 Monolithic Low Cost Plastic Light Guide for Full
9:00 Colour See-Through Personal Video Glasses***K. Sarayedine, P. Benoit, G. Dubroca, X. Hugel**Optinvent, France*

Low cost see-through personal video glasses technology for consumer market was developed. Monolithic transparent plastic light guide with an array of small surface mirrors enables a bright image with a field of view of 27 degrees in an esthetic form factor.

PRJ2 - 2 Projection Displays in Avionics**9:20***D. Cuypers, H. D. Smet*, X. Hugel**, G. Dubroca**,
A. V. Calster***imec, Belgium***Ghent Univ., Belgium****Optinvent, France*

Avionics represents a specialized area of display applications. A possible future development in this field is a single display cockpit environment with touch input capabilities. Such a seamless, tiled cockpit display based on short throw wide angle projectors is developed in the European Project ODICIS. The current results are discussed in this contribution.

**PRJ2 - 3 Roll to Roll Patterned Film for Effective Low
Luminance Pico Projection Display Applications****9:40***W. Mphepö***, Z. Yiyi***, Y. Wei***, W. Yan***,
Q. J. Feng******Nat. Chiao Tung Univ., Taiwan****Chalmers Univ. of Tech., Sweden*****Beijing 2nd High School Attached to Beijing Normal
Univ., China*

Tinted vehicle windows are for different uses among which are providing privacy, reducing transmitted sun light in hot climates and for aesthetics. The herein reported work was geared towards retaining these traditional aspects of tinted vehicle windows while adding a new display aspect component for custom display applications.

**PRJ2 - 4L A New Light Control System for 3LCD Projectors
Enabling Contrast Improvement with Enhancing
Energy Saving****10:00***H. Horiguchi, H. Yoshimoto, T. Yamada, K. Fukuhara,
L. Schreel*, J.-J. van den Bergh*, B. Dilles*, S. Sonoda***Seiko Epson, Japan***Philips Innovative Applications N.V., Belgium*

We developed a new light control system for 3LCD projectors. This system continually optimizes both the lamp brightness according to the image and the white balance deviations that occur due to lamp power changes. The system enhances contrast ratio by approximately five times and also realizes reduction of energy consumption.

----- Break -----

10:40 - 11:55

Room 409

PRJ3: Pico-Projectors

Chair: M. Niesten, Microvision, USA

Co-Chair: T. Hayashi, 3M APAC, Japan

PRJ3 - 1: *Invited* 1 mm x 7 mm Full-Color Pico Projector Using Scanning Optical Fiber**10:40***B. T. Schowengerdt, R. S. Johnston, C. M. Lee,
C. D. Melville, E. J. Seibel**Univ. of Washington, USA*

We have developed a 1-mm x 7-mm light scanning engine, projecting full-color images through a vibrating optical fiber tip and miniature lens system. The projection head and RGB light sources can be separated and tethered together by any desired length of optical fiber, enabling flexible device configurations.

PRJ3 - 2: *Invited* Pico Projector with Anamorphic Illumination System**11:05***C.-K. Liu, C.-C. Liao, K. Wang, Y.-J. Chen***Coretronic, Taiwan***Nat. Central Univ., Taiwan*

The development of a RGB LED projection engine with anamorphic illumination system is reported in this paper. Projector equipped with this engine could produce more than 50 lumens with WVGA resolution. The volume of optical engine and projector are 108 cc and 252 cc, respectively.

PRJ3 - 3: *Invited* Scanning Laser Beam Pico Projector**11:30***M. Niesten, T. Masood, J. Miller, S. Shinzawa**Microvision, USA*

The smallest high resolution projector engine to date has been developed for high volume manufacturing. This projector has a 720 resolution at a height of 7 mm and a volume of 5 cc. Future scanning laser beam projectors will be even smaller.

PRJ3 - 4 Withdrawn

----- Lunch -----

14:50 - 16:25

Room 409

PRJ4: Laser Projection and Despeckling Technologies

Chair: H. Kanayama, Sanyo Elec., Japan

Co-Chair: T. Suzuki, JVC KENWOOD Holdings, Japan

PRJ4 - 1: Invited The Evolution and Trends of Laser Projection Displays

14:50

*S. Shikama**Setsunan Univ., Japan*

The laser was first demonstrated just half-century ago (1960). Research and development of laser projection displays had been reported from the early stage of the laser history. In this paper, evolution and trends of laser projection displays are presented including the key issues; optical systems and components, speckle noise reduction.

PRJ4 - 2: Invited Development of Wide Scan Angle and High-Speed Optical Scanning Devices

15:15

*J.-H. Park, J. Akedo**AIST, Japan*

Metal-based optical MEMS scanning devices employed an AIST-original MEMS driving method, Lamb wave resonance piezoelectric driving method. It achieved large optical scan angles of 100° or greater at high scanning speeds (over 25 kHz) and low driving voltages (20 V), those are required to be used in practical projection displays.

PRJ4 - 3: Invited A Despeckler Based on a Single FLC Cell

15:40

*I. Kompanets, A. Andreev**Lebedev Physical Inst., Russia*

The speckle-noise in images displayed by the laser projection system is suppressed in real time when a laser beam passes through a single FLC cell where spatially inhomogeneous phase light modulation takes place due to special FLC material and electric pulse regime.

PRJ4 - 4 Despeckling Method with Variable Speckle Generator Utilizing Photopolymer Film

16:05

*K. Ishida, M. Kurashige, T. Takanokura, Y. Ohyagi, M. Watanabe**Dai Nippon Printing, Japan*

Removing laser speckle which generates on a screen is important in laser projection. In this paper, different speckle patterns are superimposed continuously by giving small movement or changing direction of light to volume phase holographic beam shaper utilizing photopolymer film, which makes speckle invisible. Speckle contrast of 0.03 is achieved.

----- Break -----

16:35 - 18:00

Room 409

PRJ5: Digital Signage and Large Venue Projectors

Chair: M. D. Perkins, Christie Digital Syss. Canada, Canada
 Co-Chair: S. Shikama, Setsunan Univ., Japan

PRJ5 - 1: *Invited* Micro Tiles - An Expandable Flexible Tiled Display System

M. D. Perkins

Christie Digital Syss. Canada, Canada

MicroTiles is a video display system that can be used to create large displays out of an array of small, modular units. The architecture is described along with how it meets the needs of Digital Out-Of-Home applications. Primary goals of this system are flexibility, resolution, and ease of installation.

PRJ5 - 2 Multiple Directional Viewing Projection Display Based on the Incident-Angle-Independent Diffusion Angle Quantizing Technology

17:00

*T. Kawakami, B. Katagiri, T. Ishinabe, T. Uchida**

Tohoku Univ., Japan

**Sendai Nat. College of Tech., Japan*

We have devised an incident-angle-independent, quantized-diffusion-angle screen and have realized a multiple directional viewing projection display system using double-side lenticular lens. Our display system has advantages of easy alignment for multiple projectors, and capability of multiple different images simultaneously according to viewing angle at any distance from the screen.

PRJ5 - 3 High Resolution Projection Systems with High Dynamic Range Capabilities

17:20

*B. Maximus, P. Candry, H. Nakano**

Barco Simulation, Belgium

**Barco Tokyo, Japan*

This paper focuses on an important aspect of the development of high dynamic range capabilities on high resolution LCOS projection systems for Simulation applications, namely the bitdepth which is required from the input of the projector up to the reproduction of the image.

PRJ5 - 4 Adaptive Brightness and Color Conversion Projection System by Color Tuning Optical Engine

17:40

M. Maeda, K. Arai, M. Haraguchi, T. Abe, S. Tanase, K. Mashitani, M. Inoue, H. Kanayama

Sanyo Elec., Japan

The newly developed projection system realizes adaptive combination of high brightness and wide color gamut. This projector features a fourth liquid crystal panel, "Color Tuner", with 3LCD optical engine, which controls yellow-light separately from RGB lights of UHP lamp.

Author Interviews

18:00 – 19:00

Supporting Organizations:

Technical Group on Information Display, ITE

Laser Display Technology Research Group, Optical Society of Japan

BANQUET

Wednesday, December 1, 2010

19:30 – 21:30

Crowne Grand Ball Room (2F)

ANA Crowne Plaza Fukuoka

See page 9 for details

PRJ

EXHIBITION

12:00 – 18:00 Wednesday, Dec. 1, 2010

10:00 – 18:00 Thursday, Dec. 2, 2010

10:00 – 14:00 Friday, Dec. 3, 2010

2F Lobby, 4F Lobby

Fukuoka International Congress Center

Free admission with your registration name tag

Workshop on Electronic Paper

Wednesday, December 1

13:20 - 16:20

Poster/A.I. Room

Poster EPp: Electronic Paper

EPp - 1 **High Performance and Colorful Active Matrix Electrophoretic Display**

*C.-M. Lu, M.-C. Weng, Y.-C. Chen, H.-H. Chen,
W.-T. Tseng, H.-T. Yu*

Chunghwa Picture Tubes, Taiwan

CPT has successfully developed the 6-in. colorful AMEPD panel of the micro-capsule with the color filter. The colorful EPD technology is necessary because the market demand of the colorful E-book is so strong. Therefore, we present a full-color display with the color filter covered on the 6-in. AMEPD panel.

EPp - 2 **Realization of Vivid Image Projection in a Bright Room Using Electronic Paper Screen**

*T. Kinjo, M. Omodani, T. Yoshida**

Tokai Univ., Japan

**Freelance Profession, Japan*

We have suggested a new projection system which can realize high contrast image projection in a bright room. It is consisted of electronic paper screen, LED projector and LED room light. We have confirmed that twice higher contrast than the conventional projection system is achieved by our new system in a bright room environment.

EPp - 3 **Behavior of Image Sticking in Bistable Display Using Cholesteric LC**

M. Fukuda, Y. Kurosaki, M. Nose, T. Watanuki

Fujitsu Labs., Japan

Image sticking, which refers to the slight difference in brightness due to the previous image remaining, is a serious problem with bistable displays using cholesteric liquid crystals. Image sticking occurs after the electric field is removed, so it is greatly affected by the surface condition of the electrode.

EPp - 4 A High-Efficiency and Crosstalk-Free Pen Tracking Scheme for Passive Matrix Single-Layered Color Cholesteric LCD

*Y.-S. Chang, C.-C. Hsu, C.-J. Chen, C.-C. Liang,
C.-C. Wu, C.-H. Wu, C.-Y. Chen*

ITRI, Taiwan

A high-efficiency and crosstalk-free pen tracking scheme is proposed for high performance handwriting on low-cost passive-matrix (PM) cholesteric LCDs. With the proposed scheme, the crosstalk issue can be overcome and the handwritten paths are locally reinforced for high image quality. Furthermore, pixels are updated in-parallel for high handwriting speed.

EPp - 5 Driving Method of Cholesteric LC and Its Applications

P.-H. Chiu, S.-F. Liu, S. Chen, C.-Y. Shen, H.-A. Li

Chunghwa Picture Tubes, Taiwan

This paper applies less than 30 V voltage to drive cholesteric liquid crystal, and get different optical performances by different driving schemes. We could apply these characteristics to different applications, like monochrome content with quicker page turn speed, while color content with slower one.

EPp - 6 A Development of Color-Filter-Free Electrowetting Color Display by Using Ink Jet Printing Technology

*S.-W. Kuo, K.-L. Lo, W.-Y. Cheng, Y.-S. Ku, H.-H. Lee,
Y.-H. Tsai, P.-P. Cheng, J.-W. Shiu, C.-Y. Chen*,
Y.-S. Huan**

ITRI, Taiwan

**Nat. Chiao Tung Univ., Taiwan*

We evaluated the single layer EWD device by using various colored oils without adopting color filter. The color mediums were various colored oil that dosed into sub-pixels by ink jet printing technology. Simulation was also utilized to analyze the phenomenon of unstable fluid movement.

EPp - 7L New Bistable Mode of Electrowetting Light Valve

*I.-C. Hsieh, Y.-J. Li, H.-H. Huang**

Nat. Chung Hsing Univ., Taiwan

**D & Y Intelligent, Taiwan*

In this study, a new electrowetting mode is embedded in a light valve structure pixel which the surface tension is moderated on junction of water/oil system. The tested panel demonstrated that bistable behavior of the oil extraction/spread motion by different driving methods.

**EPp - 8L A 3.5-in. Transflective Color Active Matrix
Electrowetting Display**

*C.-Y. Chen, C.-Y. Wang, S.-J. Chang, H.-Y. Chang,
C.-Y. Chou, W.-T. Liao, W.-C. Wang*

Wintek, Taiwan

In this paper, we proposed the panel design, fabrication processes and optical performances of a 3.5-in. transflective AMEWD. Accompany with the dipping process to dose the black oil into the pixels on the COA substrate, the color AMEWD could become more simple, feasible and scalable.

**EPp - 9L Novel High Contrast Bistable Reversed-TN-LCD for
Electronic Paper**

R. Takahashi, Y. Toko, S. Saito, T. Takahashi*

Graduate School of Kogakuin Univ., Japan

**Stanley Elec., Japan*

A reflective type of Reversed (R) TN-LCD with the bistable switching was developed. The switching between the R-TN state and the splay-twist state is done by changing the direction of applied electric field. Optimizations of cell parameters are done to achieve the high contrast reflection type of the bistable R-TN-LCD.

----- Break -----

16:40 - 18:00

Room 204

FLX3/EP1: Flexible Electronic Paper

Chair: Y. Masuda, Bridgestone, Japan

Co-Chair: H. Fujikake, NHK, Japan

**FLX3/
EP1 - 1 Large Area and High Precision Organic TFT Array of
A4 Size with 200 ppi on Plastic Substrate
16:40 by Microcontact Printing Technique**

K. Yase

AIST, Japan

We have succeeded in driving a high resolution polymer network liquid crystal display (PNLCD) by using OTFT array obtained by microcontact printing (μ CP) method. By optimizing the fabrication condition, 200 ppi with the pixel size of 125 μ m on A4 size plastic substrate was achieved.

**FLX3/
EP1 - 2
17:00** **Development of Flexible Electronic Paper
with Transparent Polymer Electrodes Prepared
through Directly Printing Approach**

*M. Nishii, Y. Iwabuchi, H. Kotsubo, R. Sakurai,
Y. Masuda, R. Hattori**

Bridgestone, Japan

**Kyushu Univ., Japan*

A 4.0-in. diagonal and 88 dpi flexible electronic paper with line-shaped electrodes composed of transparent conductive polymer of PEDOT/PSS was prepared and passive matrix images were successfully displayed. The line-shaped electrodes of the conductive polymer were directly formed onto the flexible PET substrate by using screen printing method.

**FLX3/
EP1 - 3
17:20** **Flexible Color Ch-LC E-Papers**

*S.-C. Chen, H.-Y. Chen, C.-C. Liang, C.-L. Chin,
C.-W. Chen, J.-Y. Su*

ITRI, Taiwan

This paper proposes flexible color Ch-LC e-papers. By adding photochiral dopant, single substrate flexible Ch-LCD becomes sensitive to UV light. Therefore, UV exposure can cause the discontinuous change in the helical pitch of the Ch-LC pixels to locally colorize the e-paper. After being colorized, the color e-paper can be electrically driven to update the displayed content. In this paper, the 50 dpi color R2R Ch-LC e-paper is implemented.

**FLX3/
EP1 - 4
17:40** **Preliminary Evaluation of LED Photo-Addressing
on ChLCD Electronic Paper**

*W.-J. Li, C.-J. Li, M.-Y. Lu, B.-W. Xiao, T.-T. Chang,
K.-J. Hu*

ITRI, Taiwan

We have done a preliminary work on photo-addressing method for ChLCD electronic paper with auxiliary LED light source. The ChLCD electronic paper could be written more efficiently by controlling high luminous intensity LED appropriately. Finally we have realized the prototype of the photo-addressable electronic paper with LED light pen.

Author Interviews

18:00 – 19:00

Thursday, December 2

9:00 - 9:05

Main Hall

Opening

Opening Remarks

9:00

A. Suzuki, Ricoh, Japan

9:05 - 10:15

Main Hall

EP2: Electrophoretic Displays

Chair: T. Kitamura, Chiba Univ., Japan

Co-Chair: Y. Hotta, Ricoh, Japan

**EP2 - 1: Invited Color Quality Improvement in Active Matrix
9:05 Electrophoretic Display**

*N.-S. Roh, T. Hwang, S. Kwon, W. Lee, S. Kim, S. Lim
Samsung Elect., Korea*

E-Reader using E Ink technology is limited on black and white contents, so colorization of e-paper is eagerly awaited to expand the market. In this paper, we will discuss about color of reflective display, comparing with printed paper and what is the key factor to increase the performance.

**EP2 - 2: Invited Advanced Technology in Electrophoretic
9:30 Display**

*Y.-I. Park, S.-H. Paek, O.-N. Kwon, C.-H. Park,
C.-D. Kim, Y.-K. Hwang, I.-J. Chung
LG Display, Korea*

We have developed and demonstrated B5-sized color flexible electrophoretic display and world largest A3-sized flexible electrophoretic display using E-ink micro-encapsulated technology. These EPD displays give us wider applications because of color image and large screen as well as flexibility and paper-like look. And we also achieved large flexible electrophoretic display for its application extension to e-newspaper and digital signage.

EP2 - 3 **Understanding Electrophoretic Displays: Transient Current Characteristics of Dispersed Charges in a Non-Polar Medium**
9:55

Y. Jeon, P. Kornilovitch, P. Beck, Z.-L. Zhou, R. Henze, T. Koch

Hewlett-Packard, USA

Transient currents of reverse micelles in a non-polar solvent from voltage step stimuli were studied to investigate the electrophoretic behavior of the charges. It showed various time-dependent transients depending on the applied voltage and the charge content. A one-dimensional drift-diffusion model could reproduce the behaviors for various conditions.

----- Break -----

10:40 - 11:55

Main Hall

EP3: Color Electrophoretic Displays

Chair: M. Omodani, Tokai Univ., Japan

Co-Chair: M. Tsuchiya, E Ink, Japan

EP3 - 1: **Invited Reflective Electronic Media with Print-Like Color**
10:40

T. Koch, J.-S. Yeo, B. Benson, J. Mabeck, R. Hoffman, V. Korthuis, Z.-L. Zhou, D. Hentz

Hewlett-Packard, USA

A novel architecture and proprietary electrically addressable inks have been developed to provide print-like full color reflective digital media. The thin, flexible, low-power media is fabricated with a roll-to-roll manufacturing platform, and it is integrated with a multi-component oxide (MCO) thin-film transistor backplane to produce active matrix reflective electronic display.

EP3 - 2: **Invited Zero-Energy E-Skin**

11:05

K.-M. H. Lenssen, L. W. G. Stofmeel, M. H. W. M. van Delden, R. J. M. Vullers, H. J. Visser*, V. Pop**

Philips Res. Labs., the Netherlands

**imec, the Netherlands*

Bright e-Skin technology makes "green" applications possible, like eco-skin and smart windows. Another "green" aspect is the ultra-low power consumption, which enables "zero-energy" e-Skin, i.e. devices that do not need a battery or connection to an external electrical power supply. As examples, solar-powered and RF-powered e-Skin are presented.

EP3 - 3: Invited Electro-Osmosis: The Key to In-Plane Electrophoretic Displays

11:30

*A. Henzen, J. Groenewold**

IRX Innovations, the Netherlands

**Denkwerk, the Netherlands*

Electrophoretic displays require encapsulation to prevent particle drift. Also, in-plane electrophoresis requires extreme accuracy in driving and pixel layout to provide homogeneous imaging. This new method solves both problems.

----- Lunch -----

13:20 - 14:25

Main Hall

EP4: Frontier Research for e-Paper

Chair: S. Maeda, Tokai Univ., Japan

Co-Chair: M. Higuchi, NIMS, Japan

EP4 - 1: Invited Human Interface Aspects for Realizing Readable Electronic Paper

13:20

M. Omodani

Tokai Univ., Japan

We must be able to obtain useful guidelines for e-Paper if we find clear answers for the primitive question why we generally prefer reading on paper than on electronic displays. Several experiments have been performed to extract essential difference between paper and displays from various aspects; readability, fatigue, and efficiency.

EP4 - 2 Novel Display Device with Dual Emissive and Reflective Modes by Using Luminescent Lanthanide(III) Complexes and Electrochromic Materials

13:45

K. Nakamura, K. Kanazawa, N. Kobayashi

Chiba Univ., Japan

A novel display device with dual emissive and reflective display mode is demonstrated. The device consists of luminescent lanthanide(III) complexes (photo- luminescence materials) and an electrochromic material. The device functions as an electrochromic device when bias voltages are applied and as a light-emitting device if excitation lights are irradiated.

EP4 - 3 **Novel Imaging Device with Reflective and Emissive Mode Driven by Electrochemical Reaction**
14:05

Y. Watanabe, K. Nakamura, N. Kobayashi
Chiba Univ., Japan

We successfully demonstrated novel imaging cell with reflective and emissive mode driven by electrochromic and electrochemiluminescence reactions. This dual-mode cell has simple structure and driving feature which reflective and emissive mode can be controlled by selecting DC and AC driving method, respectively.

----- Break -----

15:00 -16:30

Main Hall

EP5: Electrochromic Displays

Chair: N.-S. Roh, Samsung Elect., Korea
 Co-Chair: Y. Toko, Stanley Elec., Japan

EP5 - 1: ***Invited* Electrochromic Display Using Organic-Metallic Hybrid Polymers**
15:00

M. Higuchi^{*}^{**}

^{*}*NIMS., Japan*

^{**}*Japan S&T Agency, Japan*

To achieve the next generation display that contributes to energy conservation and the saving resource, we created organic-metallic hybrid polymers as new electrochromic material in which multi-colors are expressible and fabricated solid-state electrochromic devices using them. The device properties are introduced in my presentation.

EP5 - 2: ***Invited* Development of Color Electrochromic Displays Based on Thin Film Transistor**
15:25

Y. W. Jin, C. H. Noh, J. W. Kim, D. S. Chung, Y. J. Yi,
S. J. Jeon, R. R. Das, M. H. Jung, S. Y. Lee

Samsung Elect., Korea

We have developed active matrix color electrochromic displays(AMECD) based on a-Si TFTs backplane For the high resolution(100 ppi) and gray scalable(16 levels) display, cross-talk free structure and a unique process to deposit selectively titanium dioxide on each pixel electrode were presented.

EP5 - 3 High Performance Electronic Paper Utilizing Leuco Dye
15:50

*W. Weng, T. Fukuoka, S. Kihara, T. Higuchi, M. Suzuki,
 T. Shimomura, M. Ono, M. Omodani**

*Funai Elec. Advanced Appl. Tech. Res. Inst., Japan
 Tokai Univ., Japan

We have developed a QVGA electrochromic display of 16 gray scale with 300 μm pixels by using leuco dye. Improving electric scanning procedures and the structure of the device, we attained clear images of 150 μm pixels with eliminated cross talk and the weaker image flickering.

EP5 - 4 Printed/Coated Electrochromic Non-Volatile Displays with Dispersible Prussian Blue Nanoparticles
16:10

T. Kawamoto, H. Tanaka*, M. Kurihara***,
 M. Sakamoto**, T. Kiyoshi****, Y. Taguchi*****

**AIST, Japan*

***Yamagata Univ., Japan*

****Alps Elec., Japan*

By printing/coating electrochromic nanoparticles, we developed new non-volatile displays: a simple display that is switchable between two patterns, and a pixel device that is switchable between blue and white. The devices can work only by application of ca. 1 V. Using the technologies, a pattern-switchable keyboard was fabricated.

----- Break -----

16:40 - 18:00	Main Hall
EP6: Cholesteric LCDs	

Chair: H. Arisawa, Fuji Xerox, Japan

Co-Chair: T. Fujisawa, DIC, Japan

EP6 - 1 Driving Scheme of Color E-Paper Using Ch-LC for High Image Quality
16:40

M. Nose, H. Uehara, T. Shingai

Fujitsu Labs., Japan

An improved driving scheme of color electronic paper using cholesteric liquid crystals for high image quality has been developed. The key factors were a contrast ratio and highlights uniformity. The achieved contrast ratio was 8.8 that was higher than newspapers, with 262,000 colors by using 2 different electro-optic responses.

EP6 - 2 Fast Driving Scheme for Color Ch-LCD**17:00***H. Uehara, M. Nose, T. Shingai**Fujitsu Labs., Japan*

We developed e-paper based on cholesteric liquid crystals, capable of fast re-write (0.7 seconds) with a high contrast ratio (6.9). Adopting a modified DDS from the high-speed driving method where grayscale is hard to control, the e-paper with a new grayscale control techniques achieves XGA resolution with 64 colors.

EP6 - 3 Spot Color Encapsulated Cholesteric LCD**17:20***C.-W. Chen, W.-W. Chiu, C.-Y. Wang, P.-W. Liu,**K.-W. Lan, C.-Y. Wu**ITRI, Taiwan*

In this paper, the fabrication of high reflectivity and low driving voltage encapsulated cholesteric liquid crystal display (En-ChLCD) for E-signage application was demonstrated. The performance of 22% reflectivity and 80 V driving voltage were achieved by optimized sheet to sheet coating manufacture process, respectively.

EP6 - 4 Large Scale Bistable Cholesteric LCD with Thermal Addressing**17:40***C.-Y. Wang, C.-C. Tsai, W.-H. Huang, P.-W. Liu**ITRI, Taiwan*

In this study we developed a 3-bit gray scale thermal-addressing writer which is able to refresh the image of 28 centimeters wide and 3 meters long cholesteric liquid crystal display in 3.5 minutes. To render color, a single-layer color Ch-LC display was developed for color thermal-addressing.

Author Interviews

18:00 – 19:00

IDW Tutorial in Japanese

Tuesday, November 30, 2010

Room 412

Fukuoka International Congress Center

Detailed information is announced at

<http://www.sidchapters.org/japan/>

Friday, December 3

9:00 - 10:25

Main Hall

EP7: Electrowetting and LCDs

Chair: A. Suzuki, Ricoh, Japan
 Co-Chair: G. F. Zhou, Philips Res., the Netherland

**EP7 - 1: Invited "No Power" (Green) Electrowetting Displays
 9:00 for Indicators as LED Replacement**

K. Blankenbach, F. Bartels, J. Rawert**, D. Jerosch***
Pforzheim Univ., Germany
**Bartels Mikrotechnik, Germany*
***ADT, Germany*

High reflectivity and transmissive backlight mode are advantages of electrowetting displays; ADT's approach is the only bistable one. This paper deals with LED replacements for energy-saving systems. Achievements are fully compatible integration into LED housings, superior optical performance of electrowetting indicators in bright light compared to LEDs and "in-cell" touch.

**EP7 - 2: Invited Electrofluidic Displays – First Prototypes, A
 9:25 New Bistable Architecture, and 'Perfect' Segmented Electronic Paper**

J. Heikenfeld **, S. Yang*, E. Kreit*, M. Hagedon*,
 K. Dean **, K. Zhou **, S. Smith **, B. Brollier **,
 J. Rudolph***
**Univ. of Cincinnati, USA*
***Gamma Dynamics, USA*

Electrofluidic displays transpose brilliant pigment dispersions between a fluid reservoir of small viewable area and a channel of large viewable area. We report recent prototyping progress for the technology, a new multi-stable device architecture, and a novel approach for segmented displays that can display pigment without the optical losses of pixel borders.

**EP7 - 3 Three-Terminal Bistable Splay Twist LCD
 9:50**

C. Y. Lee, M. C. Tseng, H. S. Kwok
Hong Kong Univ. of S&T, Hong Kong

A bistable splay-twist LCD is proposed and demonstrated. Such a bistable display consists of two stable states, splay and pi-twisted states. Switching is achieved by using three-terminal electrodes. Optimizations of the optics and electrodes have also been performed. The display is permanent bistable and is suitable for electronic paper applications.

EP7 - 4L
10:10

**Novel Development of AM Electrowetting Display
 with Color Filter on TFT-Array**

*H.-H. Lee, S.-W. Kuo, K.-L. Lo, W.-Y. Cheng, P.-P. Cheng,
 Y.-H. Tsai, Y.-S. Ku, J.-L. Chen, J.-W. Shiu, C.-Y. Wang*,
 C.-Y. Chen*, S.-J. Chang*, C.-Y. Chou*, H.-Y. Chang*,
 W.-T. Liao*, W.-C. Wang**

ITRI, Taiwan

**Wintek, Taiwan*

An active matrix electrowetting display had been developed by using color filter on TFT-array. We adopted the black matrix and black oil with optical density of 1.2 to improve the optical performance. Due to the polarizer-free structure, this panel could be read easily with low-power backlight compared with traditional LCD.

Author Interviews

16:20 – 17:20

Supporting Organization:

The Imaging Society of Japan

BANQUET

Wednesday, December 1, 2010

19:30 – 21:30

Crowne Grand Ball Room (2F)

ANA Crowne Plaza Fukuoka

See page 9 for details

Evening Get-Together with Wine

Tuesday, November 30, 2010

18:00 – 20:00

at RACONTER (1F),

Fukuoka International Congress Center

(Sponsored by Merck Ltd., Japan)

See page 9 for details

Workshop on MEMS and Emerging Technologies for Future Displays and Devices

9:00 - 9:05

Room 402

Opening

Opening Remarks

9:00

M. Nakamoto, Shizuoka Univ., Japan

Thursday, December 2

9:05 - 10:25

Room 402

MEET1: Emerging Technologies

Chair: K. Sato, Nagoya Univ., Japan

Co-Chair: M. Takamiya, Univ. of Tokyo, Japan

MEET1 - 1: *Invited* Optimisation of CNTs and CNT/ZnO Nanostructures for Use as Electron Sources

9:05

W. I. Milne^{,**}, M. Mann^{*}, Y. Zhang^{*}, D. Hasko^{*}, C. Li^{*}*

^{}Univ. of Cambridge, UK*

*^{**}Kyung Hee Univ., Korea*

The aim of this paper is to describe the growth and optimization of ballasted carbon nanotube (CNT) and CNT/Zinc Oxide nanostructures to produce novel electron sources for use in lighting and x-ray applications.

MEET1 - 2: *Invited* Fabrication and Field Emission Properties of Vertically Aligned Carbon Nanotubes

9:30

Y. Bonnassieux, C. S. Cojucaru, A. Dhar, P. Legagneux^{}*

Ecole Polytech., France

^{}Thales Res. & Tech., France*

We present some comparisons concerning field emission from two types of nanostructures, multiwall carbon nanotubes grown by plasma enhanced CVD and metal nanowires grown by electrochemical deposition. Various treatments with simple and low-cost processes are presented in order to decrease the growth temperature and to improve the emitted current uniformity.

MEET1 - 3 **Enhanced Electron Emission Property of Carbon Nanotube Grown with High Temperature**
9:55

*A. N. Ha, J. H. Ryu, H. M. Oh, N. Y. Bae, E. H. Lee,
 W. M. Bae, J. Jang, K. C. Park*

Kyung Hee Univ., Korea

A electron emission property of carbon nanotube (CNT) emitter grown with high temperature condition is studied. CNTs were grown on Si wafer with different temperature conditions. The electron emission current was enhanced with high growth temperature. The effect of high growth temperature on electron emission properties of CNTs was investigated.

MEET

MEET1 - 4 **Suppress Speckle in Line Scan Display System by Binary Code**
10:10

W. Gao^{,**}, M. N. Akram^{*}, G. Ouyang^{*}, Z. Tong^{*}, X. Chen^{*}*

^{}Vestfold Univ. College, Norway*

*^{**}Beijing Inst. of Tech., China*

A set of 2D binary codes are created, phase plates are fabricated by etched glass according to the code. It is introduced in laser based line scan display system to reduce speckle. According to experiment, the phase plate with the code of order 5 successfully reduces speckle contrast to 17.5%.

----- Break -----

10:40 - 12:15

Room 402

MEET2: Fundamental Components, Process Technologies (1)

Chair: W. Milne, Univ. of Cambridge, UK

Co-Chair: T. Yatsui, Univ. of Tokyo, Japan

MEET2 - 1: *Invited* Extension of 3D Microstructures on Silicon
10:40 **Wafer Realized by Wet Etching**

K. Sato

Nagoya Univ., Japan

Advanced bulk micromachining using aqueous tetramethylammonium hydroxide (TMAH) solutions with and without a surfactant Triton X-100 [C₁₄H₂₂O(C₂H₄O)_n, n = 9-10] is developed in order to extend the range of MEMS structures. A wide range of advanced fixed and freestanding microstructures are fabricated.

MEET2 - 2: *Invited* Large Area Electronics with Organic Transistors and Novel Interconnects: EMI Measurement Sheet with Stretchable Interconnects and User Customizable Logic Paper (UCLP) with Ink-Jet Printed Interconnects

11:05

M. Takamiya, K. Ishida, T. Sekitani, Z. Ute^{}, H. Klauk^{*}, T. Someya, T. Sakurai*

Univ. of Tokyo, Japan

^{}Max Planck Inst. for Solid-State Res., Germany*

Large area electronics, which takes advantage of the flexibility and the low cost per area, is a good application of the organic FETs. In this paper, some examples of large area electronics using organic transistors including an EMI measurement sheet and a User Customizable Logic Paper (UCLP) are shown.

MEET2 - 3: *Invited* Nonlinear Spring of Thin Film Torsion Bar with Tension for Micromirror

11:30

S. Ogawa, S. Kumagai, M. Sasaki

Toyota Tech. Inst., Japan

Nonlinear spring gives the wider balancing region against the electrostatic actuator. The thin film torsion bar with tension shows the large hard-spring effect. Its displacements are accurately measured using the white-light interferometer. Explanation based on the tension and the vertical shift gives reasonable agreement with the frequency change.

MEET2 - 4L Spherically Curved Guest-Host Display for Use in a Contact Lens

11:55

J. De Smet^{}, A. Avci^{*}, R. Beernaert^{*}, D. Cuypers^{**}, H. De Smet^{*,**}*

^{}Ghent Univ., Belgium*

*^{**}imec, Belgium*

A spherically curved cavity filled with a dichroic dye doped liquid crystal was made using flexible LCD processing techniques in order to create a contact lens display technology. Processing issues are described and their influence on uniformity and contrast are discussed.

MEET2 - 5L Speckle Reduction Using a Sinusoidal Rotating Grating

12:05

S. Egge, M. Nadeem Akram, V. Kartashov**,
U. Österberg, A. Aksnes*

Norwegian Univ. of Sci. & Tech., Norway

**Vestfold Univ. College, Norway*

***poLight AS, Norway*

Laser illumination in display projectors requires the presence of *speckle* to be reduced. A novel idea for speckle reduction uses the rotation of a diffraction pattern to cover different areas on a diffuse surface, producing independent speckle pattern. A speckle contrast of 0.27 was achieved, with further reduction possible.

----- Lunch -----

13:20 - 14:40

Room 402

MEET3: Optical MEMS and Device Technologies

Chair: Y. Bonnassieux, Ecole PolyTech., France

Co-Chair: R. Sawada, Kyushu Univ., Japan

MEET3 - 1: *Invited* LED Backlighting with Quantum Dots

13:20

S. Sadasivan, S. Shah, S. Coe-Sullivan

QD Vision, USA

Quantum dots (QDs) are nanomaterials that emit saturated light. In combination with blue LEDs, green and red QDs create white light. QD LCDs show improved color gamut over white LED LCDs. The increased gamut leads to higher perceived brightness. Such benefits make QDs a compelling choice for use in LCDs.

MEET3 - 2: *Invited* Emerging Front Light Technologies for Reflective Displays Technologies

13:45

R. Rao, R. Grulkhe, M. Mienko, I. Bitá

Qualcomm MEMS Techs., USA

Reflective Displays are gaining tremendous popularity in mobile devices (e.g. e-readers) due to their sunlight readability and low power consumption. Main contribution to their power efficiencies is lack of backlight. However reflective displays need supplemental front-lighting in darker ambients. We highlight emerging front-lightings based on the work accomplished at Qualcomm.

**MEET3 - 3 A Study of Light Guide Film with External
14:10 Illuminance Backlight Module**

Y.-C. Fang, J.-C. Yu, C.-M. Tsai, C.-H. Huang,
B.-R. Hsueh, C.-A. Chen*

*Nat. Kaohsiung First Univ. of S&T, Taiwan
Kun Shan Univ., Taiwan

This research proposes the concept of Back Light Unit(BLU) with external illuminance. This special optical design may introduce the external light into BLU in order to improve the power-saving. One is for 14-in. monitor, which has 21% improvement. Another for 3.5-in. display might have improvement 15%.

**MEET3 - 4 Will Display Type LED Light Source Suitable for the
14:25 Matching of the Chlorophyll/PAR Spectrum?**

C. R. Ou, J. S. Wang, H. P. Lo, L. Tasi

Hsiuping Inst. of Tech., Taiwan

LED illuminating technologies provide a promising future for plant growth and global farming. However, there are misunderstandings and the disadvantages for part of the LED based application to the plant growth system. Discussion and recommendation based on the comparison of the spectrums will be present.

----- Break -----

15:00 - 16:20

Room 402

MEET4: Displays and Imaging

Chair: S. Coe-Sullivan, QD Vision, USA

Co-Chair: M. Sasaki, Toyota Tech. Inst., Japan

**MEET4 - 1: *Invited* Successful Optical MEMS and their
15:00 Application**

R. Sawada

Kyushu Univ., Japan

Optical MEMS is one of the most promising and successful targets of the application of MEMS technology. There has been developing various kinds of category of this field. Some topics will be shown in this presentation; analogue mirror and sensors such as displacement sensor. Packaging and bonding technology are also hot topics as is always the case. In addition to such topics sensor in living body will be shown as a new topics in this field.

MEET4 - 2: *Invited* MEMS Based Time Multiplexed Optical Shutter (TMOS) Full Color Display

15:25

D. V. Ostrand, R. Ramakrishnan

Uni-Pixel Displays, USA

The most significant challenge in making a full color MEMS display with a deformable membrane is the membrane. It must have the correct optical, mechanical and electrical properties. The membrane we have developed for TMOS™ fulfills these challenges.

MEET4 - 3 Review of Microdisplay Device and System Components for Optogenetic and Optical Neural Guided Experiments

15:50

*C. R. Ou, C.-I. Shen**

Hsiuping Inst. of Tech., Taiwan

**Nat. Chung Hsing Univ., Taiwan*

Optogenetic technology is been consider as one of the most promising biomedical breakthrough for neuron science. The contribution of the display technology for the neuron science research will be report, and the common platform for optogenetic and optical neuro guiding device will be addressed.

MEET4 - 4 Switching Property of Carbon Nanotube Emitters by Using MOSFET

16:05

W. M. Bae, J. H. Ryu, N. Y. Bae, H. M. Oh, E. H. Lee, A. N. Ha, J. Jang, K. C. Park

Kyung Hee Univ., Korea

The electron emission current of CNTs was well switched with a low voltage with MOSFET. The switching properties of CNT emitters was studied. For 500 μ A emission current switching, the electron emitter keeps constant electron emission current between 1300 V and 2100 V region with 0.02 % variation.

----- Break -----

16:40 - 17:55

Room 402

MEET5: Fundamental Components, Process Technologies (2)

Chair: D. V. Ostrand, Uni-Pixel Displays, USA
 Co-Chair: R. Rao, Qualcomm MEMS Techs., USA

MEET5 - 1: *Invited* Increased Spatial Homogeneity in a Light-Emitting InGaN Thin Film Using a Phonon-Assisted Optical Near-Field Process

16:40

T. Yatsui, M. Ohtsu

Univ. of Tokyo, Japan

We report a self-assembly method that produces greater spatial uniformity in InGaN thin films using optical near-field desorption. Spatial homogeneity in the In fraction was reduced by introducing additional light during the photo-enhanced chemical vapour deposition of InGaN.

MEET5 - 2 Development of Full-Color Active-Matrix Quantum Dot Light Emitting Diode Displays

17:05

P. Kazlas, Z. Zhou, M. Stevenson, Y. Niu, C. Breen, J. Perkins, S.-J. Kim, G. Mahan, J. Steckel, S. Coe-Sullivan, J. Ritter

QD Vision, USA

Quantum dot light emitting diodes are a printable thin film electroluminescent technology that delivers exceptional color and efficiency at low cost of manufacture for display and solid-state lighting applications. We report on our progress developing efficient, stable QLEDs for full-color active-matrix displays, including recent advances in device performance and lifetime.

MEET5 - 3 Sharp and Uniform Conductive Ceramic Transfer Mold Field Emitter Arrays

17:20

K. Suzuki, M. Nakamoto, J. H. Moon

Shizuoka Univ., Japan

Sharp and uniform conductive ceramic $\text{Cr}_3\text{Si}\cdot\text{SiO}_2$ Transfer Mold field emitter arrays with less than 5.0 nm tip radius have been developed by Transfer Mold method to realize the low operation voltage and stable vacuum nanoelectronic devices for lamps, backlight units, and electric propulsion engines for satellites and spaceships.

MEET5 - 4L Processing of Interferometric MEMS-type Reflective Display using Photoresist as Sacrificial Layer

17:35

H.-C. Park, Y.-S. Kim

Hongik Univ., Korea

In this study, an attempt was made to utilize photoresist as a sacrificial layer in the processing of interferometric type MEMS reflective displays. The results indicated that the photoresist became dissolved in etching solution more cleanly, making the process more productive and economic.

**MEET5 - 5L Transmittance Enhancement in an IZO/Ag/IZO
Transparent Electrode Using Surface Plasmon**

17:45

*S. H. Oh, S.-M. Lee, K. C. Choi**KAIST, Korea*

In this work, an IZO/Ag/IZO structured transparent electrode was investigated through a silver annealing process. A silver layer was independently deposited in an additional annealing process. This method resulted in an increment of 7% of the transmittance through the successful formation of a silver layer with a corrugated surface.

MEET

Author Interviews

18:00 – 19:00

Workshop on Display Electronic Systems

Thursday, December 2

9:00 - 12:00

Poster/A.I. Room

Poster DESp: Display Electronic Systems

DESp - 1 **Adaptive Frame Rate Modulation Architecture for Power Saving**

*D.-W. Kuo, J.-S. Liao, H.-H. Chen, W.-T. Tseng,
C.-R. Lee*

Chunghwa Picture Tubes, Taiwan

Chunghwa Picture Tubes, LTD. (CPT) has presented an algorithm of power saving for TFT LCD. This technique could change regional frame rate according to what kind of image data is displayed. If the image is static state, the frame rate can be reduced that can also reduce power consumption.

DESp - 2 **Novel Signal Interface for TFT-LCD Module Test Using Power Line Communication Method**

J. M. Lee, H. S. Kim, J. H. Yoo, S. Y. Han

Samsung Elect., Korea

We firstly proposed the power line communication as novel signal interfaces in the LCD module test. Comparing with conventional auto contact, low failure rate and high speed communication were achieved. No side effect of electromagnetic interference was observed, meaning that PLC could be a promising signal interface in the future.

DESp - 3 **A Novel Passive Matrix Drive Scheme for Bistable Chiral Splay Nematic LCDs**

*J. G. Ying, S. B. Kwon, C. G. Jhun, Y. M. Lee, K. S. Kim,
D. C. Jeong*

Hoseo Univ., Korea

In this paper we discuss a novel passive matrix drive scheme for bistable chiral splay nematic LCDs. We use three voltage levels for the addressing in this drive scheme. And different from other passive matrix drive schemes, the data voltage is hundreds of mV and the frequency is about 1 Hz.

DESp - 4 High Performance Digital Signage Using Color Sequential Technique*T.-C. Yang, K.-H. Chien, W.-C. Tai**Chunghwa Picture Tubes, Taiwan*

A high performance digital signage has been developed. Color Sengquential Display (CSD) panel which using PWM control RGB LED backlight and color filter less glass composed the digital signage. This high performance digital signage achieves high color gamut, contrast and low power consumption.

DESp - 5L LCD Backlight Controller Using Passive Sigma-Delta Modulator PWM Generator*Y.-M. Lee, K.-S. Lee**Sun Moon Univ., Korea***Univ. of Akron, USA*

This works describes a LCD backlight controller using passive $\Sigma\Delta$ modulator PWM generator. In this scheme, a PWM signal corresponding to the ambient light level is generated from the pulse density modulated $\Sigma\Delta$ output. Therefore, the area and power can be reduced compared to conventional PWM generator circuits.

----- Lunch -----

13:20 - 14:50**Room 412****VHF4/DES1: Multi Primary (1)**

Chair: K. Sekiya, Tohoku Univ., Japan

Co-Chair: T. Matsumoto, Sony, Japan

VHF4/DES1 - 1: Invited Measuring Light and Color: An Introductory Talk to Colorimetry**13:20***N. Ohta**Rochester Inst. of Tech., USA*

Colorimetry is quantifying colors, that is, an art of expressing colors by numbers. There are two classes of quantification: color appearance system and color mixing system. The gist of the two methods will be introduced.

**VHF4/
DES1 - 2
13:50** **A New Evaluation Method of Color Reproductive Performance and Evaluation of Multi-Primary Color Display**

*M. Teragawa, T. Kanda, T. Fujine, M. Sugino,
Y. Miyanaga**

Sharp, Japan

**Hokkaido Univ., Japan*

This paper proposed new evaluation of color reproductive performance, and evaluated MPC display. We used coverage ratio against object color for evaluation of outer frame structure, and CDI for evaluation of inner structure. We clarified MPC display was suitable for expressing object colors and had advantage of smooth color reproduction.

**VHF4/
DES1 - 3
14:10** **Color Reproduction of Multi-Primary Color Display: Numerical Analysis Method and Application to Lower Power Consumption**

*T. Fujine, M. Teragawa, N. Ohta**

Sharp, Japan

**Rochester Inst. of Tech., USA*

We analyze color reproduction of multi primary color (MPC) display, and propose to calculate primary amount of color mixing for MPC in minimum power consumption by linear programming. As an example, we analyze characteristics of RGB+Y four primary color system in comparison with RGB system.

**VHF4/
DES1 - 4
14:30** **A Numerical Evaluation across Multi-Primary Color Systems**

*A. Yoshida, K. Yoshiyama, K. Tomizawa, K. Nakamura,
Y. Yoshida, M. Teragawa, Y. Yamamoto*, N. Ohta***

Sharp, Japan

**CIS Labs., Japan*

***Rochester Inst. of Tech., USA*

We conducted a numerical analysis over several Multi-Primary Color (MPC) display systems consisting of RGB + Cyan primaries. We compared the results with our previous results (RGB + Yellow and RGB + White) for indicating characteristics of different MPC systems in terms of luminance reproduction and power consumption.

----- Break -----

15:00 - 16:20

Room 412

VHF5/DES2: Multi Primary (2)

Chair: N. Ohta, Rochester Inst. of Tech., USA

Co-Chair: T. Matsumoto, Sony, Japan

VHF5/ DES2 - 1: Invited Four Primary Color (RGB+Y) Displays: The Latest Technologies and Advantages

15:00

*M. Teragawa**Sharp, Japan*

This paper reviews the latest RGB+Y four primary color LCD technologies and the advantages. RGB+Y LCD has advantages for not only color reproducibility but also power consumption, in addition, higher resolution. RGB+Y LCD along with UV2A can make LCD-TV improved in all ways.

VHF5/ DES2 - 2: High Resolution Reproducibility of Multi-Primary Color Displays

15:40

*K. Yoshiyama, H. Furukawa, N. Kondoh, S. Nakagawa, Y. Yoshida**Sharp, Japan*

In this paper, we focus on high resolution characteristic of Multi-Primary Color (MPC) display, and show that horizontal resolution can be approximately twice for stripe-patterned four-primary color display by the combination with advanced sub pixel signal processing.

VHF5/ DES2 - 3: Advanced RGBW Display Image Process Using Sub-pixel Rendering

16:00

*M.-C. A. Kao, P.-L. Hsieh, H.-T. Lin**Chunghwa Picture Tubes, Taiwan*

A novel image process has been developed to transform RGB into RGBW. It comprise the "RGBW mapping algorithm" is used to adjust color of image. And the "Virtual resolution scaling" is used to increase the apparent resolution. And the "W signal controlling" is used to increase sunlight readability.

----- Break -----

16:40 - 18:00

Room 413

3D3/DES3: 3D System and Content

Chair: J.-Y. Son, Daegu Univ., Korea

Co-Chair: T. Fujine, Sharp, Japan

**3D3/
DES3 - 1: Invited Full HD and Super-High Image Quality 3D
Plasma TV Technology**

16:40

*K. Tasaka, M. Kawashima, K. Suetsugi, M. Ishizuka,
T. Yamashita, Y. Sugio**Panasonic, Japan*

This paper introduces the basic concept of Full HD and High Image Quality 3D Plasma Theater System and the key technology of Full HD and Super-High Image Quality 3D Plasma TV which was realized by the newly developed technology of Plasma panel improvement and new 3D system technology of both Plasma panel and 3D eyewear.

**3D3/
DES3 - 2: Invited Real-Time 2D-to-3D Conversion: Basic
Concepts and Practical Use**

17:00

*K. Yamada, Y. Suzuki**JVC Kenwood Holdings, Japan*

This paper describes the algorithm for our original 2D-to-3D conversion technology, which is beginning to be used for both consumer and professional apparatuses to fulfill the growing need for high quality 3D contents. The algorithm has advantages in quality, numerical complexity, no need of frame memory and very low latency.

**3D3/
DES3 - 3: Invited From 3D technology to New Styles of Visual
Images**

17:20

*M. Ikeo, A. Saito, Y. Nishida**NHK Media Tech., Japan*

The desire to visualize our imagination in new ways has encouraged the evolution of the media, while technical innovation has inspired our imagination. However, recent rapid advances in digital technology are leading the media not to represent human imagination but to mirror the actual world with ever greater reality. Can filmmakers' imagination catch up with the hyperrealism of the visual media? Content creators must shed the bonds of 3D images and develop new styles of visual images.

**3D3/
DES3 - 4: Invited 3D Video Formats and Compression for
Content Distributions**

17:40

*H. Kimata**NTT, Japan*

Usage of 3D video would increase as the growth of 3D content production. The suitable 3D video format depends on the purpose in applications. This paper summarizes 3D video formats and compression technologies distinguished by purposes and it addresses the trends of stereoscopic video and multi-view video formats.

Author Interviews

18:00 – 19:00

Friday, December 3

9:00 - 10:00

Room 413

DES4: Display Electronics

Chair: T. Yamamoto, NHK, Japan

Co-Chair: H. Sasaki, Toshiba, Japan

DES4 - 1 The Optimal RGB LED Driving Scheme for Color Sequential LCD

9:00

*T. P. Lin, K. T. Hu, C. L. Liu, C. H. Tien***Chunghwa Picture Tubes, Taiwan***Nat. Chiao Tung Univ., Taiwan*

This paper demonstrated a 15-inch color sequential display by using RGB LED-based backlit embedded with a color sensor feedback system. The driving sequence of RGB LEDs is essential for eventual image qualities. And a color sensor feedback system was employed to regulate LED brightness and any customized white point.

DES4 - 2 Withdrawn**DES4 - 3 A Linear 10-Bit DAC for LCD Driver ICs Using Charge Subtraction Interpolation**

9:20

*J. Bae, Y. Jang, H. N. Nguyen, S. Lee**KAIST, Korea***Silicon Works, Korea*

A linear 10-bit digital-to-analog converter has been designed for LCD driver ICs. The proposed architecture suggests charge subtraction interpolation technique with switched-capacitor DAC. The size of DAC will be decreased around half and DNL, INL simulation results are smaller than 0.04 LSB.

DES4 - 4 On-Chip DC-DC Converter Technique for Mobile Flat-Panel Display

9:40

Y.-S. Ahn^{,**}, J.-M. Choi^{*}, J.-S. Lee^{*}, Y.-S. Kim^{*},**H.-S. Oh^{*}, J.-K. Kang^{**}***Silicon Works, Korea****Inha Univ., Korea*

One of single-chip display driver's components is power management block. Unfortunately, power management block is an interfering. So, a spread spectrum is widely applied technique to reduce EMI. But, power management block using spread spectrum lowers display's image quality. We propose a single-chip display driver for lossless display's image quality.

----- Break -----

10:40 - 12:00

Room 413

DES5: Low Power Technology

Chair: H.-S. Koo, Ming-Hsing Univ. of S&T, Taiwan
 Co-Chair: K. Sekiya, Tohoku Univ., Japan

**DES5 - 1: *Invited* Method to Save Power While Watching TV
 10:40 According to Viewer Watching Action**

*T. Yoshinaga, S. Nagaya, T. Fujita, H. Sakaniwa, H. Ito
 Hitachi, Japan*

We propose a method to conserve TV power according to the viewer's watching action. In this method, a camera is used to classify the action, and the panel backlight power is then automatically controlled. Experimental results indicated the power consumption was reduced by 18.6% using this method.

**DES5 - 2: *Invited* Low-Power Mobile Processor Design for
 11:00 Full-HD Video Coding**

*M. Kimura, K. Iwata, S. Mochizuki, H. Ueda,
 R. Hashimoto, H. Hatae, H. Watanabe
 Renesas Elect., Japan*

Today's cellular phone must support full high-definition video encoding and decoding. In order to reduce static and dynamic power consumption, this paper introduces multiple power-domain control, dynamic clock control, and video codec architecture based on picture level pipeline manner. Our mobile application processor consumes 342 mW in real-time decoding of Full-HD video.

**DES5 - 3 Contrast Ratio Enhancement and Power Saving for
 11:20 17.3-in. LCD with Side-Lit LED-Backlight Structure**

*T.-C. Shen, S.-M. Chang
 Chunghwa Picture Tubes, Taiwan*

This paper proposes a method to calculate the brightness distribution of backlight model for 17.3-in. LCD LED-backlight display. An exact data compensation calculation method is applied to Site-lit LED-backlight structure so that power is conserved and also contrast ratio is increased.

**DES5 - 4 Key Feature Highlighting: A High Ambient Display
 11:40 and Extreme Display Power Reduction Technology**

*X. Xu, L. Kerofsky
 Sharp Labs. of America, USA*

Low contrast viewing of LC displays occurs often nowadays which includes high ambient viewing of mobile LC devices and LC TV viewing at extreme low power mode. In this paper, Key Feature Highlighting (KFH) technology is proposed to improve perceived contrast and visibility of images at low contrast viewing conditions.

----- Lunch -----

13:20 - 14:40

Room 413

DES6: Display Quality

Chair: T. Fujine, Sharp, Japan
 Co-Chair: A. Nagase, Mitsubishi Elec., Japan

DES6 - 1: *Invited* Halo Artefact Visibility for Local Backlight Dimming LCD Systems

M. Hammer, R. Muijs, E. H. A. Langendijk*

Philips Consumer Lifestyle, the Netherlands

**Philips Res. Labs., the Netherlands*

To increase display contrast, local backlight dimming LCDs have become common practice. However, the spatial resolution of a segmented backlight is typically well below that of the LC-panel. In dark image regions, this may result in undesirable halo artefacts due to light leakage through the panel of the low-resolution backlight image. In this contribution we propose a signal processing approach to determine the visibility of halo artefacts.

DES6 - 2: *Invited* Universal Overdrive Technology for LCD Systems and High-Refresh Rate LC TVs

S.-W. Lee

Kyung Hee Univ., Korea

This paper describes a universal overdrive technology for LCD systems regardless of LC modes. This paper shows a method to simulate transient optical responses of matrix-driven LCDs using dynamic circuit model of LC pixels. Special considerations on the OD technology applicable to high refresh-rate LC TVs will be presented.

DES6 - 3: *Invited* Mobile Color Depth: A Perceptual Color-Performance Metric for Mobile Displays

J. Gille, G. U'Ren

Qualcomm MEMS Techs., USA

Display color performance is regularly described by data input format (e.g., 24-bit color) as opposed to perceived number of colors output for a given viewing environment. Mobile Color Depth (MCD) is developed as a vision-based metric quantifying perceived numbers of colors, providing an understandable, unitary, display-performance metric.

DES6 - 4 Subjective Quality Assessment of Adaptive Temporal Filter for High Frame-Rate Video

Y. Bando, S. Takamura, H. Jozawa

NTT, Japan

In the design of an adaptive temporal filter for high frame-rate sequence, it is important to set suitable filter parameter in order to keep subjective quality of down-sampled sequence. In this paper, we clarify relationship between the subjective quality of down-sampled sequence and filter configuration for generating down-sampled sequence.

----- Break -----

15:00 - 16:20

Room 413

DES7: Visible Light Communication

Chair: S. Ito, Shizuoka Univ., Japan

Co-Chair: H. Okumura, Toshiba, Japan

DES7 - 1: *Invited* Visible Light Communication**15:00***S. Haruyama**Keio Univ., Japan*

Visible light communication is a new way of wireless communication using visible light. Main transmitters used for visible light communication are visible light LEDs and receivers are photodiodes and image sensors. We present new applications which will be made possible by visible light communication technology, such as indoor navigation system.

DES7 - 2: *Invited* Image Sensor Communication - A New Way of Visible Light Communication**15:40***N. Iizuka**Casio Computer, Japan*

Image Sensor communication (ISC) is a new communication technology using two-dimensional image sensors such as CCDs or CMOS sensors. It is a new way of Visible Light Communication (VLC). And it has remarkable features. In this paper, we present the results of feasibility trials and various applications of ISC.

DES7 - 3: *Invited* A CMOS Image Sensor for Car-to-Car and Road-to-Car Optical Communication**16:00***S. Itoh, M. S. Z. Sarker, K. Yasutomi, M. Hamai,
Y. Iwama, I. Takai*, M. Andoh*, S. Kawahito**Shizuoka Univ., Japan***Toyota Central R&D Labs., Japan*

A CMOS image sensor for Car-to-Car and Road-to-Car optical communication is presented. A prototype sensor chip achieves high data rate up to 10 Mbps at the communication distance of over 100 meters while attaining signal light source finding and tracking functions.

16:20 - 16:25

Room 413

Closing**Closing Remarks**

16:20

*H. Okumura, Toshiba, Japan***Author Interviews**

16:20 – 17:20

Supporting Organizations:

Technical Committee on Electronic Information Displays, Electronics Society, IEICE

Technical Committee on Image Engineering, Information and Systems Society, IEICE

Information Sensing Research Committee, ITE

DES

EXHIBITION

12:00 – 18:00 Wednesday, Dec. 1, 2010

10:00 – 18:00 Thursday, Dec. 2, 2010

10:00 – 14:00 Friday, Dec. 3, 2010

2F Lobby, 4F Lobby

Fukuoka International Congress Center

Free admission with your registration name tag

SID 2011

International Symposium, Seminar and Exhibition

May 15-20, 2011

Los Angeles, California, U.S.A.

Workshop on Flexible Displays

Wednesday, December 1

13:20 - 13:25

Room 204

Opening

Opening Remarks

13:20

T. Furukawa, Kyodo Printing, Japan

13:25 - 14:30

Room 204

FLX1: Advanced Flexible Display Technologies

Chair: H. Naito, Osaka Pref. Univ., Japan

Co-Chair: H. Hirata, Toray Eng., Japan

FLX1 - 1: *Invited* Recent Advances in Flexible Displays of e-Paper Application

13:25

*J.-W. Shiu, W.-W. Chiu, C.-C. Tsai, C.-Y. Huang, J. Chen
ITRI, Taiwan*

The flexible display reported here is ideal for roll-to-roll process with a simple structure on single substrate. The performance has improved in reflectance and contrast ratio. A thermal addressing method is developed for ultra long e-paper applications with high resolution. Many novel applications of the display are also revealed.

FLX1 - 2 Low Temperature Annealing Amorphous In-Ga-Zn-O Thin-Film Transistor on Plastic Substrate

13:50

*T. Hanada, T. Negishi, M. Soeda, T. Shiro
Teijin, Japan*

For flexible display development, amorphous In-Ga-Zn oxide thin film transistors were fabricated on plastic substrate at ambient temperature. The transistor structure was coplanar top-gate. After annealing at 150 °C the field-effect mobility was 7.4 cm²/Vs, threshold voltage 0.3 V, subthreshold swing 0.29 V/decade and on-off current ratio 10⁸.

FLX1 - 3 Effect of AC and DC Gate Bias-Stress on the Performance of a-IGZO TFTs on Plastic Substrate

14:10

*M. Mativenga, M. H. Choi, J. W. Choi, J. Jang
Kyung Hee Univ., Korea*

The effect of AC and DC gate bias stress is investigated in a-IGZO TFTs on polyimide. For the same effective stress time, AC induces a smaller positive ΔV_{th} compared to DC stress, indicating trapping as the main degradation mechanism. The time dependence of ΔV_{th} thus follows the stretched exponential equation.

----- Break -----

15:00 - 16:25

Room 204

FLX2: Printing Fabrication Processes

Chair: M. Funahashi, Kagawa Univ., Japan

Co-Chair: T. Furukawa, Kyodo Printing, Japan

FLX2 - 1: Invited Low Temperature Wiring Technology for Printed Electronics

15:00

*K. Suganuma, M. Nogi, M. Hatamura, T. Araki, J. Jiu
Osaka Univ., Japan*

Flexible low temperature wiring methods have been developed. The room temperature curable Ag nanoparticle ink and the Ag carboxylate ink have been successfully developed for temperature sensitive substrates. Ag-urethane conductive adhesive exhibits excellent stretchability on a flexible substrate up to 600% elongation without serious damage.

FLX2 - 2: Invited Development of Low Temperature Printing Techniques for Flexible Display Fabrication

15:25

*T. Kamata, M. Yoshida, T. Kozasa, S. Uemura,
N. Takada, K. Suemori, S. Hoshino, N. Ibaraki
AIST, Japan*

We have developed several kinds of low temperature printing techniques of metal, inorganic semiconductor and dielectric layers for flexible display fabrication. These developed techniques were effective to obtain enough high electronic performance of the printed layer although process temperature was below 100°C .

FLX2 - 3 All-Printed Flexible 5.35-in. Organic TFTs with 150 ppi Resolution for Electrophoretic Electronic Papers

15:50

*Y. Ito, R. Matsubara, O. Kina, M. Ishizaki, M. Ito
Toppan Printing, Japan*

All-printed flexible 5.35-in. VGA electronic papers were successfully driven by organic thin film transistors (OTFTs) with 150 ppi resolution. A poly-ethylene-naphthalate (PEN) film was used for the substrate and all the components were printed without any photo-lithographical process. The printed OTFTs showed over 0.2 cm²/Vs mobility and excellent uniformity.

FLX2 - 4L 16:10 Development of Printed, High-Performance Organic Semiconductor Devices

*G. Lloyd, T. Backlund, P. Brookes, L. W. Tan,
P. Wierzchowicz, S. Bain, J.-Y. Lee, M. James,
J. Canisius, S. Tierney, K. Kawamata*, T. Wakimoto**
Merck Chems., UK
**Merck, Japan*

We present our new formulation and material developments enabling high volume and high throughput printing techniques to be used for electronic circuit and backplane production. Performance levels in excess of 2 cm²/Vs, comparable to spin coating are demonstrated for flexographic and gravure based printing techniques for both top-gate and bottom-gate architectures.

----- Break -----

16:40 - 18:00

Room 204

FLX3/EP1: Flexible Electronic Paper

Chair: Y. Masuda, Bridgestone, Japan
Co-Chair: H. Fujikake, NHK, Japan

FLX3/EP1 - 1 16:40 Large Area and High Precision Organic TFT Array of A4 Size with 200 ppi on Plastic Substrate by Microcontact Printing Technique

K. Yase
AIST, Japan

We have succeeded in driving a high resolution polymer network liquid crystal display (PNLCD) by using OTFT array obtained by microcontact printing (μ CP) method. By optimizing the fabrication condition, 200 ppi with the pixel size of 125 μ m on A4 size plastic substrate was achieved.

FLX3/EP1 - 2 17:00 Development of Flexible Electronic Paper with Transparent Polymer Electrodes Prepared through Directly Printing Approach

*M. Nishii, Y. Iwabuchi, H. Kotsubo, R. Sakurai,
Y. Masuda, R. Hattori**
Bridgestone, Japan
**Kyushu Univ., Japan*

A 4.0 in. diagonal and 88 dpi flexible electronic paper with line-shaped electrodes composed of transparent conductive polymer of PEDOT/PSS was prepared and passive matrix images were successfully displayed. The line-shaped electrodes of the conductive polymer were directly formed onto the flexible PET substrate by using screen printing method.

- FLX3/ EP1 - 3**
17:20 **Flexible Color Ch-LC E-Papers**
*S.-C. Chen, H.-Y. Chen, C.-C. Liang, C.-L. Chin,
 C.-W. Chen, J.-Y. Su*
ITRI, Taiwan

This paper proposes flexible color Ch-LC e-papers. By adding photochiral dopant, single substrate flexible Ch-LCD becomes sensitive to UV light. Therefore, UV exposure can cause the discontinuous change in the helical pitch of the Ch-LC pixels to locally colorize the e-paper. After being colorized, the color e-paper can be electrically driven to update the displayed content. In this paper, the 50 dpi color R2R Ch-LC e-paper is implemented.

- FLX3/ EP1 - 4**
17:40 **Preliminary Evaluation of LED Photo-Addressing on ChLCD Electronic Paper**
*W.-J. Li, C.-J. Li, M.-Y. Lu, B.-W. Xiao, T.-T. Chang,
 K.-J. Hu*
ITRI, Taiwan

We have done a preliminary work on photo-addressing method for ChLCD electronic paper with auxiliary LED light source. The ChLCD electronic paper could be written more efficiently by controlling high luminous intensity LED appropriately. Finally we have realized the prototype of the photo-addressable electronic paper with LED light pen.

FLX

Author Interviews
 18:00 – 19:00

Thursday, December 2

9:00 - 10:15	Room 204
FLX4/OLED4: Flexible OLED	

- Chair: T. Kamata, AIST, Japan
 Co-Chair: S. Naka, Univ. of Toyama, Japan

- FLX4/ OLED4 - 1**
9:00 **Solution-Processed Organic Films of Multiple Small-Molecules and White Light-Emitting Diodes**
*W. Dongdong, W. Zhaoxin, Z. Xinwen, J. Bo, L. Shixiong,
 W. Dawei*, H. Xun*
Xi'an Jiaotong Univ., China
**Univ. of Arkansas, USA*

We found that the spin-coated films of NPB, and blends of NPB and DPVBi, though having lower densities, were more uniform than their vacuum-deposited counterparts. Using the spin-coated films of NPB:DPVBi as mixed host, doped with blue and yellow dyes, new white organic light-emitting devices (WOLEDs) were demonstrated.

- FLX4/
OLED4 - 2
9:20** **Flexible OLED Encapsulation by Glass Base Technology**
*G. Chen, S.-T. Yeh, P.-I Shih, J.-L. Wu, K.-Y. Cheng,
L.-Y. Jiang, Y.-Y. Chang*
ITRI, Taiwan

A flexible OLED encapsulation process was successfully developed with glass base OLED mass production equipment. These flexible encapsulation OLED devices have good flexibility and environment reliability. We expected this approach will be the important way to manufacture the flexible OLED devices using currently most OLED equipment facility.

- FLX4/
OLED4 - 3
9:40** **Graphene Sheet Synthesized with Microwave Irradiation and Interlinked by Carbon Nanotubes for High-Performance Transparent Flexible Electrodes**
G. Xin, W. Hwang, N. Kim, H. Chae
Sungkyunkwan Univ., Korea

High quality graphene was obtained through microwave irradiating expansion following a solution process. By combining Carbon Nanotubes (CNTs) as bridges between graphene flakes, allowed the fabrication of high performance conductive films with conductivities and optical properties: $181 \Omega\text{sq}^{-1}$ at 82.2% transmittance after chemical treatment and doping.

- FLX4/
OLED4 - 4L
10:00** **Fabrication of QVGA Flexible Phosphorescent AM-OLED Display using Ink-jet Printing**
*M. Suzuki, H. Fukagawa, G. Motomura, Y. Nakajima,
M. Nakata, H. Sato, T. Shimizu, Y. Fujisaki, T. Takei,
S. Tokito*, T. Yamamoto, H. Fujikake*
NHK, Japan
**Yamagata Univ., Japan*

We demonstrated a 5-inch QVGA flexible phosphorescent AM-OLED display driven by OTFTs on a plastic substrate. Cross-linked olefin polymer was used as the gate insulator. Phosphorescent polymer materials were used for emitting layer of OLEDs, which were patterned by ink-jet printing. Color moving images were achieved by the display panel.

----- Break -----

10:40 - 12:10

Room 204

FLX5/AMD4: Flexible Active-Matrix Devices

Chair: K. Tsukagoshi, NIMS-MANA, Japan

Co-Chair: T. Shiro, Teijin, Japan

**FLX5/
AMD4 - 1: Invited Application of Organic Thin-Film Transistors
for Circuits on Flexible Foils**

10:40

P. Heremans^{,**}, K. Myny^{*,**}, H. Marien^{**},
E. V. Veenendaal^{***}, S. Steudel^{*}, J. Genoe^{*},
M. Steyaert^{**}, G. H. Gelinck^{****}*

^{}imec, Belgium*

*^{**}Katholieke Univ. Leuven, Belgium*

*^{***}Polymer Vision, the Netherlands*

*^{****}Holst Ctr. TNO, the Netherlands*

We present the state of the art of digital and analog circuits (in particular code generators for RFID tags, amplifiers, AC-DC and DC-DC converters) using organic TFTs on plastic foil, and discuss some design considerations needed to overcome today's technology limitations.

**FLX5/
AMD4 - 2: Invited A Rollable OTFT-OLED Display**

11:05

*I. Yagi, M. Katsuhara, A. Yumoto, N. Kobayashi, M. Noda,
R. Yasuda, S. Ushikura, G. Yukawa, N. Hirai, K. Nomoto,
T. Urabe*

Sony, Japan

A rollable OLED display, which can be rolled-up in a radius of 4 mm, is driven by a newly-developed OTFT backplane. The backplane equips with an integrated gate driver circuit and it is constructed of OTFTs using a self-developed organic semiconductor, a PXX derivative.

**FLX5/
AMD4 - 3: The High Stability and Uniformity a-IGZO Thin Film
Transistors Array for AM-OLED Application**

11:30

*J.-Y. Yan, H.-C. Yao, Y.-P. Chen, C.-Y. Hung, Y.-Y. Wu,
K.-Y. Ho, H.-C. Cheng*

ITRI, Taiwan

The high stability and uniformity amorphous InGaZnO₄ TFTs were fabricated on plastic substrate. We optimize the process and abandon the ES layer to reduce photomask and processing time. The mobility, SS and V_{th} of a-IGZO TFTs is 7.33 cm²/Vs, 0.42 V/dec and 0.79 V. The lifetime of AMOLED is exceeding 10 years.

FLX5/ AMD4 - 4 **Full Color AM-LCDs on Flexible Glass Substrates**
S. Hoehla, S. Garner, M. Hohmann, O. Kuhls, X. Li*,
 A. Schindler, N. Fruehauf*
Univ. of Stuttgart, Germany
**Corning, USA*

We have realized a full color 4-in. quarter-VGA amorphous Silicon AM-LCD on 75 μm flexible glass substrates. With this work we demonstrate that the incorporated ultra-thin glass substrates have suitable properties to be compatible with a standard color AM-LCD process and achieve active matrix backplanes with reliable performance.

----- Lunch -----

13:20 - 14:45

Room 204

FLX6: Flexible Organic TFT

Chair: H. Maeda, DNP, Japan
 Co-Chair: K. Yase, AIST, Japan

FLX6 - 1: Invited Organic-Inorganic Hybrid Materials for Flexible Thin-Film Transistors

*H. Naito, T. Nagase, M. Yoshikawa, T. Kobayashi,
 Y. Michiwaki*, K. Matsukawa***

Osaka Pref. Univ., Japan

**Fuso Chem., Japan*

***Osaka Municipal Tech. Res. Inst., Japan*

Excellent characteristics of field-effect transistors fabricated using the following hybrid materials have been demonstrated. A hybrid gate insulator of poly(methylsilsequioxane) exhibits excellent insulating properties, low curing temperature and low surface energy. Hybrid semiconductors, silica nanoparticles added organic semiconductors, exhibit drastic improvement of their wettability on low-surface-energy surfaces.

FLX6 - 2 High Performance Organic Semiconductors with High Field-Effect Mobilities and Low Contact Resistances for Flexible Displays

*K. Terai, E. Kawashima, N. Kurihara, H. Nagashima,
 H. Kondo, M. Saito, H. Nakamura*

Idemitsu Kosan, Japan

We have succeeded in developing p-type of organic semiconductors with phenylethynyl groups, which have high field-effect mobilities ($>3 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$). We have found that they have lower contact resistances to Au electrodes, and confirmed that they had the potential to be used as a carrier injection layer.

FLX6 - 3 **Solution Processed Organic Field Effect Transistors from Novel Soluble Dinaphthothienothiophene Precursor**

14:05

*Y. Ikeda, T. Negishi, S. Ohomori, T. Shiro, K. Takimiya**

Teijin, Japan

**Hiroshima Univ., Japan*

A soluble dinaphthothienothiophene (DNNT) precursor is developed for printed O-FETs. The precursor is annealed in air to produce DNNT, an organic semiconductor with high mobility and durability. O-FETs using the precursor are fabricated on silicon or plastic substrates by spin coating and spray deposition followed by the thermal annealing.

FLX6 - 4 **Flexible Field-Effect Transistors Based on a Liquid-Crystalline Semiconductor Fabricated by the Solution Shared-Deposition Method**

14:25

M. Funahashi, F. Zhang, N. Tamaoki***

Kagawa Univ., Japan

**Chinese Ac. of Sci., China*

***Hokkaido Univ., Japan*

Thin-film transistors based on Liquid-crystalline phenylterthiophene, 3-TTP-Ph-5 were fabricated with a solution-shared deposition method. The transistors on Si/SiO₂ substrates exhibit the field-effect mobility of the hole reached $8 \times 10^{-2} \text{ cm}^2 \text{V}^{-1} \text{s}^{-1}$ with the on/off ratio of 10^7 . The carrier mobility and the on/off ratio of the field-effect transistors fabricated on a polyimide films improved to be $5 \times 10^{-2} \text{ cm}^2 \text{V}^{-1} \text{s}^{-1}$ and 10^5 , respectively. Their carrier mobilities are retained when the strain reaches 3%.

----- Break -----

FLX

15:00 - 16:00

Room 204

FLX7/FMC6: Materials & Components for Flexible Displays

Chair: T. Tomono, Toppan Printing, Japan

Co-Chair: T. Ogura, Nippon Steel, Japan

FLX7/ **Transparent High Barrier Coating on Flexible Film**
FMC6 - 1 **Substrate by Roll to Roll PECVD System**

15:00

H. Tamagaki, T. Okimoto, T. Segawa

Kobe Steel, Japan

A new Roll to Roll PECVD System, which generates plasma between a pair of rollers, is developed for the deposition of SiO_x transparent high barrier coating on film. At SiO_x deposition, the deposition rate of 900 nm-m/min and barrier performance (WVTR) below $5 \times 10^{-4} \text{ g/m}^2 \text{day}$ is demonstrated.

**FLX7/
FMC6 - 2
15:20**

Robust Folding Structure for a Foldable Display

*H.-J. Kwon, H. S. Shim, S. K. Kim, Y. T. Chun, I. S. Kee,
S. Y. Lee*

Samsung Advanced Inst. of Tech., Korea

Design and analysis of folding structure applied hyperelastic material for foldable display are described. This structure allows to realize extendable and foldable large display using conventional glass panels. From Finite Element Method (FEM) analysis and mechanical and optical experimental results, we can confirm the design of more stable folding structure.

**FLX7/
FMC6 - 3
15:40**

Direct Connection of LSI Chips to Polyethylene Naphthalate Using Au Cone Bump

T. Shuto, N. Watanabe, A. Ikeda, T. Higashimachi,
T. Asano*

Kyushu Univ., Japan

**Sojo Univ., Japan*

We show that the direct connection of LSI chip to PEN (polyethylene naphthalate) film can be realized by using Au cone bump for flexible display. More than 10,000 connections at 20 μm pitch with low resistance can be realized at 150 °C.

Author Interviews

18:00 – 19:00

Friday, December 3

9:00 - 12:00

Poster/A.I. Room

Poster FLXp: Flexible Materials and Devices

FLXp - 1

High Performance Nanocrystalline Silicon Thin Film Transistors: Mechanical Device Reliability

*H.-C. Lin, H.-S. Dai, K.-Y. Ho, C.-C. Hsu, S.-Y. Peng,
C.-W. Lin, P.-F. Lee, C.-H. Cheng, B.-C. Kung,
W.-Y. Chao, J.-Y. Yan, H.-C. Cheng*

ITRI, Taiwan

High performance nanocrystalline silicon thin film transistors (nc-Si TFTs) on polyimide (PI) substrate are demonstrated successfully. Mechanical reliability of nc-Si TFTs on PI shows an excellent characteristic than hydrogenated amorphous silicon (a-Si:H) TFTs. The TFT density of state proves that the shallow-level or deep-level defects originate from different bending directions.

FLXp - 2 Characteristics Improvement for Flexible a-Si:H Thin Film Transistor with Post Treatment Processes

*L.-F. Teng, P.-T. Liu, Y.-T. Chou, Y.-S. Fan
Nat. Chiao Tung Univ., Taiwan*

The performances of flexible a-Si:H TFTs on stainless foil with and without silicon nitride passivation layer were discussed in this study. The experiment results indicated the reliability of a-Si:H TFTs with passivation layer under mechanical strains was improved. That's related to the hydrogen passivating effect during deposition and post-annealing process.

FLXp - 3 Flexible Ferroelectric-TFTs Using IGZO-Channel and P(VDF-TrFE)

G.-G. Lee, S.-M. Yoon, J.-W. Yoon, Y. Fujisaki**,
H. Ishiwara, E. Tokumitsu
Tokyo Inst. of Tech., Japan
*ETRI, Korea
**Hitachi, Japan*

We report on the fabrication of a-IGZO-based flexible nonvolatile memory TFTs with P(VDF-TrFE) ferroelectric polymer on the PEN substrate. Excellent device performances, such as the field effect mobility of $7.1 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$, the subthreshold swing of 200 mV/dec, and drain current on/off ratio of more than 10^5 were confirmed.

FLXp - 4 Color Shift Analysis of Reflective Flexible Display on Bending Conditions

*S.-C. Liao, B.-J. Wen
ITRI, Taiwan*

The purpose of this study is to analyze the color shift of the reflective-type cholesteric liquid crystal display (Ch-LCD). Under different radius of curvature by using a flexible-characteristic inspection system with an adjustable light source is presented in this paper. The color shift behaviors of reflective flexible display were discussed.

FLXp - 5 Moisture Permeability of Coating Film on Stainless Steel Foil

*N. Yamada, T. Ogura, S. Ito, K. Nose
Nippon Steel, Japan*

OLEDs fabricated on glass substrates were encapsulated with coated and non-coated stainless steel foils followed by accelerated shelf life test in order to estimate the moisture permeation of the coating film. HP-coated stainless steel foil showed the lowest moisture permeation among the three coated stainless steel foils.

FLXp - 6 Aluminum Oxide Layer Formation via PEALD for Enhancement of Barrier Properties of Plastic Substrates

J. S. Jang, H. G. Kim, S. S. Kim

Kyung Hee Univ., Korea

Aluminum oxide layers were successfully deposited on plastic substrates via plasma enhanced atomic layer deposition (PEALD) process using trimethylaluminum (TMA) and oxygen. Several process parameters in PEALD process were optimized. Thin and densely packed aluminum oxide layers deposited via PEALD showed the potentials as promising barrier coating layers for substrates.

FLXp - 7 Colorless Polyimide Substrate for Flexible Display

G. H. Kim, W. J. Lee, J.-Y. Cai, K.-H. Choi**

ETRI, Korea

**KITECH, Korea*

Transparent colorless polyimide (C. PI) substrate for flexible display was developed. In order to explore the performance and processability of this substrate, flexible LCDs were fabricated and their characteristics were investigated.

FLXp - 8 Spraying Conductive Transparent Layer on Flexible Thermal-Resistant Substrate

W.-M. Chou, H. H. Yu, H. -H. Lin

Nat. Formosa Univ., Taiwan

Polyarylate (PAR) substrate was prepared by hot pressing, and then a conductive polypyrrole (PPy) layer was deposited on its surface by chemical in-situ polymerization. Different temperatures were controlled for PPy preparation. The optical transmittance and surface resistivity of the PPy layers for different polymerization times and reaction temperatures were compared.

FLXp - 9 Stable Flexible Organic Thin Film Transistor with Self-Assembled Monolayers Surface Treatment

C. L. Liao, C. C. Chou, C. W. Liu, K. Y. Chiang, C. Y. Leu, J. M. Ding, J. P. Hu

ITRI, Taiwan

We deposited self-assembled monolayers by simple spin-coating technique onto gas barrier/PEN substrate. Spin-cast SAMs had ultra smooth crystalline surface and provided an excellent surface for organic thin film transistors. In fact on the SAM treated gas barrier, OTFT showed mobility of $1.42 \times 10^{-2} \text{ cm}^2/\text{Vs}$ and excellent bias stress stability.

FLXp - 10 A Low-Temperature and Highly Reproducible Fabrication Process for High-Mobility Solution-Processed Small Molecule Field-Effect Transistors

T. Endo^{}, T. Nagase^{*,**}, T. Kobayashi^{*,**}, K. Takimiya^{***}, M. Ikeda^{****,*****}, H. Naito^{*,**}*

^{}Osaka Pref. Univ., Japan*

*^{**}The Res. Inst. for Molecular Elect. Devices, Japan*

*^{***}Hiroshima Univ., Japan*

*^{****}Nippon Kayaku, Japan*

*^{*****}Ctr. for Organic Photonics & Elect. Res., Japan*

A simple, low-temperature, and reproducible fabrication process of di octylbenzothienobenzothiophene top-gate field-effect transistors has been reported. A total of 116 devices exhibit high mobilities of $1.59 \pm 0.40 \text{ cm}^2/\text{Vs}$, low threshold voltages of $-1.48 \pm 3.02 \text{ V}$, and excellent electrical stability against a 10^4 -s-duration gate-bias stress of -1.2 MV/cm .

FLXp - 11 Electrical Characteristics of Flexible Organic Thin-Film Transistors under Bending Conditions

F.-C. Chen, T.-D. Chen

Nat. Chiao Tung Univ., Taiwan

The electrical properties of flexible organic thin-film transistors fabricated on stainless steel substrates were measured under different bending conditions. We found that the compressive strain resulted in an increased mobility while the tensile strain led to a decreased one. The strains probably influenced the barrier height between the pentacene grains.

FLXp - 12 Chemical In-Situ Polymerization of Polypyrrole on Transparent Conductive Flexible Polyarylate Substrate

H. H. Yu, S.-C. Huang, H.-F. Lee, W.-M. Chou

Nat. Formosa Univ., Taiwan

High optical transmittance, high thermal-resistant and anti-ultraviolet radiation Polyethersulfone (PES) substrate was prepared by hot-melting and thermal annealing process. Single-walled carbon nanotubes (SWCNTs) were dispersed separately with jelly fig pectin solution under sonication first, and then sprayed on PES surface as the conductive transparent layer.

FLXp - 13 New Method for Detecting Permeation Pass Way of Thin Film Encapsulation

*J. K. Lee, J. S. Kim, C. K. Yoo, S. Y. Yoon, C. D. Kim,
Y. K. Hwang, I. J. Chung*

LG Display, Korea

We research relations between O/Al ratio and barrier properties of aluminum oxide which has been deposited with varying process voltage controlled reactive sputtering conditions. A new method, using photoluminescence material for detecting defects, is introduced here to evaluate barrier characteristics, especially sizes or density of defects in the barrier layer.

FLXp - 14L Annealing Effect of Low Temperature (< 150 °C) Cat-CVD Gate Dielectric Silicon Nitride Films Diluted With Atomic Hydrogen

*K.-S. Keum, K.-M. Lee, J. D. Hwang, Y.-J. Lee, K.-S. No,
W.-S. Hong*

Univ. of Seoul, Korea

We fabricated silicon nitride (SiN_x) films for gate dielectric layers at low temperature (< 150°C) by Cat-CVD system. in-situ annealing was performed without vacuum breaking after SiN_x films deposition. Samples were annealed by oven. As a result, including hydrogen samples show more effective dielectric properties improvement.

FLXp - 15L Characteristics of Silicon Nanocrystals Embedded in the Silicon Nitride Films Deposited by PE-CVD at a Low Temperature

*J.-D. Hwang, K.-S. Keum, Y.-J. Lee, K.-M. Lee, S. Jang,
M. Han, W.-S. Hong*

Univ. of Seoul, Korea

Silicon nitride (SiN_x) films prepared by PECVD technique at a low temperature (200 °C). Controlling the gas mixing ratio, $R = [\text{N}_2]/[\text{SiH}_4]$, and the plasma power can be composition parameter, X, varied from 0.83 to 1.62. Photoluminescence (PL) spectra of these films revealed existence of nano-sized silicon particles.

IDW '11

The 18th International Display Workshops

December 7-9, 2011

Nagoya Congress Center
Nagoya, Japan

<http://www.idw.ne.jp>

Topical Session on Touch Panels and Input Technologies

Wednesday, December 1

13:20 - 14:40

Room 502

INP1: Touch Panel (1)

Chair: C. J. Brown, Sharp Labs. of Europe, UK
 Co-Chair: T. Nakamura, Toshiba Mobile Display, Japan

INP1 - 1: *Invited* In-Cell Touch Panels: A Review of Technologies and Applications

13:20

C. J. Brown

Sharp Labs. of Europe, UK

In recent years touch panels have become a standard feature of portable electronic devices ranging from mobile phones to tablet PCs. In this paper we review the recent progress of in-cell capacitance and optical type touch panel technologies and summarize their prospects in the near future.

INP1 - 2: Read-Out Circuit Employing Varying Reference Voltage for Capacitive Touch-Screen

13:40

K. Gwak, Y.-S. Jang, S.-G. Lee

KAIST, Korea

A new capacitance measuring circuit based on a constant current charging method for a touch-screen read-out is proposed. The method employs a linearly varying reference voltage to a comparator to increase the sensitivity and noise immunity. An 8bit architecture is implemented and proved by simulation with 0.13 um technology.

INP1 - 3: A Novel Embedded Touch Display with Integrated Chip Solution

14:00

S.-Z. Peng, C.-C. Chan, S.-H. Huang, H.-H. Chen, W.-T. Tseng, C.-R. Lee

Chunghwa Picture Tubes, Taiwan

We propose a novel embedded capacitive touch display with sensing display driver (SDD) IC solution to improve TSP performances. Our novel design is not only integrated touch function and TFT driver into one chip, but also embedded touch panel into display. This novel design is raised up product competition.

INP

INP1 - 4: Invited In-Cell Capacitive Type Touch Sensor Using LTPS TFT-LCD Technology
14:20

T. Nakamura, S. Tomita

Toshiba Mobile Display, Japan

We discuss in-cell light sensor technologies and describe an LTPS TFT-LCD with in-cell capacitive type touch sensors which amplify voltage change caused by capacitive coupling between the sensor electrode and an input object (user's finger).

----- Break -----

15:00 - 16:20

Room 502

INP2: Touch Panel (2)

Chair: S. Yoon, LG Display, Korea

Co-Chair: H. Haga, NEC LCD Techs., Japan

INP2 - 1: Invited The Golden Age of Touch Digital life on One's Fingertip
15:00

S. Yoon

LG Display, Korea

Touch has been certainly popularized. None of touch technologies is yet perfect but it can be said pretty much matured. But in the other hand, touch at present is only the first step and next step should focus on improving natural human interface.

INP2 - 2 Low Cost Multi-touch Embedded System
15:20

C.-L. Li, J.-S. Liao, H.-H. Chen, W.-T. Tseng, C.-R. Lee

Chunghwa Picture Tubes, Taiwan

Chunghwa Picture Tubes, LTD. (CPT) sets up a low-cost multi-touch embedded system that all software and drivers are free except the hardware of this platform. And in this system, multi-touch function is implemented using resistive multi-touch panel. It is satisfied with the result of the operating efficiency of this platform.

INP2 - 3 Subjective Analysis on Touch Screen Panel Tapping Properties
15:40

J.-H. Lu, Y.-W. Fang, K.-S. Wang, J.-Y. Lee

AU Optronics, Taiwan

For verifying the tapping forces on touch screen panels (TSP), we conducted subjective experiments. Tapping forces, surface properties of TSPs and styluses were investigated. Based on the experimental results, the tapping model of TSP could be established.

INP2 - 4 **Low Cost and Easy Manufacturing Flexible
16:00** **Projective Capacitive Touch Sensing Film**

*C. J. Liu, G. R. Hu, Y. J. Chen, C. J. Tsai, M. H. Wang,
P. H. Wang, W. J. Chiang, C. P. Kung, J. C. Ho, C. C. Lee
ITRI, Taiwan*

An easy process of high quality of projective capacitive touch sensing film is developed by transparence polymer insulating film with patterning ability, high quality and bendable ITO with low resistance, colorless polyimide substrate with thickness less than 30 μ m. It costs low by less process time, less expansive equipment.

Author Interviews

18:00 – 19:00

Thursday, December 2

13:20 - 14:40

Room 413

INP3: Imaging System

Chair: J. Tanida, Osaka Univ., Japan

Co-Chair: S. Itoh, Shizuoka Univ., Japan

INP3 - 1: ***Invited* The Impact of a New Camera-System for
13:20** **Medical-Use on the Display Technologies**

Y. Ide

Pixera, USA

No manuscript was submitted.

INP3 - 2: ***Invited* A Super Hi-Vision Camera Using Three
13:40** **33-M-pixel CMOS Image Sensors**

T. Yamashita, R. Funatsu, T. Yanagi, K. Mitani,
T. Yoshida*, Y. Nojiri*

NHK, Japan

**Hitachi Kokusai Elec., Japan*

We developed world's-first camera system that can capture full-resolution Super Hi-Vision images (7680 \times 4320/59.94p, R/G/B-4:4:4). For this system, we also developed a 33-million-pixel CMOS image sensor, an ultra-high-resolution lens, and a signal-processing for correcting lens chromatic aberration in real time. As a result, the limiting resolution was achieved 4,320 TV lines.

INP3 - 3: Invited Multi-Dimensional Data Acquisition Using a Compound-Eye Imaging System
14:00

J. Tanida, R. Horisaki, K. Kagawa
Osaka Univ., Japan

Effective methods for multi-dimensional data acquisition are developed using a compound-eye imaging system. The images captured by ommatidia contain multi-dimensional information of the object, and proper processing extracts the information. As applications related to multi-dimensional data acquisition, long-distance observation, focus extension, and generalized sampling are presented.

INP3 - 4 A 5-bit qVGA CMOS Image Sensor for Optical Sensor Array in OLED-on-Silicon (OLEDoS)
14:20

K. Min, D. Lee, C. Yoo*
Univ. of Hanyang, Korea
**Hynix Semiconductor, Korea*

An optical sensor array and its readout circuit for OLED-on-silicon (OLEDoS) are described. A qVGA optical sensor array is implemented on a 0.4 inch VGA OLED pixel array in a 0.18 um CMOS process. A 5-bit single-slope analog-to-digital converter with delta reset scheme is adopted for optical sensor readout circuits.

----- Break -----

15:00 - 16:20

Room 413

INP4: 3D Interactive System

Chair: T. Komuro, Univ. of Tokyo, Japan
Co-Chair: N. Hashimoto, Citizen, Japan

INP4 - 1: Invited Vision-Based 3D Input Interface Technologies
15:00

T. Komuro
Univ. of Tokyo, Japan

Vision-based user interfaces are technologies where human motion is detected by a camera or cameras and is used as input. In this paper we describe advantages and disadvantages, technological issues, and related research of vision-based user interfaces as well as examples of 3D input interface systems that we developed.

INP4 - 2: Invited Tactile Interaction with 3D Images
15:20

H. Shinoda
Univ. of Tokyo, Japan

In this talk, our project on non-contact tactile display is introduced. Radiation pressure by convergent airborne ultrasound beams produces tactile sensations on bare skins, without installing bulky mechanical arms or forcing people to hold/wear special devices. Combining the tactile display with 3D images, we can realize literally touchable 3D images.

INP4 - 3: Invited A system for Holographic Display without Interference Measurement

15:40

*K. Nitta**Kobe Univ., Japan*

A three-dimensional (3D) image system based on multi vision imaging and wavefront reconstruction is reported. One of the features in our research is to use graphic processing units (GPU) for signal processing. It is shown that the GPU is effective for large scale information processing required in the 3D system.

INP4 - 4: Invited High Density Directional Ray Scan System for Autostereoscopic Displays

16:00

Y. Momonoi, M. Sekine, T. Saishu*, Y. Yamauchi***Toshiba Visual Prods., Japan***Toshiba, Japan*

We introduce a newly developed prototype of a ray scan system for an autostereoscopic display system. This system synthesizes various 3-D images to acquire high-density multiple light rays. One application of this system is capture of birds-eye-view photographic content suitable for a flatbed autostereoscopic display.

Author Interviews

18:00 – 19:00

INP

Asia Display 2011

Kunshan, China

IDW Tutorial in Japanese

Tuesday, November 30, 2010

Room 412

Fukuoka International Congress Center

Detailed information is announced at

<http://www.sidchapters.org/japan/>

Topical Session on Lighting Optics, Devices and Systems

Wednesday, December 1

13:20 - 14:25

Room 409

LIT1: LED Light Source Technologies

Chair: K. Kälantär, LEIZ Advanced Tech., Japan

Co-Chair: K. Hara, Shizuoka Univ., Japan

LIT1 - 1: 13:20 *Invited* **Recent Developments and Future Prospects of LED Technologies for Displays and General Lighting**

H. Amano

Nagoya Univ., Japan

An overview of the progress of GaN-based blue light emitting diode (LED) chips will be discussed. Several groundbreaking technologies by which various efficiencies were considerably improved will be shown. In addition, recent progress of UV/DUV LEDs and future prospects of the progress of visible long-wavelength LEDs will be explained.

LIT1 - 2 13:45 **Integration of Imprinting with Reflector for Designing High Efficiency Street-Lamp Module**

J.-W. Pan, S.-H. Tu, C.-W. Fan, S.-H. Lin, J.-Y. Huang, C.-S. Wang*

Nat. Chiao Tung Univ., Taiwan

**Genesis Photonics, Taiwan*

A cost effective, high throughput, and high yield method for street lamp was proposed in this paper. We integrated the imprinting technology and the reflective optical element to improve the conventional street lamp. The novel design has 40% enhancement in illumination intensity, the uniform illumination and the glare effect elimination.

LIT1 - 3 **Withdrawn**

LIT1 - 4 **Withdrawn**

LIT1 - 5L **Photoconductivity in Silicon Rich Silicon Nitride Films Containing Silicon Nanocrystals Prepared by Catalytic CVD**
14:05

*K.-M. Lee**, *J.-D. Hwang**, *Y.-J. Lee**, *K.-S. Kuem**,
*K.-S. No**, *K. S. Yoon***, *S. H. Yang***, *W.-S. Hong**

**Univ. of Seoul, Korea*

***Samsung Elect., Korea*

We fabricated metal-insulator-semiconductor (MIS) capacitors and p-i-n diodes using silicon rich silicon nitride (SRSN) film containing silicon nanocrystals (Si NCs) prepared by catalytic chemical vapor deposition (Cat-CVD). Photo/dark current difference and photo/dark hysteresis appeared in the current-voltage (I-V) and the capacitance-voltage (C-V) curves, respectively.

----- Break -----

15:00 - 16:20

Room 409

LIT2: Backlight

Chair: K. Kälantär, LEIZ Advanced Tech., Japan

Co-Chair: M. Shinohara, Omron, Japan

Organizer: FMC-WS

LIT2 - 1 **Ultra-Slim 7-in. Light-Guide Plate using Roll-to-Roll UV Embossing Process**
15:00

Y.-Y. Chang, *G.-H. Liu**, *C.-J. Ting*, *T.-H. Lin*, *C.-L. Fu*,
H.-H. Lin, *J.-H. Tsai*

ITRI, Taiwan

**Epoch Chemtronics, Taiwan*

We proposed a 7-in. ultra-slim LGP fabricated by R2R UV embossing process which has the advantage of high throughput and high microstructural transfer rate. The surface plasma treatment is applied to enhance the adhesion. A 0.42 mm prototype with outcoupling etching-dots is achieved with its uniformity more than 70%.

LIT2 - 2 **Highly-Collimating Backlighting Systems with Multi-Stacked and Multi-Layered Optical Sheets**
15:20

Y.-Y. Chang, *T.-H. Lin*, *C.-L. Fu*, *C.-F. Lan*, *R.-H. Tsai*,
H.-H. Lin, *J.-H. Tsai*

ITRI, Taiwan

We proposed a highly-collimating backlighting system with multi-stacked optical sheets. The optical components can be fabricated by ultra-precision diamond tooling and UV embossing. A best FWHM of 6 degree is realizable in an optimized manufacturing process.

LIT2 - 3 Thermal Network Analysis of Edge-Type LED Backlight

15:40

*K. Misono**Miyakonojo Nat. College of Tech., Japan*

We developed a thermal network model of edge-type LED backlight. The effects of various design parameters of the backlight on the junction temperature of LED were analyzed by using the L18 orthogonal array. The important design parameters to reduce the junction temperature were clarified.

LIT2 - 4 Analysis of Luminous Flux Measuring Methods for Flat Lightings

16:00

*E. Lee, S.-J. Choi, J.-W. Bae, O.-K. Song, S. Lee, H.-K. Chung**Samsung Mobile Display, Korea*

R&D for so-called eco-friendly lightings like OLED lamps is rapidly progressing. New devices having flat-panel-shape require different measuring method from conventional ones. Several different measuring methods are analyzed for finding appropriate method for flat lightings. The analysis will be helpful to evaluate and standardize measuring method for flat lightings.

Author Interviews

18:00 – 19:00

Thursday, December 2

10:40 - 11:50

Room 413

LIT3: Phosphors for Lighting

Chair: K. Ohmi, Tottori Univ., Japan

Co-Chair: R. J. Xie, NIMS, Japan

Organizer: PH-WS

LIT3 - 1: Invited Preparation and Luminescence of Novel Oxysulfide Phosphors for White Light LEDs

10:40

*T.-M. Chen, T.-W. Kuo**Nat. Chiao Tung Univ., Taiwan*

Two unprecedented phosphors, CaZnOS:Eu^{2+} and $\text{Sr}_8\text{Al}_{12}\text{O}_{24}\text{S}_2\text{:Eu}^{2+}$, were prepared and investigated. The PL spectra of both reveal a broad emission band extending from 550 to 700 nm under blue light pumping. Both phosphors exhibit superior luminescence stability than SrS:Eu^{2+} in thermal quenching up to 120°C and great potential for LED application.

LIT3 - 2 **Luminance Improvement of EL Devices Using ZnS-Phosphors Sintered by Vacuum Microwave Process**
11:10

N. Taguchi, S. Horiguchi, Y. Uraoka**

Image Tech, Japan

**Nara Inst. of S&T, Japan*

We improved the luminance of EL devices using ZnS phosphors sintered by the new microwave method that original ZnS powders were previously given mechanical damages to enhance the diffusion of activators inside ZnS. The EL devices dispersed with other inorganic phosphors gave more enhanced luminance and change of luminescent color.

LIT3 - 3 **Electric Field Effect by Using Thermal Annealing Process for Inorganic Electroluminescent Devices**
11:30

Y.-H. Chien, K.-F. Chen, C.-C. Chang, M.-Y. Chuang, J.-C. Ho, Y.-Y. Chang, C.-C. Lee, F.-H. Wang, C.-S. Ho**

ITRI, Taiwan

**Nat. Chung Hsing Univ., Taiwan*

This work proposes a novel inorganic electroluminescent (IEL) device with a built-in electric charge (BIEC) layer which is called EFBI-PDEL device. Using thermal anneal process to improve device performance under same driving condition: reduce turn-on voltage from 80 V to 35 V, increase brightness from 269.2 nits to 397.3 nits.

----- Lunch -----

13:20 - 14:25

Room 409

LIT4: Solid State Projection Light Source

Chair: P. Rudy, Kaai, USA
 Co-Chair: K. Takeda, Seiko Epson, Japan
 Organizer: PRJ-WS

LIT4 - 1: **Invited State-of-the-Art Continuous-Wave InGaN Laser Diodes in the Violet, Blue, and Green Wavelength Regimes**
13:20

J. W. Raring, M. C. Schmidt, C. Poblenz, Y.-C. Chang, B. Li, M. Mondry, R. Craig, P. Rudy, J. S. Speck, S. P. DenBaars, S. Nakamura

Soraa, USA

We present state-of-the-art performance from green, blue, and violet InGaN laser diodes fabricated on nonpolar and semipolar GaN substrates. Using these novel orientations, we demonstrate high power, high efficiency, continuouswave operation from single-lateral-mode electrically pumped laser diodes from 405 nm to 525 nm, including over 60 mW at 520 nm.

LIT4 - 2 **Withdrawn**

LIT4 - 3 **RGB Laser Light Source Module with High
14:05 Efficiency for Large Screen Projectors**

*A. Furukawa, K. Takahashi, K. Murakami, Y. Maeda,
M. Oka*, K. Kimura*, T. Mochizuki*, M. Suzuki*,
N. Eguchi**

*Sony Manufacturing Syss., Japan
Sony, Japan

A compact and high power laser module with output of 10, 6, and 5 watts for the red green and blue wavelengths has been developed. The very high efficiency of 18% in electro-optical conversion ratio makes it an attractive light source in substitution to xenon lamps for large screen projectors.

Author Interviews

18:00 – 19:00

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The 18th International Display Workshops

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S. Tokito	Yamagata Univ.
K. Yasukawa	Seiko Epson

Workshop on 3D/Hyper-Realistic Displays and Systems

Workshop Chair:	S. Yano	NHK
Program Chair:	M. Tsuchida	NTT
General Secretary:	K. Yamamoto	NICT
Program Committee:	T. Fujii	Tokyo Inst. of Tech.
	T. Koike	Hitachi
	K. Mashitani	Sanyo Elec.
	T. Mishina	NHK
	S. Ohtsuka	Kagoshima Univ.
	J.-Y. Son	Daegu Univ.
	C.-H. Tsai	ITRI
	M. Tsuboi	NTT DoCoMo
	H. Yamamoto	Univ. of Tokushima

Workshop on Applied Vision and Human Factors

Workshop Chair:	Y. Shimodaira	Shizuoka Univ.
Program Chair:	K. Masaoka	NHK
General Secretary:	T. Matsumoto	Sony
Program Committee:	J. Bergquist	Nokia
	S. Clippingdale	NHK
	N. Hiruma	NHK
	M. Idesawa	Univ. of Electro-Commun.
	H. Isono	Nippon Inst. of Tech.
	S. Kubota	Seikei Univ.
	T. Kurita	NICT
	T. Mitsunashi	Shobi Univ.
	J. Someya	Mitsubishi Elec.
	T. Tamura	Tokyo Polytech. Univ.
	T. Wake	Kanagawa Univ.
	R. Yoshitake	IBM Japan

Workshop on Projection and Large-Area Displays and Their Components

Workshop Chair:	K. Takeda	Seiko Epson
Program Chair:	T. Hayashi	3M
Program Vice-Chair:	H. Kikuchi	NHK
	S. Shikama	Setsunan Univ.
General Secretary:	T. Suzuki	JVC KENWOOD Holdings
Program Committee:	O. Akimoto	Sony
	Y. Asakura	Nittoh Kogaku
	Y. Fushimi	Panasonic
	H. Kanayama	Sanyo Elec.
	S. Koike	Seiko Epson
	Y. Moromizato	Techno Syss. Res.
	H. Nakano	Barco
	T. Ogura	Panasonic
	K. Ohara	Texas Instr. Japan

S. Ouchi	Hitachi
M. Sakai	Ushio
H. Sugiura	Mitsubishi Elec.
Z. Tajima	Mobara Atecs
M. Takaso	Techno Syss. Res.

Workshop on Electronic Paper

Workshop Chair:	A. Suzuki	Ricoh
Program Chair:	T. Fujisawa	DIC
General Secretary:	H. Arisawa	Fuji Xerox
Program Committee:	M. Higuchi	NIMS
	Y. Hotta	Ricoh
	T. Kitamura	Chiba Univ.
	S. Maeda	Tokai Univ.
	Y. Masuda	Bridgestone
	M. Omodani	Tokai Univ.
	N.-S. Roh	Samsung Elect.
	Y. Toko	Stanley Elec.
	M. Tsuchiya	E-ink
	G. F. Zhou	Philips Res.

Workshop on MEMS and Emerging Technologies for Future Displays and Devices

Workshop Chair:	M. Nakamoto	Shizuoka Univ.
Program Chair:	Y. Nakai	Toshiba
General Secretary:	T. Komoda	Panasonic Elec. Works
Program Committee:	T. Akinwande	MIT
	G. Barbastathis	MIT
	M. Esashi	Tohoku Univ.
	H. Fujita	Univ. of Tokyo
	J. Jang	Kyung Hee Univ.
	H. Kikuchi	NHK
	J. M. Kim	SAIT, Samsung Elect.
	K. Matsumoto	Olympus
	W. I. Milne	Univ. of Cambridge
	T. Ooasa	Tokyo Electron
	S. Sugiyama	Ritsumeikan Univ.
	H. L. Tuller	MIT
	S. Uchikoga	Toshiba
	J.-B. Yoon	KAIST
	Y. Yoshida	BEANS Lab.

Workshop on Display Electronic Systems

Workshop Chair:	H. Okumura	Toshiba
Program Chair:	K. Sekiya	Tohoku Univ.
General Secretary:	T. Yamamoto	NHK
Program Committee:	T. Fujine	Sharp
	S. Itoh	Shizuoka Univ.
	K. Käläntär	Leiz Advanced Tech.
	T. Kim	Apple
	M. A. Klompenhouwer	Philips Res.
	H.-S. Koo	Ming-Hsing Univ. of S&T
	O.-K. Kwon	Hanyang Univ.
	A. Nagase	Mitsubishi Elec.
	H. Nitta	Hitachi
	S. Ono	Panasonic
	H. Sasaki	Toshiba
	S. Takamura	NTT

K. Takeuchi Univ. of Electro-Commun.

Workshop on Flexible Displays

Workshop Chair:	H. Fujikake	NHK
Program Chair:	T. Furukawa	Kyodo Printing
General Secretary:	T. Shiro	Teijin
Program Committee:	H. Hirata	Toray Eng.
	M. Itoh	Toppan Printing
	T. Kamata	AIST
	M. Kimura	Nagaoka Univ. of Tech.
	H. Maeda	DNP
	Y. Masuda	Bridgestone
	T. Nagatsuka	Nitto Denko
	K. Nomoto	Sony
	T. Ogura	Nippon Steel
	T. Sekitani	Univ. of Tokyo
	T. Tomono	Toppan Printing
	K. Yasukawa	Seiko Epson

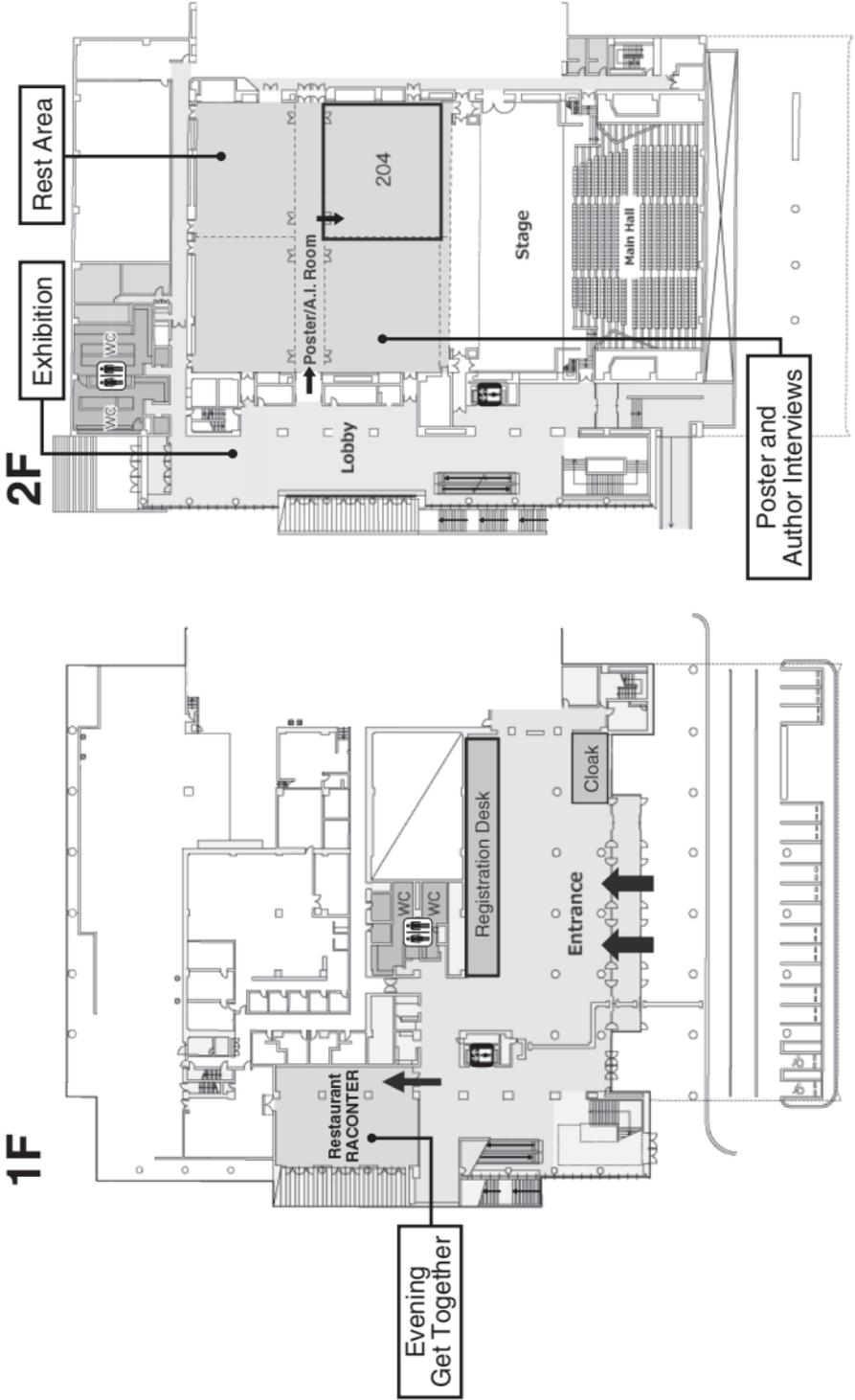
Topical Session on Touch Panels and Input Technologies

Session Chair:	H. Okumura	Toshiba
Program Chair:	I. Fujieda	Ritsumeikan Univ.
General Secretary:	N. Hashimoto	Citizen Holdings
Program Committee:	H. Haga	NED LCD Techs.
	T. Horie	Wacom
	S. Itoh	Shizuoka Univ.
	H. Kato	Sharp
	I. Mihara	Toshiba
	Y. Mizushima	Corning Holding Japan
	T. Nakamura	Toshiba Mobile Display
	K. Nakatani	Touchpanel Labs.
	H. Sasaki	Toshiba
	A. Suzuki	Ricoh
	K. Takatori	NEC LCD Techs.

Topical Session on Lighting Optics, Devices and Systems

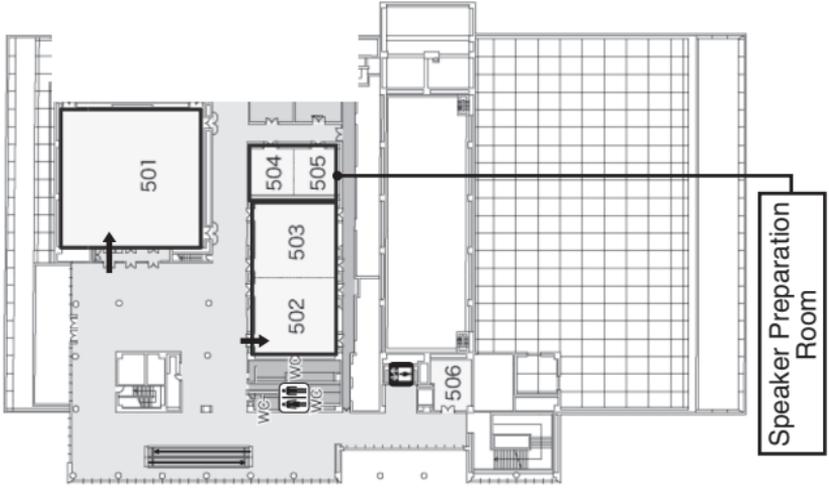
Session Chair:	K. Käläntär	Leiz Advanced Tech.
Program Chair:	K. Hara	Shizuoka Univ.
General Secretary:	T. Miyashita	Tohoku Univ.
Program Committee:	T. Hayashi	3M
	T. Inoue	TDK
	Y. Kijima	Sony
	N. Matsuda	Toshiba
	S. Oshio	Panasonic
	M. Shinohara	Omron
	Y. Yang	Sony

FLOOR PLAN

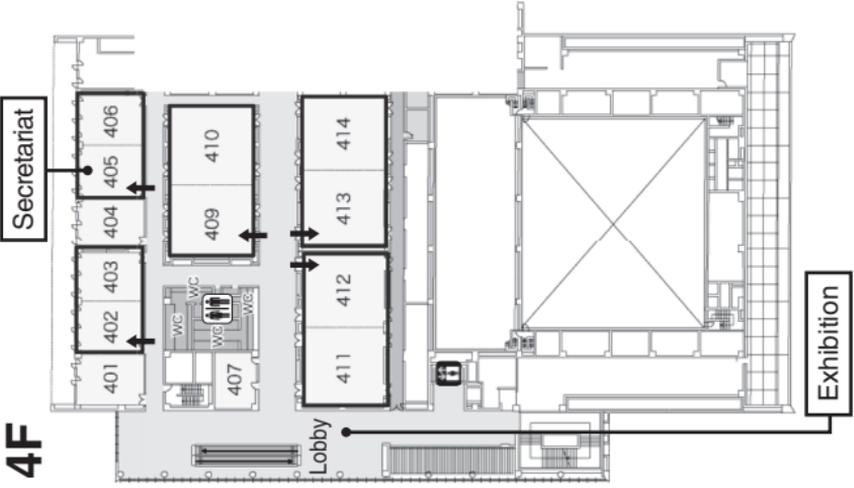


FLOOR PLAN

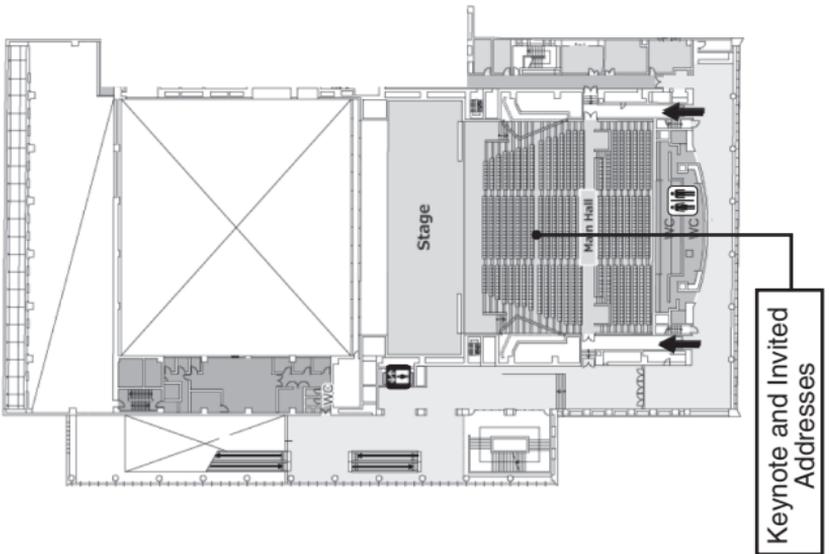
5F



4F



3F



IDW '10 Timetable

Date	1F Lobby	Main Hall	Room 204	Room 402	Room 409	Room 412	Room 413	Room 501	Room 502	Poster/A.I. Room	2F Lobby 4F Lobby	
Tue., Nov. 30	Registration 17:00-20:00	Evening Get-Together with Wine at RACONTER (1F) 18:00-20:00										
Wednesday, December 1		Opening, Keynote Address 10:20-11:15										
		Invited Address 11:15-12:00										
	Registration 8:00-18:00	Lunch									LCTp PRJp EPp 13:20-16:20	Exhibition 12:00-18:00
		OLED1 13:20-14:50	FLX1 13:20-14:30		LIT1 13:20-14:25	VHF1 13:20-14:50			INP1 13:20-14:40			
		Break										
		OLED2 15:00-16:10	FLX2 15:00-16:25	PRJ1 15:00-16:25	LIT2 15:00-16:20	VHF2 15:00-16:20	PH1 15:00-16:40	AMD1 15:00-16:25	INP2 15:00-16:20			
		Break										
		OLED3 16:40-18:05	FLX3/EP1 16:40-18:00		FMC1 16:40-18:00	VHF3 16:40-18:10		AMD2 16:40-17:40	LCT1 16:40-18:05			
											Author Interviews 18:00-19:00	
		Break										
	Banquet at the Crowne Grand Ball Room (2F) in ANA Crowne Plaza Fukuoka 19:30-21:30											
Thursday, December 2		EP2 9:00-10:15	FLX4/OLED4 9:00-10:15	MEET1 9:00-10:25	PRJ2 9:00-10:20	3D1 9:00-10:20	PH2 9:00-10:10	AMD3 9:00-10:20	LCT2 9:00-10:25	FMCp VHFp DESp 9:00-12:00	Exhibition 10:00-18:00	
		Break										
		EP3 10:40-11:55	FLX5/AMD4 10:40-12:10	MEET2 10:40-12:15	PRJ3 10:40-11:55	3D2 10:40-12:00	LIT3 10:40-11:50	OLED5 10:40-11:50	LCT3 10:40-11:55			
	Registration 8:00-18:00	Lunch										
		EP4 13:20-14:25	FLX6 13:20-14:45	MEET3 13:20-14:40	LIT4 13:20-14:25	VHF4/DES1 13:20-14:50	INP3 13:20-14:40	PDP1 13:20-14:40	LCT4 13:20-14:40	AMDp PHp OLEDp 3Dp 13:20-16:20		
		Break										
		EP5 15:00-16:30	FLX7/FMC6 15:00-16:00	MEET4 15:00-16:20	PRJ4 14:50-16:25	VHF5/DES2 15:00-16:20	INP4 15:00-16:20	PDP2 15:00-16:20	LCT5 15:00-16:10			
		Break										
		EP6 16:40-18:00	PDP5 17:00-18:00	MEET5 16:40-17:55	PRJ5 16:35-18:00	VHF6 16:40-18:00	3D3/DES3 16:40-18:00	AMD5/OLED6 16:40-18:05	PH3 16:40-17:50			
											Author Interviews 18:00-19:00	
Friday, December 3	Registration 8:00-13:00	EP7 9:00-10:25	LCT6 9:00-10:20	FED1 9:00-10:00	FMC2 9:00-10:20		DES4 9:00-10:00	AMD6 9:00-10:10	VHF7 9:00-10:15	PDPp FLXp 9:00-12:00	Exhibition 10:00-14:00	
		Break										
			LCT7 10:40-11:55	FED2 10:40-12:10	FMC3 10:40-12:00		DES5 10:40-12:00	AMD7 10:40-12:00	VHF8/3D4 10:40-12:10			
		Lunch										
				FED3 13:20-14:40	FMC4 13:20-14:40	PDP3 13:00-14:40	DES6 13:20-14:40	AMD8 13:20-14:40	3D5 13:20-14:40			
		Break										
			FED4 15:00-15:40	FMC5 15:00-16:20	PDP4 15:00-16:20	DES7 15:00-16:25	AMD9 15:00-16:05	3D6 15:00-16:20				
										Author Interviews 16:20-17:20		

IDW '10 Session Navigator

	Location	Wednesday, Dec. 1				Thursday, Dec. 2				Friday, Dec. 3						
		10:20-12:00	PM			18:00-19:00	AM		PM		18:00-19:00	AM		PM	16:20-17:20	
Keynote & Invited	Main Hall	Opening, Keynote & Invited Addresses														
LCT	Room 204												Nanostructured LC	New LCD Design		
	Room 502			Photo Alignment Technology		High Performance LC Technology	New Functional LCDs	High Performance LCDs	Emerging LC Application							
	Poster/A.I. Room	Posters			A.I.						A.I.					A.I.
AMD	Room 204						*Flexible Active-Matrix Devices									
	Room 501		AM-LCD	System on Panel & Sensing Device		Si TFT					*AM-OLED	Organic & Carbon TFT	Oxide TFT (1)	Oxide TFT (2)	Nanodevice & Oxide TFT	
	Poster/A.I. Room				A.I.			Posters			A.I.					A.I.
FMC	Room 204								*Materials & Components for Flexible Displays							
	Room 409			Optical Films								Manufacturing Technologies (1)	Manufacturing Technologies (2)	Materials (1)	Materials (2)	
	Poster/A.I. Room				A.I.	Posters					A.I.					A.I.
PDP	Room 204									Protective Layer						
	Room 412													High Efficiency	Protective Layer	
	Room 501							Panel Configuration	Picture Quality							
	Poster/A.I. Room										A.I.	Posters				A.I.
PH	Room 413		Phosphors in General			Phosphors for LEDs										
	Room 502									Emissive Displays & Phosphors						
	Poster/A.I. Room				A.I.			Posters			A.I.					
FED	Room 402											FEDs & BLUs	Field Emitters (1)	Field Emitters (2)	Field Emitters (3)	
	Poster/A.I. Room															A.I.
OLED	Main Hall		OLED Keynote & Materials	OLED Soluble Technologies	OLED Display Applications											
	Room 204					*Flexible OLED										
	Room 501						OLED Device Technologies			*AM-OLED						
	Poster/A.I. Room				A.I.			Posters			A.I.					
3D	Room 412					Holography & 3D Display	3D Display (1)									
	Room 413									*3D System & Content						
	Room 502											*3D Human Factors	3D Image Quality	3D Display (2)		
	Poster/A.I. Room							Posters			A.I.					A.I.
VHF	Room 412		Lightness Perception	Color Perception	Color Reproduction			*Multi Primary (1)	*Multi Primary (2)	Moving Image Quality & Backlight System						
	Room 502											Display Human Factors	*3D Human Factors			
	Poster/A.I. Room					A.I.	Posters				A.I.					A.I.
PRJ	Room 402		Illumination Systems													
	Room 409					New Projection Applications	Pico-Projectors		Laser Projection & Despeckling Tech.	Digital Signage & Large Venue Projectors						
	Poster/A.I. Room		Posters			A.I.					A.I.					
EP	Main Hall					Electrophoretic Displays	Color Electrophoretic Displays	Frontier Research for e-Paper	Electrochromic Displays	Cholesteric LCDs		Electrowetting & LCDs				
	Room 204					*Flexible Electronic Paper										
	Poster/A.I. Room		Posters			A.I.					A.I.					A.I.
MEET	Room 402					Emerging Technologies	Fundamental Components, Process Technologies (1)	Optical MEMS & Device Technologies	Displays & Imaging	Fundamental Components, Process Technologies (2)						
	Poster/A.I. Room										A.I.					
DES	Room 412							*Multi Primary (1)	*Multi Primary (2)							
	Room 413									*3D System & Content		Display Electronics	Low Power Technology	Display Quality	Visible Light Communication	
	Poster/A.I. Room					Posters					A.I.					A.I.
FLX	Room 204		Advanced Flexible Display Technologies	Printing Fabrication Processes	*Flexible Electronic Paper	*Flexible OLED	*Flexible Active-Matrix Devices	Flexible Organic TFT	*Materials & Components for Flexible Displays							
	Poster/A.I. Room					A.I.					A.I.	Posters				
INP	Room 413							Imaging System	3D Interactive System							
	Room 502		Touch Panel (1)	Touch Panel (2)												
	Poster/A.I. Room					A.I.					A.I.					
LIT	Room 409		LED Light Source Technologies	Backlight				Solid State Projection Light Source								
	Room 413						Phosphors for Lighting									
	Poster/A.I. Room					A.I.					A.I.					

LCT: Workshop on LC Science & Technologies

AMD: Workshop on Active Matrix Displays
 FMC: Workshop on FPD Manufacturing, Materials & Components

PDP: Workshop on Plasma Displays

PH: Workshop on EL Displays & Phosphors

FED: Workshop on Field Emission Display & CRT

OLED: Workshop on Organic LED Displays

3D: Workshop on 3D/Hyper-Realistic Displays & Systems

VHF: Workshop on Applied Vision & Human Factors

PRJ: Workshop on Projection & Large-Area Displays & Their Components

EP: Workshop on Electronic Paper

MEET: Workshop on MEMS & Emerging Technologies for Future Displays & Devices

DES: Workshop on Display Electronic Systems

FLX: Workshop on Flexible Displays

INP: Topical Session on Touch Panels & Input Technologies

LIT: Topical Session on Lighting Optics, Devices & Systems

A.I.: Author Interviews

*: Joint Session

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**IDW '10
FINAL PROGRAM**