



IDW '09

THE 16TH 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 (LAD)
- Electronic Paper (EP)
- MEMS for Future Displays and Related Electron Devices (MEMS)
- Display Electronic Systems (DES)

Topical Sessions on

- Flexible Displays (FLX)
- Input Technologies (INP)

Final Program

***World Convention Center Summit
Miyazaki, Japan
December 9(Wed) –11(Fri), 2009***

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IDW '09 Timetable
IDW '09 Session Navigator

PROGRAM HIGHLIGHTS

Scientific and technological advances in research and development on information displays can be found at the 16th International Display Workshops (IDW '09). Features of the IDW '09 include the integration of the following thirteen workshops as well as two topical sessions focusing on recent progress of flexible displays and Image 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 for Future Displays and Related Electron Devices
- Display Electronic Systems

Topical Sessions on

- Flexible Displays
- Input Technologies

The three-day conference will feature 564 papers, including 2 keynote addresses, 2 invited addresses, 99 invited papers, 199 oral presentations, and 262 poster presentations. Following keynote and invited addresses focused on "Promising New Technologies and Markets" in the Wednesday morning, presentations will begin and continue in seven parallel sessions through Friday. Poster sessions and author interviews will enable participants to discuss topics in detail. IDW '09 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 '09 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)

Full of opportunities to stimulate your intellectual curiosity with interesting invited talks and contributed papers, this workshop covers various applications such as LCD and OLED for TV, flexible displays and novel applications, etc. It also features TFT technologies including oxide-semiconductor TFT, organic TFT, poly-Si TFT, $\mu\text{c-Si}$, and so on. Join us in discussions of the latest progress in active-matrix displays and TFT technologies.

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)

This year the PDP workshop provides even larger number of papers related to protective layers. (It seems that we are creating problems rather than solving.) New materials of protecting layers having high gamma values are introduced, that may have a possibility of replacing the existing MgO. One of the techniques introduced at the PDP session is an "all-in-vacuum process," with which a SrCaO layer is formed without exposing the layer to ambient air, resulting in higher luminance. Deeper studies are introduced with regards to exo-electron emission from MgO. In order to understand completely the functioning of exo-electrons, however, we may need further more years. The PDP workshop will have at least two invited papers; one is on 2m x 3m film displays using plasma tube arrays, and the other is on analysis of driving 4K2K, 103"-diagonal PDPs which have intrinsic stray capacities and inductances. A special note is that the workshop is organizing a session "Essentials of PDP Physics," in which two 40-minute lectures are arranged, providing extensive discussion periods.

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, CCFLs and computational approaches for phosphors including interesting topics such as luminescent mechanism 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 field emission displays equipped with carbon nanotube (CNT) field emitter arrays and MIM-Cathode-Array is presented. Field emission characteristics and various field emitter materials, such as CNTs, ZnO, transition metal nitride and nanocrystalline silicon, are also discussed.

Workshop on Organic LED Displays (OLED)

This workshop includes recent developments in OLED materials, devices, display systems, OLED lighting and evaluation methods. OLED technologies based on new full-color patterning methods are reported on technologies facilitating the use of OLED in mobile and TV applications. Device architecture for highly efficient emissions and novel materials supporting these device technologies are also presented.

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

This workshop focuses on recent progress in 3D, hyper-realistic image system and related visual sciences. It also covers 3D acquisition, measurement, standardization, holography, high-fidelity color reproduction. Invited talks in this workshop 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 discussing the latest academic and industrial R&D in the field of applied vision and human factors associated with display technology. These include methods for improved color reproduction, contrast enhancement, dynamic performance and assessment and improvement of perceived quality of images. This workshop constitutes a unique opportunity to interact with world-renowned experts in the field and discuss the latest advances with them.

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

The hottest technologies for projection displays will make this workshop exciting. Emerging technologies such as pico projectors with LED and laser light sources will be highlighted. Ongoing progress in the fields of digital cinema, digital signage, light sources, light valves, screens and optical systems 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. 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 for Future Displays and Related Electron Devices (MEMS)

This 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. Invited speakers are from Ecole Polytech., MIT, QD Vision (MIT's venture company), Univ. of Cambridge, Alces Technology, Kyung Hee Univ., Samsung, Tohoku Univ., Univ. of Hyogo, Univ. of Tokyo, NIMS and Ritsumeikan Univ. Together 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, in combinations with other input/output devices, applications to the new arena. In addition, the systems for a wide and high dynamic range of color reproduction, high-fidelity systems for professional use, and exploration of future standards such as post-HDTV are specially focused.

Topical Session 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 practical applications. 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 related across LCT, AMD, FMC, OLED and EP workshops.

Topical Session on Input Technologies (INP)

The new topical session, INP, covers all aspects of input technologies on materials, devices and systems, in which we include not only recently attention-catching touch panels but also imaging sensor technologies. INP is expected to open new technology fields by focusing the combination of input technologies and display technologies. INP sessions are held by the related workshops of DES, AMD, FMC and EP. This year's INP will be composed of 3 sessions, including attractive invited papers such as on the trend of CMOS image sensors and on the retinal sensing devices.

IDW Best Paper Award and IDW Outstanding Poster Paper Award

IDW will present "IDW Best Paper Award" and "IDW Outstanding Poster Paper Award". The awards committee of IDW will select the most outstanding papers from those presented at IDW '09. The award winners will be announced on the IDW website and given a plaque after the conference.

Exhibition

The IDW '09 Exhibition, which will be held from December 9 through December 11, 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.

December 9: 12:00 – 18:00

December 10: 10:00 – 18:00

December 11: 10:00 – 14:00

IDW Best Paper Award

This award will go to the most outstanding paper selected from those presented at IDW '09.

The 2009 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 '09 poster presentation.

The 2009 award winners will be announced on the IDW website: <http://www.idw.ne.jp/award.html>

GENERAL INFORMATION

SPONSORSHIP

IDW '09 is sponsored by the Institute of Image Information and Television Engineers (ITE) and the Society for Information Display (SID).

CONFERENCE SITE

World Convention Center Summit
Hamayama, Yamazaki-cho, Miyazaki, Miyazaki 880-8545, Japan

ON-SITE SECRETARIAT

Telephone and fax machines for IDW '09 use will be temporarily set up in the secretariat room (ORCHARD Room, 2F) at the World Convention Center Summit (December 8-11).

Phone/Fax: +81-985-21-1105

BANQUET

A buffet-style banquet will be held on December 9 from 19:30 to 21:30 in the TENZUI Room (4F). 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 December 8 from 18:00 to 20:00 in the FOUNTAIN Room (2F). 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 or a memory, if there is an unexpectedly large number of on-site registrations. Advance registration is strongly recommended.

Registration Fees

The registration fee for IDW '09 includes admission to the conference and CD-ROM of the proceedings. The proceedings may also be purchased in book format, on a USB flash drive or SD card, if you have registered and paid by November 6 (Japan Standard Time). Details are shown in the pullout.

| | Paid by Nov. 6 | After Nov. 6 |
|-------------------------------------|----------------|--------------|
| 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, the membership fee will be subsidized by IDW '09 committee.

See <http://www.idw.ne.jp/> for more information.

*** Student ID is required.

Please note that the reduced registration fee must be paid by November 6. The full fee will be charged for payments made later than November 6. 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 |
| Airmail after the conference | ¥ 15,000 |
| Domestic mail after the conference | ¥ 10,000 |

*Additional sets of Book and CD-ROM can be selected only by those applying with payment by November 6.

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 27, 2009.

(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 27, 2009.

IDW '09 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 (VISA or MasterCard)

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:

December 8 (Tue.) 17:00 – 20:00

December 9 (Wed.) 8:00 – 18:00

December 10 (Thu.) 8:00 – 18:00

December 11 (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 checks are not accepted. Payment by cash is recommended.

Cancellation Policy

Refunds for registration, banquet, additional sets of proceedings etc. will be made upon receipt by IDW '09 secretariat of written cancellation by **November 6**. For cancellations received after November 6 or no-shows, refunds will not be made. However, after IDW '09 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 '09 due to infectious disease and other unavoidable factors, we will substitute the IDW with the mail delivery of the '09 proceedings at a later date to all those who have registered for participation.

INQUIRIES

IDW '09 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

ACADEMIC SUPPORTING ORGANIZATIONS

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

Funds for the conference are furnished in part by the following organizations:

- Grant-in-Aid for Scientific Research (KAKENHI: 2062005) from MEXT
- Miyazaki Visitors and Convention Bureau (Miyazaki Prefectural Government)
- National Institute of Information and Communications Technology International Exchange Program
- The Asahi Glass Foundation
- The Telecommunications Advancement Foundation

Please keep an eye on the website (<http://www.idw.ne.jp/>) for latest information.

SID 2010

International Symposium, Seminar and Exhibition
May 23–28, 2010

Seattle, Washington, USA

HOTEL AND TRAVEL INFORMATION

ACCOMMODATIONS

JTB Corp. (JTB) 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
Yokohama Convention Center

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

JAPAN RAIL PASS AND JR KYUSHU RAIL PASS

Japan Rail (JR) provides the following economical passes for some overseas travelers. Because purchase in Japan and usage conditions are restricted, please contact your travel agency prior to your trip.

- (1) The JAPAN RAIL PASS is the most economical way to travel throughout Japan by rail and JR buses.
- (2) The JR KYUSHU RAIL PASS is an economical and flexible rail pass to travel throughout Kyushu island.

Japan Rail Pass: <http://www.japanrailpass.net/>

JR Kyushu Rail Pass: http://www.jrkyushu.co.jp/english/kyushu_railpass.html

CLIMATE

The average temperature in Miyazaki during the period is around 11°C, with temperatures of 15°C in the daytime and 6°C at night on average.

IDW '10

The 17th International Display Workshops
December 1-3, 2010

Fukuoka International Congress Center
Fukuoka, Japan

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

MIYAZAKI CITY

Miyazaki city is located in the South Eastern corner of the island of Kyushu (the Southernmost of the four main islands of Japan). The city has a total area of approximately 596 square kilometers, and a population of 368,735 people. In the center of a city, the vast stretch of the Miyazaki Plain is formed by the eastward-flowing Oyodo River, which flows into the sea of Hyuga from the Kyushu mountain range. The eastern coastline has a series of white sand and green pine zones, and the twisting coastline lies against the backdrop of overhanging mountains and Aoshima Island. The city has a year-round warm climate with a relaxed tropical environment due to the influence of warm currents from the Pacific Ocean. Miyazaki plays a prominent role in Japanese mythology, as it is believed to be the home of the Gods who created Japan. There are many traditional places of Hyuga mythology in the city such as the Miyazaki Shrine, Aoshima Shrine, Eda Shrine and Misogi Pond.

In Miyazaki city, many shops offer a variety of regional specialties from Miyazaki Prefecture. Jidori-momoyaki is a delicious char-grilled chicken using only all-natural Miyazaki chickens. Lettuce-maki is sushi rolls of Miyazaki origin, which are made by rolling together shrimp, lettuce and mayonnaise in rice and seaweed. Shochu is a very popular alcoholic drink made from sweet potato, buckwheat, wheat or corn. There are many fresh and sweet fruits, such as Hyuganatu Orange, Mango and Kinkan Orange. In the downtown area, the main transportation facilities are buses and taxis. The major bus routes start from the JR Miyazaki station or the Miyakoh City bus center, which is located near the JR Minami-Miyazaki station.

PLACES OF INTEREST

The Nichinan Coastline

From ancient times the Nichinan Coastline was known for its long sweep of scenic coastlines, which are famed as a most popular destination for honeymooners. As you drive along this breathtaking coastal road with the blue sky and horizon stretching out before you, you'll realize you really are in a tropical paradise. Take some time to stop and smell the flowers at the Horikiri Pass, and view the "Devil's Washboard" rocks of Aoshima Island. Aoshima Island is a small island with a circumference of only 1.5 km. It is surrounded by a rock formation, created by the crashing waves, known as the "Devil's Washboard". There is also a shrine on the Island that attracts tourists from home and abroad.

Phoenix Seagaia Resort

Phoenix Seagaia Resort is Japan's first large-scale international resort facilities on the Hitotsuba Coast. The land area consists of more than 700 hectares, complete with meeting space for up to 5000 persons, 4 comfortable resort hotels, a golf course, tennis court and even a natural hot spring. In the very center of the international Phoenix Seagaia Resort, a 154-meter tower skyscraper hotel dominates the landscape (Sheraton Grande Ocean Resort). You can enjoy a magnificent view of the Pacific Ocean from all rooms.

Miyazaki Pref. Museum

Miyazaki Pref. Museum was established in 1951. This is a place where you can experience the history and beauty of Miyazaki. In the grounds, a replica of an ordinary 19th Century style house has been constructed.

Aya Town

Aya Town is bordered on the west by Miyazaki city, 20 km away from the city center. This green mountain town has Japan's largest evergreen forest, which consists of evergreen trees such as oaks and camellias. Shoyo-Otsuribashi, which crosses an evergreen-gulch is one of the longest suspension bridges in Japan, 142-meter high and 250-meter long. Shusen-no-Mori is a theme park based on traditional craft and brewing; you can try your hand at traditional Japanese industrial arts, and sample shochu, wine, and local beer.

MIYAZAKI INFORMATION

For more information please refer to the following web sites.

Miyazaki Prefecture:

<http://www.kanko-miyazaki.jp/Language/english/>

Phoenix Seagaia Resort:

<http://www.seagaia.co.jp/english/guidance/>

EVENING GET-TOGETHER WITH WINE

Tuesday, December 8, 2009

18:00–20:00

Room "FOUNTAIN" (2F)

World Convention Center Summit

(Sponsored by Merck Ltd., Japan)

See page 9 for details

BANQUET

Wednesday, December 9, 2009

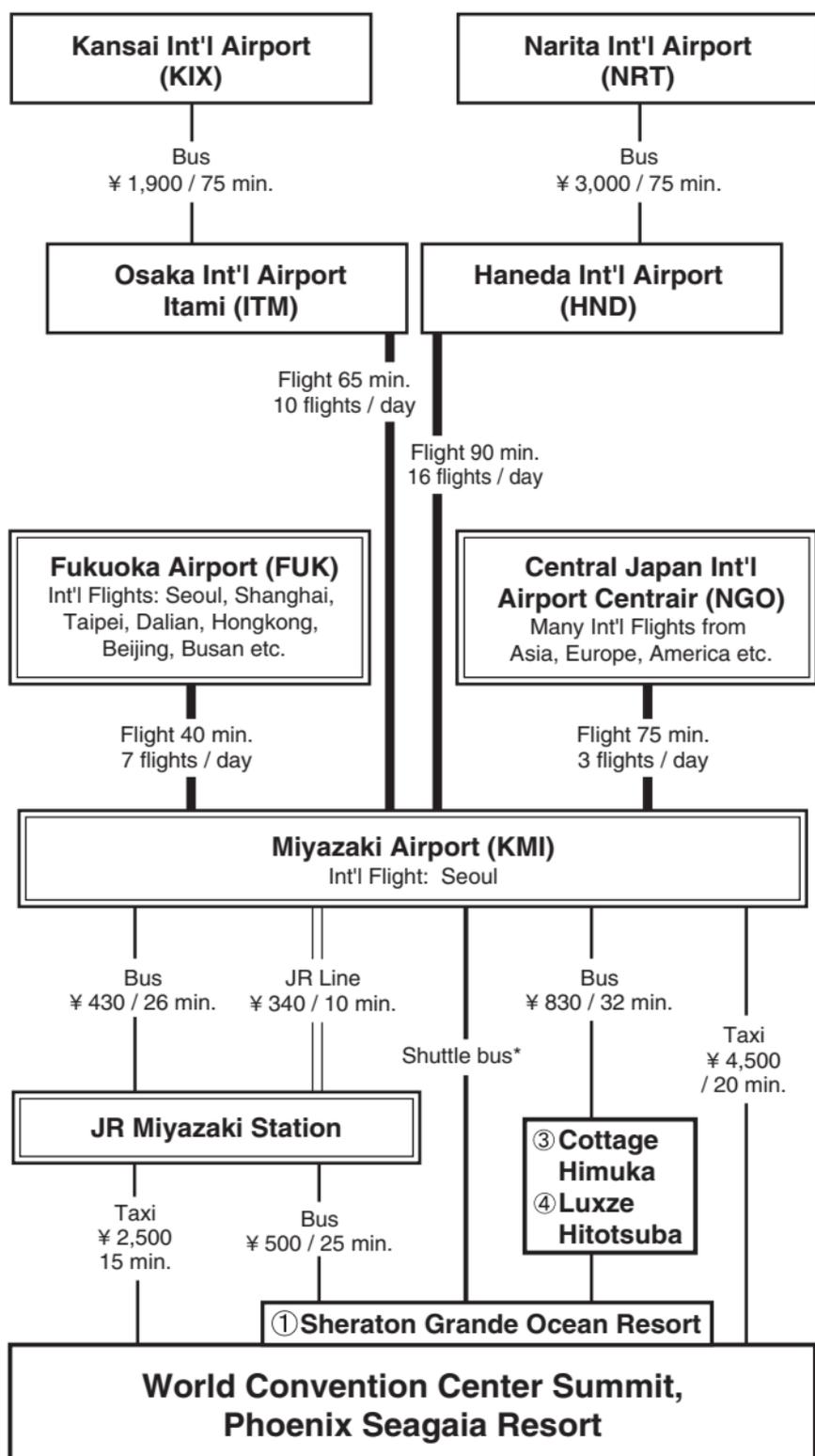
19:30–21:30

Room "TENZUI" (4F)

World Convention Center Summit

See page 9 for details

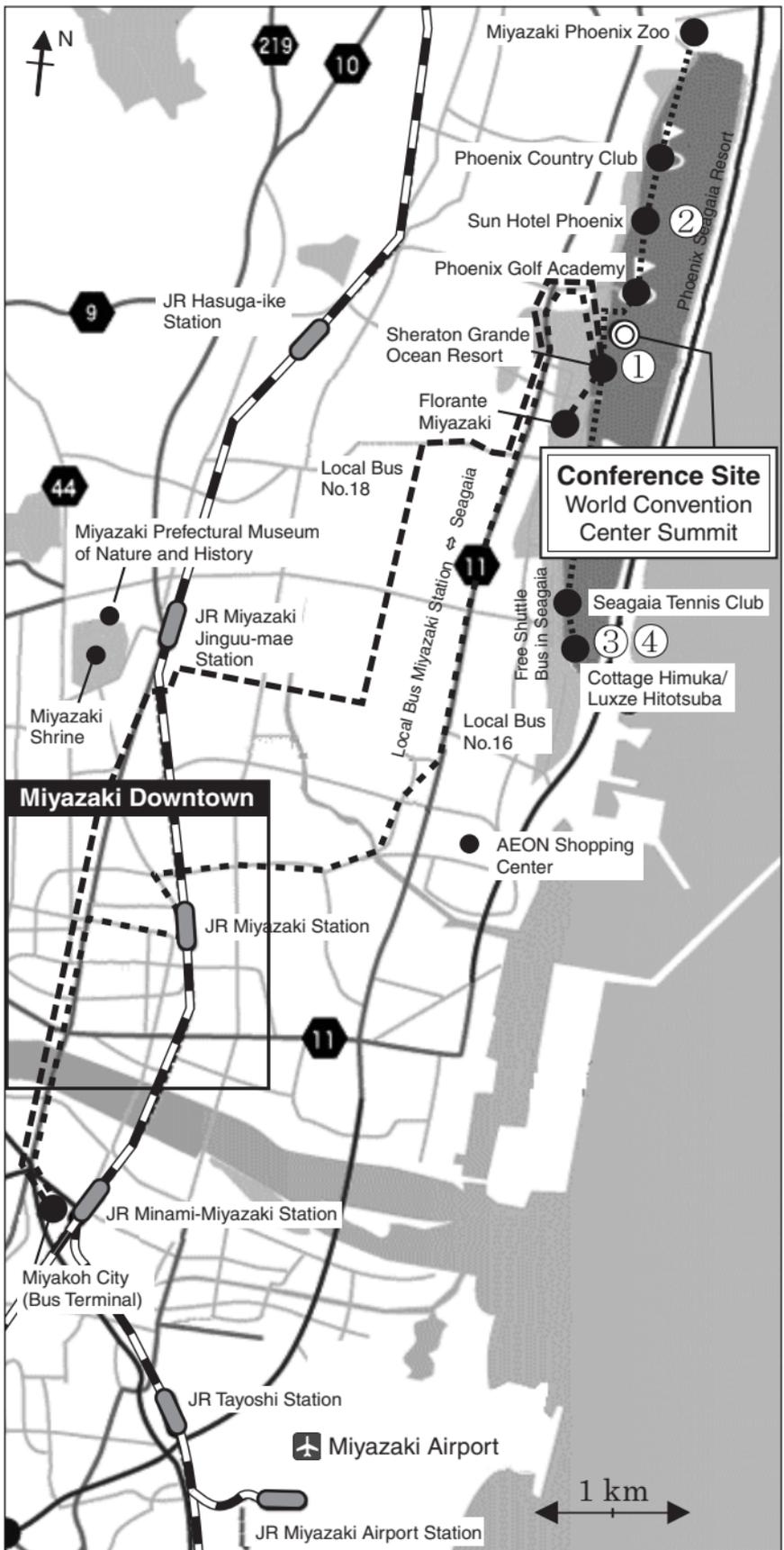
Access to Conference Site



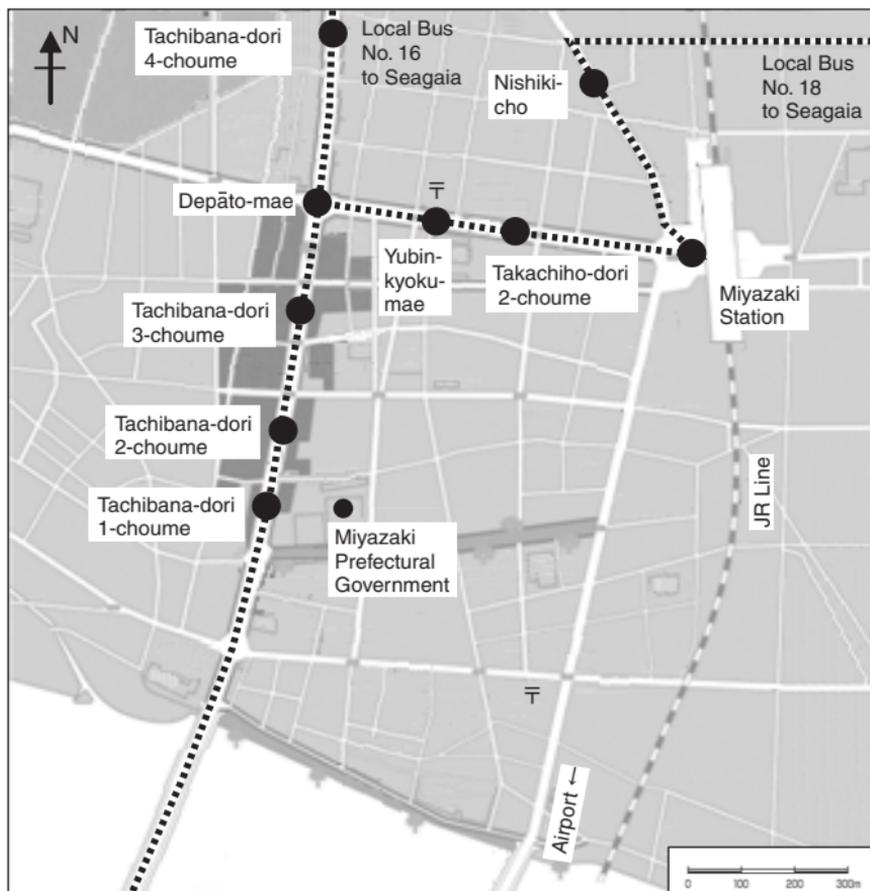
*Schedule will be announced on <http://www.idw.ne.jp/> in November.
Information of this page may be changed. Please confirm the details in each company.

(as of October 31, 2009)

Conference Site



Miyazaki Downtown



Buses from Miyazaki Airport

To Conference Site

Local Bus: Gate-4

Buses from Miyazaki Downtown (Tachibana-dori)

To Conference Site

No. **16**, No. **18**

To Miyazaki Airport



Buses from Conference Site

To Miyazaki Downtown

No. **16**, No. **18**

To Miyazaki Airport



Chartered buses between the Airport and the Conference Site will be made available by the IDW Committee.

Hotel List (Phone Number)

--- Phoenix Seagaia Resort ---

- ① Sheraton Grande Ocean Resort (+81-985-21-1133)
- ② Sun Hotel Phoenix (+81-985-21-1313)
- ③ Cottage Himuka (+81-985-21-1333)
- ④ Luxze Hitotsuba (+81-985-21-1333)

There are free shuttle buses running in the Seagaia Resort.

--- Miyazaki Downtown ---

There are several hotels along Tachibana-dori street, but the hotels in Seagaia Resort are strongly recommended because of easy access to the conference site.

Plenary Sessions

“Promising New Technologies and Markets”

Wednesday, December 9

9:30 - 9:40

TENZUI

Opening

Master of Ceremony: K. Betsui, Executive Chair, Hitachi, Japan

Opening Remarks

9:30

*Y. Yamamoto, General Chair, Sharp, Japan
M. Omodani, Program Chair, Tokai Univ., Japan*

9:40 - 11:00

TENZUI

Keynote Addresses

Chair: M. Omodani, Program Chair, Tokai Univ., Japan
Co-Chair: Y. Yamamoto, General Chair, Sharp, Japan

Keynote Address - 1 Paradigm Shift in Books and Newspapers by Electronic Media

9:40

*S. Furukawa
Keio Univ., Japan*

An era of electronic books is expected to begin shortly. The popularization of electronic books has begun already after Amazon started marketing their e-book “Kindle” in 2007. Electronic books could become a major media for reading books, magazines, comics, newspapers and all kinds of printed material, which have been dominated by Gutenberg’s press printing technologies. This paradigm shift cannot be avoided, especially in the field of books and newspapers.

Keynote Address - 2 Towards 3D Display and Multisensory Interfaces Based on Human Perceptual and Cognitive Mechanisms

10:20

*H. Ando
NICT, Japan*

The paper discusses multi-view 3D displays and multisensory interfaces which can be more natural and realistic to humans. Our investigation on human perceptual and cognitive mechanisms using psychophysical and brain activity imaging methods is also described to explore more human-oriented information and communication technologies in the future.

11:10 - 12:10

TENZUI

Invited Addresses

Chair: R. Hattori, Program Vice-Chair, Kyushu Univ., Japan
Co-Chair: H. Mori, Program Vice-Chair, FUJIFILM, Japan

**Invited Address - 1 Trends and Future of e-Paper Technologies
11:10**

J. M. Kim
Samsung Elect., Korea

Today's in this world of highly informative society, the customer requirements for display device is ever more demanding. Recently introduced e-paper technology, getting momentum on the step towards commercializations have to meet such demands in many aspects. In this talk, we will address challenging issues at hand and suggest some of the most proper solutions.

**Invited Address - 2 Intelligent Display Systems for Future
11:40 Automobiles**

S. Kurikawa
Denso, Japan

Following electronic application on automobile, information given to driver is increasing and also to wider range. In order to improve safety, assurance, comfort and convenience, it is important to develop in-vehicle display system that will not just display the information but will convey in easy to understand manner.

----- Lunch -----

Workshop on LC Science and Technologies

Wednesday, December 9

13:20 - 16:20

3F Foyer

Poster LCTp1: Novel Materials

LCTp1 - 1 **Abnormal Molecular Orientation of Chemically Linked Rod - Disc Mesogenic LC under Vertical Electric Field**

*J. H. Jung, S.-K. Park, M. Chae, I. Y. Cho, M. S. Kim,
E. J. Jeon, D. W. Kwon, K.-U. Jeong, S. H. Lee*
Chonbuk Nat. Univ., Korea

Molecular orientation of a rod-disc liquid crystal (LC) molecule (RD12) was investigated under the vertical AC fields. Upon varying electric fields from 0 V to a certain voltage, it was found that RD12 was oriented with two-steps. Rod mesogen having a higher dipole interaction first aligned parallel to an electric field. After the frustration and stabilization of rod mesogens, disc mesogens oriented parallel to an electric field.

LCTp1 - 2 **The Effect of Aligned LC in the Electrolyte for Efficiency Improvement on Dye-Sensitized Solar Cell**

H. Kim, S.-H. Jin^{}, G.-D. Lee*
Dong-A Univ., Korea
^{}Pusan Nat. Univ., Korea*

We report a new strategy for efficiency improvement of electron transfer which is used aligned the liquid crystal by applying voltage in polymer electrolyte on a quasi solid-state dye-sensitized solar cell.

LCTp1 - 3 **Bistable Cholesteric LCD with Self-Assembled Nano-Particles**

Y. Hung, C. Huang, S. Jeng^{}, S. Hwang*
Nat. United Univ., Taiwan
^{}Nat. Chiao Tung Univ., Taiwan*

A novel broadband bistable cholesteric liquid crystal display is demonstrated by doping polyhedral oligomeric silsesquioxane (POSS). The multi-domain planar CLC structure, which presents the white appearance in the planar state, can be easily achieved.

LCTp1 - 4 Effect of CNTs on the Electro-Optical Properties of the VA LC Cells*C.-Y. Huang, P.-Y. Chiou, Y.-J. Huang**Nat. Changhua Univ. of Education, Taiwan*

We investigate electro-optical properties of the CNT-doped VA LC cells. When the CNT concentration is low, the LCs and CNTs form a guest host system; When the CNT concentration is high, the CNTs become entangled networks, impeding the LC flow. The CNTs markedly decrease the response time of the cell.

LCTp1 - 5L Analysis on Solubility of Functionalized Carbon Nanotubes in LC Using the Flory-Huggins Theory*Y. J. Huang, Y. G. Fuh**Nat. Cheng Kung Univ., Taiwan*

An analytic study on dissolution between 5CB liquid crystal and Maleic anhydride grafted single walled carbon nanotube using the Flory-Huggins model is presented. At room temperature, this functionalized carbon nanotube can spontaneously dissolve in 5CB when the grafting ratio of the MA groups reaches up to 20 atomic wt%.

LCTp1 - 6L Improvement of Dynamic Response Time Using Pentacene Doped Negative Anisotropy Nematic LC in Vertical Alignment Cell*H. K. Shin, J.-H. Seo, T.-H. Yoon, J. C. Kim**Pusan Nat. Univ., Korea*

We propose a vertical alignment cell with a pentacene doped negative anisotropy nematic liquid crystal. The device shows a lower operating voltage and faster response time compared to a vertical alignment cell without pentacene. Fast response time is because pentacene lowers the dielectric response, which in turn reduces the rotational viscosity.

LCT

13:20 - 16:20

3F Foyer

Poster LCTp2: Novel Display Applications**LCTp2 - 1 Enhancement of the Switching Speed of a Refractive Microlens Array Based on Nematic LCs***Y. W. Kim, S. H. Lee, J. Jeong, J.-H. Kim, C.-J. Yu**Hanyang Univ., Korea*

We demonstrate a nematic liquid crystal (NLC) microlens array with an enhanced switching speed. In the refractive NLC microlens with polarization-insensitivity, the switching speed was improved by polymerization of reactive mesogen mixed with alignment layer.

LCTp2 - 2 Optimization of LC Display for Optical Addressing of the ORW E-Paper

*A. Murauski, Q. Yu, T. Du, L. Yao, V. Chigrinov,
H. S. Kwok*

Hong Kong Univ. of S&T, Hong Kong

For optical addressing ORW e-paper key role plays quality of polarization of input light. The best device for changing polarization direction is LC display without output polarizer. Different types of LC displays are tested for this purpose. Possible applications and necessary modifications for existing LCD are also discussed.

LCTp2 - 3 Wavelength-Selective Reflection of Cholesteric LCs Depending on Temperature and Dopant Concentration

K.-S. Bae, Y.-J. Jang, C.-J. Yu, J.-H. Kim

Hanyang Univ., Korea

We report temperature-dependent color variation in cholesteric liquid crystals with different concentrations of chiral dopant. The reflected color, corresponding to the chiral pitch, is governed by not only molecular thermodynamics but also temperature-dependent solubility of chiral dopant.

LCTp2 - 4 New Preparation Method of Coatable Polarizer Utilizing Photocurable Organic-Based Lyotropic Chromonic LC Solution

Y.-J. Bae, K.-U. Jeong, S.-H. Shin^{}, M.-H. Lee*

Univ. of Chonbuk Nat., Korea

^{}Korea Inst. of Ind. Tech., Korea*

We report a new fabrication method of coatable polarizer by using lyotropic chromonic liquid crystals dissolved in photocurable ionic monomer solution. The lyotropic solution was shear-coated on a substrate, and UV-cured to obtain a thin film polarizer. The new method provided various advantages which will be covered in the presentation.

13:20 - 16:20

3F Foyer

Poster LCTp3: Image Sticking and Measurement Method

LCTp3 - 1 A Measurement of Image Sticking in LCDs

Y. M. Chu, H.-H. Sung, L. M. Chen, T. Miyairi, T. Mori*,
Y. C. Lan*

Chisso Panel Tech., Taiwan

**Chisso, Japan*

This paper presented a quantitative method for image sticking (IS) evaluation, which is free of backlight luminance variance factor, and demonstrates slight IS variance caused by process variation can be detected and distinguished by our developed image sticking system.

LCTp3 - 2 Line Image Sticking Analysis on a-Si TFT-LCD by Changing the Rubbing Directions and DC Bias

P. Zhang, H. Zhao, J. You, L. Huangfu, J. Lee

BOE OptoElect. Tech., China

We made a study on the line image sticking of a-Si TFT LCD in this paper. It was resulted that the location of line image sticking was related to the rubbing directions and DC bias polarity.

LCTp3 - 3 Photo-Leakage Current Impact on Image Sticking

H. Zhao, J. You, J.-I. Ryu, L. Huangfu, J. Lee

BOE OptoElect. Tech., China

Photo-leakage current impact on image sticking was discussed in this paper. Photo-leakage current difference between black and white blocks played a more important role on image sticking compared with residual DC voltage in our study.

LCTp3 - 4 A Novel Method to Determine the Optical Parameters of a Twisted Nematic LC Cell and a EWV Film

R.-B. Li, K.-H. Yang, W.-C. Chen*

HannStar Display, Taiwan

**Nat. Chiao Tung Univ., Taiwan*

We have developed a novel method to determine optical parameters of a TN-LCD cell by iterative fittings between theoretical retardation values and experimental data. We also use similar procedures to analyze the EWV film. The derived optical parameters are essential for panel designers to obtain optical simulations of better accuracy.

LCT

LCTp3 - 5 Refractive Index Measurement Method for LC Materials in MMW Region by Using CPW Substrate

*T. Nose, E. Birukawa, Y. Sato, R. Ito, M. Honma
Akita Pref. Univ., Japan*

Novel measurement method of refractive indices of LC materials in millimeter-wave (MMW) region is proposed to reduce the quantity of test sample extremely by using CPW which is known as an excellent planar type waveguide.

LCTp3 - 6 Precise Measurement of the LC Parameters Considering the Multiple Interferences in the LC Cell for the Quantitative Evaluation of LC Devices

*T. Ishinabe, Y. Ohno, T. Miyashita, T. Uchida
Tohoku Univ., Japan*

A simple and highly accurate measurement method was devised for the refractive indices, alignment distribution and surface polar anchoring strength by considering the multiple interferences in the LC cell. The accurate measurement based on the new interference-included 2×2 matrix method resulted in the establishment of quantitative evaluation of LC devices.

LCTp3 - 7 High Precision Measurement Method for Threshold Voltage, Elastic and Dielectric Constants Ratio of LC Materials

*Y. Chiba, Y. Ohno, T. Ishinabe, T. Miyashita, T. Uchida
Tohoku Univ., Japan*

We have devised a high-precision method of measuring the threshold voltage and the elastic and dielectric constants ratios of liquid-crystal materials. We obtained these parameters from measuring the alignment distribution in the on state. We confirmed the validity of this method through measurements of several LC cells with different gaps.

13:20 - 16:20

3F Foyer

Poster LCTp4: Display Mode and Analysis

LCTp4 - 1 Study on the Homeotropic-Planar Transition of Cholesteric LCs

*C. Nakcho, L. Heekeun, J. Taesung, F. Takeshita,
L. Soonkwon, S. Sungtae
Samsung Elect., Korea*

We investigate the transition time of cholesteric liquid crystals during applying or removing voltage by simulating 2DIMOS. We could find that Polar anchoring energy of the surface affect on the Homeotropic-Planar Transition time.

LCTp4 - 2 Analysis on Transient Response Times of Bend Aligned Nematic LC Cell

*H. Shidara, T. Kobayashi, T. Takahashi, S. Saito
Kogakuin Univ., Japan*

In this paper, theoretical expression for transient response times of a bend aligned nematic liquid crystal cell are derived taking account of the bias voltage, the pre-tilt angle, the flow effect and polymer stabilization coefficient as well as the applied voltage.

LCTp4 - 3 Analysis of Polymerization of Monomer Suspended in LCD

*R. Kamoto
Micro Analysis Lab., Japan*

It has tried to analyze the monomer suspended in LCD cell dividing cross sectional direction, bulk liquid crystal (LC) layer and interface LC/PI film layer, and investigated the polymerization of monomer, the residual monomer component. The monomer suspended in LC is much condensed at the interface between LC/PI alignment film existing a little in bulk layer before UV curing.

LCTp4 - 4 Withdrawn**LCTp4 - 5L Reverse Mode Polymer Dispersed LCs with Twisted Orientation**

*R. Yamaguchi, L. Xiong
Akita Univ., Japan*

We employ twisted orientations in reverse mode polymer dispersed liquid crystal films which consist of a nematic LC with a positive dielectric constant and a UV curable LC. A contrast ratio under an unpolarized incident light is improved and the transparent off-state is haze free for all viewing angles.

LCTp4 - 6L Selective Switching of Bistable Chiral Splay Nematic LCD by Distorted Electric Fields

*C. G. Jhun, K. Kim, U.-S. Jung, J.-H. Moon, S.-B. Kwon,
J. H. Lee*, J. C. Kim*
Hoseo Univ., Korea
Pusan Nat. Univ., Korea

Switching properties of liquid crystal displays (LCDs) is strongly coupled with the dielectric interaction. In this paper, we demonstrate the selective transition of the bistable chiral splay nematic LCD by distorted electric fields. The selective switching occurs during the twist-to-splay transition process under combinations of vertical and horizontal electric fields.

LCTp4 - 7L Optimization of the Electrode Structure for Improving Transmittance in FFS Mode TFT-LCD

*J.-J. Huang, H.-P. Chiu, H.-T. Wu, H.-M. Hu, S.-F. Chen
ChungHwa Picture Tubes, Taiwan*

The FFS mode was known as wide viewing angle and less color shift, but the drawback was less transmittance than TN mode. In this paper, we present an optimized design of the pixel electrode structure in FFS Mode. The novel structure with high transmittance and excellent optical characteristics was proposed.

LCTp4 - 8L Bend-Mode LCDs Stabilized by Patterned Microstructure Using Microcontact Printing

H. Kikuchi, T. Mitsumatsu^{}, H. Sato^{**}, K. Takizawa^{*},
H. Fujikake^{**}
NICT, Japan
^{*}Seikei Univ., Japan
^{**}NHK, Japan*

We have investigated two types of novel pi-cell using patterned microstructure of high-pretitl domain fabricated by microcontact printing method. The pi-cell with hybrid-alignment-nematic domain or vertical-alignment domain has excellent characteristics, such as improvement in the speed of initial transition and stable bend orientation after initial transition.

LCTp4 - 9L A Ferroelectric LCD with Low Operation Voltage in a Pixel-Confined Geometry

*J.-H. Na, C. Keum, Y.-J. Na, S.-D. Lee
Seoul Nat. Univ., Korea*

We report on a low driving voltage VA-DHFLC display by using micro-confinement channels structure. Particularly, the alignment of FLCs is extremely stable in the confinement structure, so that the excellent electro-optic performance was obtained in the regime of high electric field.

LCTp4 - 10L Light Leakage Analysis for High Picture Quality FFS LCD-TVs

*X. Xu, H.-J. Park, Y. Song, W. Li, T.-Y. Eom, L. Huangfu,
J.-Y. Lee
Beijing BOE OptoElect. Tech., China*

We investigated the light leakage in terms of materials and process with FFS LCD-TVs. We found light leakage is caused by scattering of L/C, C/F mainly and also depolarization by process of film and rubbing. The oblique light leakage can be much more improved by using new compensation film.

13:20 - 16:20

3F Foyer

Poster LCTp5: High Performance LCDs**LCTp5 - 1 High Optical Performance with Optimum Compensated Film on Right-Rotated TN LCDs**

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

In the past, rightrotated TN had worse CR than leftrotated when we used popularly compensated film (EWW). In this paper, we utilized optimum compensation film and modified offstate voltage to reach high CR on rightrotated TN.

LCTp5 - 2 Improvement in Viewing Angle Properties of CMVA-LCDs Using Uniaxial C- and A-Plates

S. Ogumi, M. Kurokawa, Y. Iimura
Tokyo Univ. of A&T, Japan

For improving the viewing angle properties of circular-polarizer-type MVA-LCD (CMVA-LCDs), the detailed studies of optical compensation have been done by using negative-type uniaxial A and C-plates. The optimum conditions are derived from the theoretical considerations, and the results are confirmed by the computer simulations and experimental results. From the study, negative-type uniaxial compensation films are proved to be useful for achieving high-performance CMVA-LCDs with low power consumption.

LCTp5 - 3 Twisted-Nematic LCDs with Small Grayscale Inversion and Wide Viewing Angle

C.-H. Lin
Nat. Sun Yat-Sen Univ., Taiwan

This work proposes a twisted-nematic liquid-crystal display (TN-LCD) with a small grayscale inversion and wide viewing angle. The bisector effect of the TN-LC is used to improve the grayscale inversion of TN-LCDs. A viewing angle of over the entire 80° viewing cone of the proposed TN-LCD is demonstrated.

LCTp5 - 4 Required Characteristics of Lamp Response Time to Improve MPRT

J. W. Hong, B. S. Min, H. W. Jeon, D. H. Lee, K. D. Kim,
M. C. Jun, I. J. Chung
LG Display, Korea

The EEFL (External Electrode Fluorescent Lamp) and CCFL (Cold Cathode Fluorescent Lamp) are the most popular backlight source for a LCD (Liquid Crystal Display). The image quality of LCD TV, MPRT (Motion Picture Response Time) could be improved by changing materials of the phosphor that helps reducing the decay time at the moment of lamp on/off.

LCTp5 - 5 The MPRT Uniformity Improvement by the Block Division of the Backlight System

*B. S. Min, J. W. Hong, H. W. Jeon, D. H. Lee, K. D. Kim,
M. C. Jun, I. J. Chung*

LG Display, Korea

The Optimized backlight block divisions can improve the image quality of LCD TV by the M.P.R.T (Motion Picture Response Time) Uniformity.

LCTp5 - 6 The Relationships between the Performances of RTN-LCDs and the Properties of LC Materials

K. Takatoh, N. Motoishi, M. Nishitateno, M. Akimoto

Tokyo Univ. of Sci. Yamaguchi, Japan

Reverse TN-LCDs with LC materials of the chirality opposite to twist direction determined by the rubbing directions show drastically low driving voltage. It was confirmed that the small K_{11} and K_{33} values can stabilize RTN-LCDs and that the small K_{33} values can also realize the low driving voltage.

13:20 - 16:20

3F Foyer

Poster LCTp6: Polymer Stabilized LCDs

LCTp6 - 1 Improved Polymer Sustained Alignment Technology for VA Mode LCD

C.-W. Su, J.-T. Lien, T.-Y. Li, C.-H. Liu

Chunghwa Picture Tubes, Taiwan

We have improved polymer sustained alignment (PSA) technology without PI process for MVA-LCD which is called polyimide-less (PI-less). The PI-less is better than PSA for TFT-LCD manufacture process because we don't need fabrication equipment. Finally, the PI-less has high contrast ratio, high brightness and fast response (less than 20ms).

LCTp6 - 2 A Multistage UV-Curing Method of Polymeric Monomers to Improve Brightness of Bump-Less VA LCD

*J.-T. Lian, C.-W. Su, H.-C. Hung, T.-Y. Li, C.-I Chiang,
C.-S. Liu, C.-L. Tsou*

Chunghwa Picture Tubes, Taiwan

We used a Multistage UV-Curing method to eliminate black patterns on Bump-Less VA LCD panel displaying white picture. The static contrast ratio of Bump-Less VA LCD is 4800:1 and higher than normal VA LCD.

LCTp6 - 3 Surface Controlled 8-Domain Patterned Vertical Alignment Mode with Reactive Mesogen

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

Hanyang Univ., Korea

We propose the 8-domain patterned vertical alignment (PVA) mode with UV curable reactive mesogen (RM). The RM mixed with alignment layer alter pretilt angle according to the applied voltage through UV exposure and can generate the 8-domain by differentiating the pretilt angle spatially in pixel area.

LCTp6 - 4 EO Characteristics of Polymer Stabilized Vertically Aligned (PSVA)-FLC Cell Using FLC Materials with/without SmA Phase

T. Narata, T. Murata, S. Saito, T. Takahashi

Kogakuin Univ., Japan

Differences in electro-optical characteristics of PSVA-FLC cells are investigated and discussed for cases when using two types of FLC materials with/without SmA phase, and carrying out the polymer stabilization under the SmC* phase or SmA phase, and etc.

LCTp6 - 5 The PSLC Light Shutter for Transmissive Flexible Display

*J. W. Lee, M. Jamil, A. Farzana, S. W. Park, H. Y. Yoon,
Y. J. Jeon*

Konkuk Univ., Korea

We made the fabrication of lined polymer walls using monomer and photo mask attaching release tape. These walls lead liquid crystal (LC), liquid crystal monomer (LCM) and dichroic dye to align. Upon lifting photo mask off, ITO glass covers that. Inserting LC, LCM and dichroic dye by capillary action makes a PSLC.

LCT

13:20 - 16:20

3F Foyer

Poster LCTp7: Novel LCD Modes

LCTp7 - 1 Advanced Pixel Electrode Structure for High Contrast Ratio in the IPS Mode

*H. S. Cho, S. C. Jeong, J. U. Kwon, D. W. Kang,
B. C. Kim, S. J. Yu*

LG Display, Korea

We investigated electro-optical characteristics of the pixel electrode structure with double layers of MoTi/ITO as well as including that of the single layer with ITO or MoTi. It is found that the contrast ratio of the pixel electrode structure with MoTi/ITO was presented about 11.2% higher than that of ITO electrode.

LCTp7 - 2 Preparation of Black-White Reflective LC Display with Two Color Reflective Layers*W.-S. Choi**Hoseo Univ., Korea*

Black-white reflective liquid crystal display with two color liquid crystal layers, the combination of yellow color liquid crystal and blue color liquid crystal, was prepared. The rubbing of cholesteric liquid crystal panel affects the brightness and color spectrum due to increase the planar domain texture. The CIE chromaticity coordinate of white is (0.31, 0.31).

LCTp7 - 3 Withdrawn**LCTp7 - 4 Twist Stabilization in Pi-Cell***K. Sawa^{*,**}, K. Suzuki^{**}, M. Akimoto^{**}, Y. Kato^{**},
K. Takato^{**}, S. Kobayashi^{**}**^{*}Keio Univ., Japan**^{**}Tokyo Univ. of Sci., Yamaguchi, Japan*

We provide a technique to stabilize π -twist state at 0 [V] by adjusting a intermediate pretilt angle and using a liquid crystal material that has an appropriate balance on elastic constants. The pretilt angle of the state would be lower than that of the No-bias bend state.

LCTp7 - 5 Electro-Optical Stability in a Flexible LCD with Adhesive Spacers under Bending Deformation*J.-H. Kang, K.-S. Bae, S.-W. Yi, J.-S. Choi^{*}, J.-H. Kim,
C.-J. Yu**Hanyang Univ., Korea**^{*}Hongik University, Korea*

We propose a structure of flexible liquid crystal displays fabricated with adhesive patterned spacers acting as spacer and glue. In this proposed structure, the stable electro-optic performances were obtained under bending deformation.

IDW Outstanding Poster Paper Award

This award will go to the most outstanding paper selected from those presented at IDW '09 poster presentation.

The 2009 award winners will be announced on the IDW website: <http://www.idw.ne.jp/award.html>

13:20 - 16:20

3F Foyer

Poster LCTp8: LC Alignment**LCTp8 - 1 Fabrication of Flexible LCD with LC Alignment and Tight Bonding by Surface Grooves**

E.-Y. Kim, I. Y. Han, Y.-J. Lee, J. S. Gwag^{}, J.-H. Kim*
Hanyang Univ., Korea
^{*}*Yeungnam Univ., Korea*

We propose a fabrication method for flexible liquid crystal display (LCD) using micro-sized grooves which are formed on UV curable polymer layer. The UV curable polymer layer with surface grooves carries out aligning the LC molecules uniformly and making tight bonding of top and bottom plastic substrate, simultaneously.

LCTp8 - 2 Tilted Orientation of Nematic LC on Aluminum Anodic Oxide Film

Y. Kobayashi, S. Todo, K. Imai, S. Saito, T. Takahashi
Kogakuin Univ., Japan

A new method to give the pre-tilt angle with the anodized aluminum film, the inorganic material, was proposed. The anodic oxidation was carried out in the flowing electrolytic solution. The tilted orientation was obtained in the nematic LC cell.

LCTp8 - 3 Comparison of Surface Characteristics on Alignment Films by Postbake Condition with NEXAFS

M. Kwak, H. Chung, H. Kwon, D. Han, Y. Yi, H. Jeon, S. Lee, C. Lee, S. Cha
LG Display, Korea

The polyimide properties by post-bake temperature was analyzed by NEXAFS. In the case of TN mode alignment film, C=C π^* peak state was detected dependent on temperature compare to IPS mode. It is explained by the difference of material properties in charge of side chain forming pre-tilt in TN mode.

LCTp8 - 4 Directional Property Change of Rubbed Polyimide Films upon the Rubbing Condition

K.-J. Kim, H.-M. Kwon^{}, S.-M. Lee^{*}, C.-G. Lee^{*}, M.-S. Kwak^{*}, B. Kim*
POSTECH, Korea
^{*}*LG Display, Korea*

The angle dependence NEXAFS spectra at C K-edge on the twisted nematic mode or in-plane switching mode PIs were measured to know the rubbing parameter dependency. As increasing the pile contact depth, the tilt angle α was linearly decreased but the stage speed dependency was irregular in both samples.

LCTp8 - 5 Fabrication of Bistable Surface and Control of Pre-Tilt Angle by Alignment Material Coating Using an Electro-Spray Method

*N. Endo, Y. Kudou, S. Saito, T. Takahashi
Kogakuin Univ., Japan*

An electro-spray method has been applied to coat the alignment material on the substrate surface in LCDs. The fabrication of bistable surface and the control of pre-tilt angle of LC cells have been tried by using this method.

LCTp8 - 6 Effects of LCD Fabrication Process after Rubbing on LC Alignment Film

*I. Hirose, T. Koganezawa, H. Ishii**
Japan Synchrotron Radiation Res. Inst., Japan
**Nissan Chem. Inds., Japan*

Effects of LCD fabrication process after rubbing on LC alignment film (rubbed polyimide film) were investigated by grazing incidence X-ray diffraction. It was found that crystallization of surface polymers are strongly affected by washing solvent and annealing temperature.

LCTp8 - 7 Orientation Characteristics of FLC on UV Curable LC Polymer Film Used as An Alignment Layer

*N. Kubota, T. Narita, Y. Oi, S. Saito, T. Takahashi
Kogakuin Univ., Japan*

A UV curable polymer layer is used as a pre-tilt controllable alignment film. The uniform orientation of FLC cell was tried to fabricate using the polymer layer. The experiments were carried out with two types of polymer films.

LCTp8 - 8 Formation of Bi-Stable Alignment Surface Using a Mixture of Two Kinds of Photo-Alignment Material Making LC Molecules Align to Distinctive Directions for Polarization Direction of UV Light

*K. Tsukada, T. Takahashi, S. Saito
Kogakuin Univ., Japan*

A novel method is proposed to form alternating striped patterns to be planar and mutually orthogonal to the neighboring patterns as a bi-stable anchoring substrate for LC molecules. A mixture of two kinds of photo-alignment materials based on the photo-dimerization reaction and the photo-dissociation reaction is used as an alignment material.

LCTp8 - 9 Advanced Photo-Alignment Method with Fast Response Time

*A. R. Yoon, Y.-K. Kim, Y.-J. Lee, S. I. Jo, S. W. Choi,
J. S. Gwag*, J.-H. Kim
Hanyang Univ., Korea
Yeungnam Univ., Korea

We propose an advanced photo alignment method for uniform liquid crystal alignment and fast response time with reactive mesogen which is mixed in alignment layer through double step UV exposure process.

LCTp8 - 10 Studies of Frictional Properties on VA Mode Alignment Films by Temperature Condition with Frictional Force Microscopy

*M. Kwak, H. Chung, H. Kwon, D. Han, Y. Yi, J. Jeon,
S. Lee, C. Lee, S. Cha
LG Display, Korea*

The friction characteristics of VA mode alignment film by temperature and rubbing conditions were studied with AFM/FFM. The total friction was high by the increase of the surface roughness. This was described by curved structure according to the potential. In rubbing condition, pre-tilt angle decreased depending on the rubbing strength.

LCTp8 - 11 Evaluation of the Temperature Dependence of Surface Polar Anchoring Strength of LC Devices

*Y. Yoshita, Y. Ohno, T. Ishinabe, T. Miyashita, T. Uchida
Tohoku Univ., Japan*

The surface anchoring strength of liquid crystals is an important parameter in evaluating their surface alignment properties. We used a new high-precision method for determining liquid crystal parameters and measured the temperature dependence of the polar anchoring strength on the surface of alignment layers to explain the surface phenomena.

LCTp8 - 12 Surface Azimuthal Anchoring Measurement Method Using Wedge LC Cell

*S. K. Hwang, J. H. Kwon, J. S. Gwag
Yeungnam Univ., Korea*

We present an advanced method finding an azimuthal anchoring by measuring optically cell thickness and twist angles simultaneously, using a wedge LC cell. The twist angle and cell thickness are measured by adopting the total intensity ratio method (TIRM) of the transmitted light at three arbitrary wavelength regions.

LCTp8 - 13 Molecular Orientational Ordering in 5CB Thin Film above T_c on Rubbed Polyimide Film*T. Koganezawa, I. Hirozawa, H. Ishii***Japan Synchrotron Radiation Res. Inst., Japan***Nissan Chem. Inds., Japan*

We have measured dependence of the 5CB molecular distribution in a thin layer aligned rubbed polyimide on temperature by means of GIXD. We found that the N-I transition occurs at a temperature higher than the bulk-T_c.

LCTp8 - 14 Simultaneous Determination of Anchoring Energy and Elastic Constants of Nematic LCs by Capacitance Measurement*K. Iwaya*, H. Naito**, H. Ichinose***,**M. Klasen-Memmer****, K. Tarumi*******Osaka Pref. Univ., Japan****The Res. Inst. for Molecular Elec. Devices, Japan*****Merck, Japan******Merck KGaA, Germany*

A method for the simultaneous determination of anchoring energy and elastic constants of nematic liquid crystals (NLCs) by measuring capacitance (C) of NLC cells as a function of voltage (V) is proposed. The applicability of the present method has been shown in Mix.A and MLC-2039 (Merck Ltd.).

LCTp8 - 15 Multi-Domain Alignment of LC on Polyimide Layers by Using Ion Beam Scanning Method*P. K. Son, S. W. Hwang, J. C. Kim, Y. T.-Hoon**Pusan Nat. Univ., Korea*

We propose a technique for multi-domain alignment of liquid crystal on polyimide layers through ion beam scanning that can be applied to the fabrication of liquid crystal displays with a large size. The turn-on time of a 4-domain IVA cell was 35% faster than that of patterned vertical alignment cell.

16:40 - 18:00**TENRAN****LCT1: High Performance LCDs (1)**

Chair: A. Kubono, Shizuoka Univ., Japan

Co-Chair: H. Wakemoto, TMD, Japan

LCT1 - 1: Invited Development of Super Hi-Vision Displays with High Picture Quality and Ultra High Definition

16:40

*M. Kanazawa**NHK, Japan*

Outlines of the Super Hi-Vision's specifications as well as the development of a high dynamic range projector as one example of its display capabilities are explained. The projector has a Super Hi-Vision resolution and a high dynamic range of around 1,100,000 to 1.

LCT1 - 2 Panel Bruising Suppression for a MVA Mode Display

17:05

*Y.-Y. Huang, H.-T. Yu**Chunghwa Picture Tubes, Taiwan*

Concerned bruising behavior for a MVA display equipped with embedded touch sensor after varied finger moving gestures has been effectively prohibited through realizing the relation between protrusion slope and its corresponding affective ratio.

LCT

LCT1 - 3 PI-Less Technology Development for Vertical Alignment TFT-LCD

17:25

*T.-Y. Li, C.-W. Su, J.-T. Lian, C.-I Chiang, M.-D. Chou, C.-H. Liu**Chunghwa Picture Tubes, Taiwan*

A novel cell process is called PI-less is developed. PI-less can eliminate the PI process and decrease UV exposing process. We have developed a large size MVA-LCD display in which the brightness can be increased 15%, the contrast ratio is over 1300:1. Besides, the response time still can be kept.

LCT1 - 4L Low-Voltage Driving TN-LCD with High Contrast Ratio

17:45

*M. Aimatsu, T. Ishinabe, T. Uchida, N. Watanabe***Tohoku Univ., Japan***Toppan Printing, Japan*

We analyzed the polarization shift inside twisted nematic liquid crystal display (TN-LCD) and clarified the S-shaped polarization shift on Poincaré sphere in black state was important to realize low-voltage driving TN-LCD. We realized high contrast ratio of 150000:1 with low driving voltage of 2.5V by optimization of optical compensation films.

Author Interviews

18:00 – 19:00

Thursday, December 10

10:40 - 12:15

TENRAN

LCT2: Advanced Blue Phase LC Technology

Chair: H. Fujikake, NHK, Japan
 Co-Chair: M. Ozaki, Osaka Univ., Japan

**LCT2 - 1: Invited Potential and Challenges of Optically Isotropic
 10:40 LCs for Display Applications**

H. Kikuchi
Kyushu Univ., Japan

The phase behavior and electro-optical Kerr effect of the optically isotropic liquid crystal composites including polymer-stabilized blue phases, which require no surface treatment for device fabrication, are presented. New LCD materials with anomalously large Kerr constant, more than 10⁻⁸ mV⁻² and fast response, less than sub-milli-second are developed.

**LCT2 - 2: Invited Mono-Domain Growth of LC Blue Phase and
 11:05 Its Application to Photonic and Display Devices**

K. Shirota, S. Kawata
RIKEN, Japan

We have developed a mono-domain liquid-crystalline blue phase with an extended temperature range by polymer-stabilization. After investigating the optical properties of this sample, we demonstrated the bandgap lasing at room temperature as an example of photonic application.

**LCT2 - 3: Invited Simulation Study of Cholesteric Blue Phases
 11:30 Under an Electric Field**

J. Fukuda^{}, M. Yoneya^{*}, H. Yokoyama^{*,**}*
^{*}*AIST, Japan*
^{**}*Kent State Univ., USA*

We carry out a numerical study based on a Landau-de Gennes theory to investigate how a cholesteric blue phase responds to an electric field. We find a distortion of the unit cell of blue phases, and the rearrangement of disclination lines.

LCT2 - 4 Withdrawn

LCT2 - 5L 11:55 Blue Phases Observed for a Bent-Core Molecule with Biaxial Nematic Phase

M. Lee, H. Higuchi^{}, K. Song, S.-W. Choi, H. Kikuchi^{*}*
Kyung Hee Univ., Korea
^{*}*Kyushu Univ., Japan*

We investigated the blue phases (BPs) observed for a bent-core molecule with biaxial nematic (N) phase doped with a small percentage of a highly twisting chiral additive. Employing the biaxial N mesogen as a host material, the observed temperature range of BPI was expanded to several 10 °C.

----- Lunch -----

LCT

13:20 - 14:50

TENRAN

LCT3: Emerging LC Materials

Chair: K. Ishikawa, Tokyo Inst. of Tech., Japan
 Co-Chair: A. Fujita, Chisso Petrochem., Japan

LCT3 - 1: 13:20 *Invited* Liquid Crystals for TFT Applications

*J. Hanna^{***}, H. Iino^{**}, K. Nakano^{*}*
^{*}*Tokyo Inst. of Tech., Japan*
^{**}*JST-CREST, Japan*

Liquid crystals, which have a structural feature of having an aromatic π -conjugate system and hydrocarbon chains, are utilized as an organic semiconductor for TFTs. Their unique properties give several advantages over non-liquid crystalline materials. In this talk, we discuss and demonstrate high potential of liquid crystals as a TFT material.

LCT3 - 2: 13:45 *Invited* Negative Dispersion Reactive Mesogen Materials for Optical Films

O. Parri, R. Harding^{}, K. Adlem, P. Saxton,*
K. Skjonnemand, D. Wilkes
Merck Chems., UK
^{*}*Merck Advanced Tech., Korea*

Reactive mesogen mixtures which can be processed to make thin birefringent films where the wavelength dispersion is controlled by formulation will be discussed. Examples of thin quarter wave coated films with negative retardation dispersions will be presented. We believe these films can be used in circular polarizers for OLED displays.

**LCT3 - 3 Growth of Metal Nanoparticles Doped in Nematic LCs
14:10 and Its Effect on the Electrooptic Properties**

*H. Yoshida, K. Kawamoto, Y. Tanaka, H. Kubo, A. Fujii,
M. Ozaki*

Osaka Univ., Japan

A technique to fabricate highly dispersed metallic nanoparticle - liquid crystal suspensions is demonstrated. The technique is not based on chemical synthesis of nanoparticles but is purely a physical process. We describe the fabrication procedure and the growth of nanoparticles observed inside the nematic LC.

LCT3 - 4 Withdrawn

**LCT3 - 5L Polarization Converter for Axial to Azimuthal
14:30 Polarization Based on Axially Symmetric Twisted
Nematic LC Film**

*S.-W. Ko, Y.-G. Fuh, T.-H. Lin**

Nat. Cheng Kung Univ., Taiwan

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

Axially symmetric twisted nematic liquid crystal (ASTNLC) is demonstrated in paper and explained the structure by analyzing the observed phenomena. ASTNLC was used successfully to convert axially polarized light into azimuthally. Simulation results agree well with experiment. ASTNLC is useful for axially, azimuthally and vertically polarized light, as polarization converter.

----- Break -----

15:00 - 16:30

TENRAN

LCT4: New Functional LC Devices

Chair: T. Nose, Akita Pref. Univ., Japan

Co-Chair: O. Parri, Merck Chems., UK

**LCT4 - 1: Invited LC Lens and Its Application to Imaging
15:00 Devices**

S. Sato, M. Ye

Akita Pref. R&D Ctr., Japan

This paper describes the applications of liquid crystal (LC) lens to imaging devices with electrically tunable focal lengths and a zoom system built up using LC lenses without any moving parts. Fabrication of a thin LC lens with low driving voltages and reduction in response time are also reported.

LCT4 - 2: Invited Photo-Responsive LCs for Photon-Mode Color Display

*S. Kurihara, T. Ogata, M. Moritsugu**
Kumamoto Univ., Japan
**Kinki Univ., Japan*

Chiral photochromic compounds having plural chiral sites and azobenzene groups were synthesized. A cholesteric phase was induced by adding the photochromic compounds in a nematic liquid crystal. Reversible change in selective reflection was achieved by light irradiation to cause trans-cis photoisomerization of azobenzene.

LCT4 - 3 Displaying High Quality Images on a Field Sequential Color LCD Using Active Matrix Narrow-Gap TN Modules Embedded with Nanoparticles

S. Kobayashi, T. Miyama, T. Kineri, Y. Shiraishi, N. Toshima, K. Takatoh, M. Akimoto, M. Okita, H. Takemoto**, T. Fujisawa***, K. Takeuchi****, H. Takatsu****
Tokyo Univ. of Sci. Yamaguchi, Japan
**HDT, Japan*
***Okaya Elec. Ind., Japan*
****DIC, Japan*

LCT

We demonstrate field sequential color (FSC)-LCDs using two kinds narrow-gap TN(NTN)-LCD($d=2\mu\text{m}$) modules: one is a 4 inch TFT SVGA(800×600 pixels) and the other is a nanoparticle doped direct driven 10cm10cm, and 24×24 pixels. They are featured by high legibility under high illuminating condition like the direct sun shine.

LCT4 - 4 Tandem-Type Variable Optical Attenuator Composed of Both Smectic and Nematic LC Cells

M. Komatsu, S. Noka**, T. Kitamura***, A. Kakuta, S. Kobayashi*
Chitose Inst. of S&T, Japan
**Kyosera Kinseki Hokkaido, Japan*
***Miwa Elec., Japan*
****Kyushu Nanotec Optics, Japan*

The switching process of the N cell was carried out in the transient light scattering mode without a polarizer. A prototype tandem device was fabricated. It was observed that it had similar good attenuation properties as compared to a single Sm device and that the output light varied continuously.

----- Break -----

16:40 - 18:05

TENRAN

LCT5: High Performance LCDs (2)

Chair: M. Suzuki, Merck, Japan
 Co-Chair: S. Komura, Hitachi Displays, Japan

LCT5 - 1: Invited Fast Response of Hybrid TN LCD with Wide Viewing Angle

16:40

A. Kubono
Shizuoka Univ., Japan

Low-voltage operation and fast response of liquid crystal displays can be achieved using a hybrid twisted nematic (HTN) cell, which is fabricated by applying the conventional twisted nematic (TN) cell. Moreover the use of hydroxypropyl cellulose (HPC) as an alignment layer results in a wide viewing angle.

LCT5 - 2 Transflective LCD Using Photo- and Nanoparticle-Induced Alignment Effects

17:05

T.-H. Lin, W.-Z. Chen, Y.-T. Tsai
Nat. Sun Yat-Sen Univ., Taiwan

This work presents a transflective LCD with a single cell-gap in a dual-alignment configuration. The vertical alignment induced by POSS can be changed into a homogeneous alignment via absorption of photo-excited azo dye. The LC molecules at the transmissive and reflective pixels are homogeneous and hybrid alignment, respectively.

LCT5 - 3 Improving Blue Shift Technology for Mobile Applications

17:25

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

We've designed an improved blue-shift display utilizing multi-RGB cell gap with Red and Green protrusion light leakage. $\Delta E(u, v,)$ at dark state is 0.009 and average $\Delta E(u, v,)$ at gray level is 0.02 lower than conventional design.

LCT5 - 4 Optimization of Circular Polarized Transflective Vertical Alignment LC Cell

17:45

*J.-W. Moon, J.-M. Choi, G.-D. Lee
Dong-A Univ., Korea*

We propose an optical configuration for transflective vertical alignment liquid crystal cell with circular polarizer to enhance the viewing angle in the dark state. From calculations, we confirm that the proposed configuration can show high viewing angle property compared with conventional configuration.

Author Interviews

18:00 – 19:00

LCT

Friday, December 11

9:00 - 10:20

TENZUI

LCT6: Measurement Method and Characterization

Chair: M. Inoue, Toyo, Japan
Co-Chair: H. Yokoyama, Kent State Univ., USA

LCT6 - 1 A New Measurement Method of Ion Quantity in LC Cells

9:00

S. Ogawa, T. Miyashita, T. Uchida, K. Nakao,
H. Wakemoto***Tohoku Univ., Japan
Toshiba Mobile Display, Japan

We have newly developed the method for measuring ion quantity in a LC cell. Triangular waveform voltage with high frequency sine waveform voltage is applied to the cell. The high frequency current is removed by suitably-designed filters. We can measure only the current peak caused by the movement of ions.

LCT6 - 2 Determination of Dispersion of Refractive Indices Based on Plural Incidence Renormalized Transmission Spectroscopic Ellipsometry

9:20

*K. Goda, M. Kimura, T. Akahane
Nagaoka Univ. of Tech., Japan*

A novel analysis method to determine the dispersion of refractive indices based on the plural incidence renormalized transmission spectroscopic ellipsometry is proposed. The continuous dispersion of ordinary and extraordinary refractive indices of nematic liquid crystal corresponding to the wavelength can be determined.

LCT6 - 3 A Method to Monitor Birefringence Δn of LC at Small Size Panel
9:40

Y.-L. Liao, S.-H. Hung, C.-H. Shih, W.-M. Huang
AU Optronics, Taiwan

We successfully developed a simple method to monitor birefringence Δn of LC mixture and solved small size LCD panel is difficult to measure Δn of LC in the cell. A linear dependence between Δn -shift% and GC-FID area% of diluter is shown and which can be used to estimate Δn value.

LCT6 - 4 Polarization Imaging for Characterization of LCDs and Their Components
10:00

P. Boher, T. Leroux, V. Collomb-Patton, T. Bignon, D. Glinel
ELDIM, France

A new imaging colorimeter and polarimeter is presented. The homogeneity of a LCD backlight with BEF film is tested. Measurements on LCD without top polarizer allow checking the homogeneity of the crystal cell rotation. Finally polarization based stereoscopic 3D display is checked all over the surface and within pixels.

----- Break -----

10:40 - 12:05

TENZUI

LCT7: New Alignment Technology

Chair: M. Kimura, JSR, Japan
Co-Chair: T. Ishinabe, Tohoku Univ., Japan

LCT7 - 1: *Invited* Nanostructured Orientational Surface Patterns for Functional LC Alignment
10:40

H. Yokoyama, J. Niitsuma^{}, J. S. Gwag^{**}, J. Fukuda^{***}, M. Yoneya^{***}*

Kent State Univ., USA

^{}JAIST, Japan*

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

*^{***}AIST, Japan*

Orientational microscopic patterning of alignment surfaces has attracted increasing attention through the last decade as a novel approach to functionalization of cell surfaces. I briefly review the underlying principle of the patterned alignment and also the development of fabrication processes with recent results using photo-alignment and nanoimprint lithography.

LCT7 - 2 **LC Device Having the Nano-Groove Structure by Nano-Imprint Lithography**
11:05

H. Takahashi, T. Sakamoto, H. Okada
Univ. of Toyama, Japan

We have investigated an alignment of nematic liquid crystals using 50 nm nano-grooves fabricated by electron-beam and nano-imprint lithographies. Contrast ratio of twist nematic cell was 44:1. An azimuthal anchoring energy was obtained $7.9 \times 10^{-5} \text{ J/m}^2$ and polar anchoring energy were obtained $4.63 \times 10^{-5} \text{ J/m}^2$.

LCT7 - 3 **LC Alignment on the Films of Polyhedral Oligomeric Silsesquioxane Nanoparticle**
11:25

S.-C. Jeng, Y.-M. Shieh^{}, S.-J. Hwang^{*}*
Nat. Chiao Tung Univ., Taiwan
^{*}*Nat. United Univ., Taiwan*

LCT

Polyhedral oligomeric silsesquioxane (POSS) nanoparticle has been applied on the ITO glass substrate as the alignment layer of homeotropic LCDs. The characteristics of POSS alignment film fabricated by different treatments, spin coating, melting, and rubbing, were systematically investigated. The preliminary results showed that the different surface treatments had the similar anchoring energy and surface energy.

LCT7 - 4 **Effect of Nanoparticles Embedded in the Alignment Layer on the Interfacial Properties of LCD**
11:45

M. Akimoto, K. Sawa^{}, K. Suzuki, K. Isomura, S. Kobayashi, K. Takatoh*
Tokyo Univ. of Sci. Yamaguchi, Japan
^{*}*Keio Univ., Japan*

We here study the interfacial properties of liquid-crystal display with nanoparticle-embedded alignment layers at a variety of fabricating conditions. We found that the addition of nanoparticles into polyimide alignment layer reduces the pretilt angle and the azimuth anchoring strength, whereas it makes no significant difference to the polar anchoring strength.

----- Lunch -----

13:20 - 14:00

TENZUI

LCT8: Advanced Non-Contact Alignment Technology

Chair: M. Kimura, Nagaoka Univ. of Tech., Japan
Co-Chair: I. Hirose, Japan Synchrotron Radiation Res. Inst., Japan

**LCT8 - 1
13:20 The Use of Photoalignment Technology in Transflective LCD**

*T. Du, L. Yao, Q. Yu, V. Chigrinov, H. S. Kwok
Hong Kong Univ. of S&T, Hong Kong*

In this paper, photoalignment technology is studied for producing the domain alignment structure as well as the patterned in cell retardation film for transflective liquid crystal display application.

**LCT8 - 2
13:40 Photo Alignment Characteristics of Fluorine-Containing Polyimides as an Alignment Layer**

*H. Ito, T. Mizunuma, S. Sato, K. Nagai, S. Matsumoto
Meiji Univ., Japan*

We reported the study of 6FDA-TeMPD which a fluorine-containing polyimide (PI) having one phenyl group in the diamine moiety, for use as a photo alignment layer. In addition, we determined the relationship between the alignment capability and the number of methyl groups in the diamine moiety.

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 9

13:20 - 14:45

TENZUI

AMD1: System on Panel

Chair: G. Fortunato, CNR-IMM, Italy

Co-Chair: M. Hiramatsu, TMD, Japan

AMD1 - 1: *Invited* System on Glass Circuit Design Technology

13:20

Y. Aoki, H. Kimura

Toshiba Mobile Display, Japan

We have been developing System on Glass (SOG) displays and successfully mass-produced some LCDs for mobile use. In this paper, our new SOG based approach to extend the scope of application, for example, a new conceptual low power full digital display with serial digital interface, will be presented.

AMD1 - 2: *Invited* Ultra-Low Power System-LCDs with Pixel-Memory Circuit

13:45

*N. Matsuda, I. Takahashi, T. Yamaguchi, Y. Moriya,
S. Nishi, S. Gyouten, Y. Kubota, S. Fujiwara, A. Miyata,
Y. Itoh*

Sharp, Japan

This paper describes the system-LCDs with a pixel-memory driving scheme and PNLC (Polymer Network Liquid Crystal) technology which can achieve ultra-low power consumption and high reflectance. We have developed three types of 1.3 inch-diagonal LCDs with 96x96 pixel resolution; B/W monochrome, 8-step gray-scale, and 8-color.

AMD1 - 3 Integrated Ambient Light Sensor with an LTPS Noise-Robust Circuit and a-Si Photodiodes for AMLCDs

14:10

F. Matsuki, K. Hashimoto, K. Sano, F.-Y. Hsueh*,
T.-H. Wu*, R. Kakkad*, C.-C. Liu*, W.-S. Chang*,
J. Ayres**, M. Edwards**, N. Young***

TPO Displays, Japan

**TPO Displays, Taiwan*

***Philips Res., UK*

Architecture and performance of integrated ambient light sensor with LTPS and a-Si technologies are presented. The sensor consists of an LTPS differential converter circuit and highly efficient a-Si photodiodes, and achieves 5 ~ 55,000 lux detection with below 5% error and stable operation under LCD driving noises.

AMD1 - 4L Nano-Si Non-Volatile Memory (NVM) Cell Integrated in LTPS-TFT

14:30

*A.-T. Cho, W.-Y. Liu, T. Wang, A. Chen, Y. Wu,
J.-S. Chen, C.-H. Li, W.-M. Huang
AU Optronics, Taiwan*

New nano-Si nonvolatile memory cell with field enhanced trapping structure in poly-Si (LTPS) TFTs have been demonstrated successfully on glass panel. A program/erase window was ~3 V with 100ms P/E speed, good endurance of 1E4 P/E cycles, and ~2 V of window remained after 1E4 seconds for data retention.

----- Break -----

15:00 - 16:15

TENZUI

AMD2: Si Device Technologies

Chair: R. Kakkad, TPO Displays, Taiwan
Co-Chair: S. Horita, JAIST, Japan

AMD2 - 1 Gate Driver and Data Switching Circuit Integrated LCD Panel by High Performance Bottom Gate Microcrystalline Si TFT

15:00

*M. Moriguchi, Y. Saitoh, T. Yoshida, Y. Kanzaki,
A. Hoshino, Y. Takanishi, Y. Iwase, A. Tagawa,
M. Sakamoto, Y. Takahashi, A. Hatano
Sharp, Japan*

We have developed the microcrystalline Si ($\mu\text{c-Si}$) TFTs with high mobility and small bias stress V_{th} shift. The gate driver and data switching circuit integrated $\mu\text{c-Si}$ TFT 12.1" WXGA LCD panel was successfully fabricated by using same process flow as a-Si TFT.

AMD2 - 2 Microcrystalline Silicon Thin Film Transistors by Excimer Laser Annealing for Large-Sized TFT-LCDs

15:20

*T. Okabe, T. Yaneda, T. Aita, T. Inoue, M. Takeji,
Y. Harumoto, H. Nishiki, N. Kimura
Sharp, Japan*

We successfully fabricated microcrystalline silicon thin film transistors with inverted-staggered structure by applying Excimer Laser annealing process to conventional a-Si TFT process. Field effect mobility of the TFTs is $2.2\text{cm}^2/\text{Vs}$ that is good enough for next generation large-sized TFT-LCDs with high resolution of 4K2K or more.

AMD2 - 3 15:40 Comparison of Corning Silicon-on-Glass Technology and ELA Poly-Si TFT Uniformity Performance

J. G. Couillard, C. K. Williams, C. Wang, E. Mozdy, J. Cites, J. Choi, S. Park*, S. Saxena*, Y. Son*, J. Cheon*, J. Kim*, J. Jang*, J. Lai**, J. Chang**, G. Heiler**, T. Tredwell***

Corning, USA

**Kyung Hee Univ., Korea*

***Carestream Health, USA*

The performance uniformity of TFTs fabricated in single-crystal Silicon-on-Glass (SiOG) and ELA poly-Si substrates was investigated. The SiOG devices exhibited better electrical performance with greater uniformity in mobility, threshold voltage, and subthreshold swing. This illustrates potential advantages for SiOG in display manufacturing.

AMD2 - 4L 16:00 Fabrication of Poly-Si TFT CMOS Inverter by Direct Stencil Maskpatterning during Sputtering Film Deposition

W. Yeh, C. Chiu, B. Huang

Nat. Taiwan Univ., Taiwan

poly-Si TFT CMOS inverter was fabricated by direct patterning during sputtering deposition through stencil masks. The fabricated n-/p-channel TFTs exhibited a subthreshold slope of 2.5/1.7 V/decade and on/off ratios of $4 \times 10^5/6 \times 10^5$. The fabricated poly-Si TFT CMOS inverter showed full-range abrupt voltage transfer characteristics.

----- Break -----

AMD

16:40 - 17:40

TENYO

OLED3/AMD3: AM-OLED (1)

Chair: A. Mikami, Kanazawa Inst. of Tech., Japan
Co-Chair: T. Inoue, TDK, Japan

OLED3/AMD3 - 1 16:40 An OLED-on-Silicon Pixel Structure for Microdisplays

B.-C. Kwak, H. Kim, H.-S. Lim, O.-K. Kwon
Hanyang Univ., Korea

In this paper, we propose an organic light emitting diode on silicon (OLEDoS) pixel structure for microdisplays with 6-bit gray scale. The "ON" time pulse width of the pixel emission current for representation of gray scale is determined by switching operation of p-MOSFET and ramp signal.

**OLED3/
AMD3 - 2
16:55** **A Low Mask Count Top Gate Process for AMOLED Displays Based on Amorphous or Polymorphous Silicon**

P. Schalberger, H. Baur, T. Buergestein^{}, N. Fruehauf
Univ. Stuttgart, Germany
^{*}Robert Bosch, Germany*

We have developed a top gate a-Si:H process for AMOLED displays which requires only four mask steps for the realization of passivated TFTs. Furthermore we have successfully processed pixel circuits, gate drivers and AMOLEDs.

**OLED3/
AMD3 - 3
17:10** **Three-Dimensional Organic Field-Effect Transistors**

M. Uno^{,**}, K. Nakayama^{*}, J. Takeya^{*}
^{*}Osaka Univ., Japan
^{**}TRI-Osaka, Japan*

We have developed easy MEMS-based processes that realize three-dimensional organic field-effect transistors with multiple vertical channels on plastic platforms. The devices present outstanding current and on-off ratio which sufficiently drive pixels of organic light-emitting diodes.

**OLED3/
AMD3 - 4L
17:25** **Development of an Industrial Compatible Process for BG OTFTs Using Solution Processable Organic Semiconductors**

*M. Carrasco-Orozco, C. Leonhard, P. Brookes, T. Cull,
D. Mueller, G. Lloyd, F. Meyer, S. Tierney, J. Canisius,
M. Heckmeier, J. Nakanowatari^{*}
Merck Chems., UK
^{*}Merck, Japan*

We present our newly developed materials compatible with industrial process in an effort to bring the use of solution processable organic semiconductors closer to mass production. We demonstrate OTFTs with mobilities over 1.5 in BG architecture and (sputtered) silver electrodes.

----- Break -----

Thursday, December 10

9:00 - 10:10

TENGYOKU

AMD4/OLED4: AM-OLED (2)

Chair: Y. Matsueda, Matsueda Consulting, Japan
 Co-Chair: S. Utsunomiya, Seiko Epson, Japan

AMD4/ OLED4 - 1: 9:00 *Invited* **Top Emitting White OLED Technology for Small and Medium-Sized AMOLED Displays**

D. Peng, R. Nishikawa

TPO Displays, Taiwan

A 3.5" nHD AMOLED display has been developed with top emitting WOLED + CF technology. It features high-resolution, low power, and extended lifetime. Moreover, to improve the uniformity for high-resolution AMOLED, a module compensation approach has been applied. With these technologies, a high-resolution AMOLED display with better front-of-screen performance could be achieved.

AMD4/ OLED4 - 2: 9:25 *Invited* **Development of 4.0-in. AMOLED Display with Driver Circuit Using Amorphous In-Ga-Zn-Oxide TFTs**

J. Sakata, H. Ohara, M. Sasaki, T. Osada, H. Miyake, H. Shishido, J. Koyama, Y. Oikawa, H. Maruyama*, M. Sakakura*, T. Serikawa, S. Yamazaki*

Semiconductor Energy Lab., Japan

**Advanced Film Device, Japan*

We have developed a 4.0-inch QVGA AMOLED display integrated with gate and source driver circuits using amorphous In-Ga-Zn-Oxide TFTs. And we have successfully developed the world's first 3.4-inch QHD AMOLED display integrated with driver circuits.

AMD4/ OLED4 - 3: 9:50 **Sample and Hold DeMUX Method for Threshold Voltage Compensation Pixel Circuits of AMOLEDs**

S. Choi, C. Kang, S. Hwang, K. Kim, B. Kim

Samsung Mobile Display, Korea

In this paper, a new demultiplexing method is proposed to ensure adequate time for compensation of threshold voltage variation in a LTPS TFT. An AMOLED panel has been successfully developed and driven at 120Hz frame frequency using the proposed method.

----- Break -----

10:40 - 12:10

TENGYOKU

AMD5: Sensing Devices

Chair: J. Jang, Kyung Hee Univ., Korea

Co-Chair: H. Hamada, Sanyo Elec., Japan

AMD5 - 1: *Invited* Flexible Sensors Integrated with Electronic Circuits Based on Polysilicon Thin Film Transistor
10:40

*G. Fortunato, A. Bearzotti, M. Cuscunà, A. Macagnano,
L. Maiolo, F. Maita, L. Mariucci, A. Minotti, S. Pantalei,
A. Pecora, D. Simeone, A. Valletta, E. Zampetti*
CNR-IMM, Italy

Sensors with integrated readout circuits, based on low-temperature polysilicon TFTs, have been fabricated on flexible substrates using a process we recently developed on polyimide. In particular, a humidity sensor, based on BCB, and an ammonia sensor, based on polyaniline (PANi) nanofibres produced by electrospinning technique, are presented.

AMD5 - 2: *Invited* Printable Organic Transistor Integrated Circuits for Large-Area Sensors and Actuators
11:05

T. Sekitani, U. Zschieschang^{}, H. Klauk^{*}, T. Someya*
Univ. of Tokyo, Japan
^{}Max Planck Inst. for Solid State Res., Germany*

Employing printing techniques, we fabricated large-area organic transistor active matrices on plastic films for applications to large-area sensors and actuators. Furthermore, we manufactured ultra-fine top-contact organic transistors by combining the sub-femtoliter inkjet and self-assembled monolayer technologies. A 1- μm channel length was achieved without pre-patterning or pre-treatment on high-performance organic semiconductors.

AMD5 - 3 Vertical a-Si Schottky Diodes and NIP Diodes for Photo-Sensing Applications in LTPS Displays
11:30

*R. Kakkad, R. Chang, C. C. Liu, F. Y. Hsueh, K. C. Yang,
H. Y. Liang, K. Sano, F. Matsuki, K. Hashimoto,
N. D. Young^{*}*
TPO Displays, Taiwan
^{}Philips Res., UK*

Vertical a-Si Schottky and NIP photodiodes were integrated into LTPS TFT array fabrication process for photo-sensing applications. These diodes have show good spectral response, signal, signal to noise ratio compared to lateral LTPS diodes. Detection of ambient light as low as 1-10 lux was achieved using these diodes.

AMD5 - 4 Characterization of Si Films Crystallized by RTA for Photo-Sensor Diode
11:50

*J. de Dieu Mugiraneza, T. Miyahira, A. Sakamoto,
T. Noguchi, C.-P. Chiu*, M.-H. Chen*, W.-C. Yeh**
Univ. of the Ryukyus, Japan
**NTUST, Taiwan*

We report on anticipated photoconductivity of poly-Si Thin films prepared by sputtering at room temperature on glass and annealed by Rapid Thermal Annealing (RTA). Results of photoconductivity and electrical characteristics show potential application in photo-sensor diodes for futuristic System on Glass (SOG).

----- Lunch -----

13:20 - 14:45

TENGYOKU

AMD6: Organic TFT

Chair: T. Sekitani, Univ. of Tokyo, Japan
Co-Chair: K. Nomoto, Sony, Japan

AMD

AMD6 - 1: Invited A 169 dpi Flexible OTFT Backplane with Printed Organic Semiconductor for Electrophoretic Display
13:20

*N. Kawashima, N. Kobayashi, N. Yoneya, H. Ono,
T. Fukuda, T. Ohe, Y. Ishii, A. Nomoto, M. Sasaki,
K. Nomoto*
Sony, Japan

We have developed a high resolution 169 dpi electrophoretic display driven by partially printed OTFT backplane. The soluble organic semiconductor of *peri-xanthenoxanthene* (PXX) was precisely patterned by inkjet. The inkjetted OTFT exhibited the mobility of 0.4 cm²/Vs and the passivation layer was screen printed with small degradation of TFT characteristics.

AMD6 - 2 High Resolution, 200 ppi LCD Driven by Entirely Printed Organic TFT
13:45

K. Matsuoka^{,**}, O. Kina^{*,***}, M. Koutake^{*,****},
K. Noda^{*,*****}, H. Yonehara^{*,****}, K. Nakanishi^{*,}, K. Yase^{*,*****}*
**Japan Chem. Innovation Inst., Japan*
***Konica Minolta Tech. Ctr., Japan*
****Toppan Printing, Japan*
*****DIC, Japan*
******ADEKA, Japan*
******AIST, Japan*

We have succeeded in driving a high resolution polymer network liquid crystal display (PNLCD) by using an organic thin-film transistor (OTFT) array prepared by the microcontact printing (μ CP) method.

**AMD6 - 3 Stable Bottom-Contact Organic Thin-Film Transistor
14:05 Array with Fluoropolymer Dielectric for Flexible
 Displays**

*Y. Fujisaki, D. Kumaki, Y. Nakajima, T. Yamamoto,
H. Fujikake, S. Tokito*

NHK, Japan

An air stable organic semiconductor material, DNTT, was used as the active layer in combination of an amorphous fluoropolymer Cytop gate dielectric. The device exhibited a near-zero turn-on voltage, a steep onset, subthreshold swing of 0.26 V/decade, a low off current ($<10^{-13}$ A), and excellent stability under ambient conditions without passivation.

**AMD6 - 4 Photopatterned Organic/Inorganic Hybrid
14:25 Complementary Thin-Film Transistor Inverter**

*B. Kim, Y. H. Hwang, H. Moon, N. Jeon, B.-S. Bae,
S. Yoo*

KAIST, Korea

We present our study on complementary thin-film transistor inverters with aluminum indium oxide(AIO) for the n-channel and pentacene for the p-channel fabricated by conventional photolithography method. The AIO channel layer was prepared via sol-gel route by simple solution processing. Our inverter shows a voltage gain of ~ 39 at $V_{DD}=15V$.

Author Interviews

18:00 – 19:00

Friday, December 11

9:00 - 12:00

3F Foyer

Poster AMDp: Active-Matrix Devices

**AMDp - 1 Novel Low Power Consumption Color Sequential
 Display**

*Y.-H. Chen, S.-J. Chiou, L. Li, K.-H. Chien, S.-H. Yu,
C.-L. Liu, C.-N. Mo*

Chunghwa Picture Tubes, Taiwan

A novel CSD has been developed. The pixel design combines three-subpixels into one-pixel. It greatly decreases addressing time by 3-gate-line driving and remove storage capacitor. The CSD achieves high color gamut, contrast and low power.

AMDp - 2 Withdrawn

AMDp - 3 One-Chip Structure and Low Cost Design for 4.8-in. WVGA a-Si TFT-LCDs

*K.-C. Chiu, H.-H. Chen, Y.-N. Chu, W.-T. Tseng, H.-T. Yu
Chunghwa Picture Tubes, Taiwan*

Chunghwa Picture Tubes, LTD. (CPT) has successfully implemented a 4.8-inch WVGA TFT-LCD display with One-Chip driving structure. Comparing with traditional structures, this structure can save Driver-IC cost by 31%, FPC cost by 48%, and PCB cost by 29.6%. It also saves 89% power consumption of digital voltage with One-chip structure.

AMDp - 4 A Novel a-Si TFT LCD with New AFFS for Superior Sunlight Readability

*M. S. Im, J. K. Park, J. H. Park, D. L. Choi, S. Y. Choi,
O. S. Son, D. H. Suh, S. Gon
Hydis Tech., Korea*

We report the improvement in brightness, inner reflectance through New AFFS TFT-LCD structure for outdoor readable panel. In conclusion, the optimization of pixel structure has shown the transmittance over 6.8%, contrast ratio over 1000:1 and in inner reflectance over 4.5%.

AMD

AMDp - 5 Design Methodology for Operational Amplifiers Using Poly-Si TFTs

K. Setsu^{}, H. Hashimoto^{*}, M. Kimura^{**}
^{*}Ryukoku Univ., Japan
^{**}Innovative Materials & Processing Res. Ctr., Japan*

Design methodology for operational amplifiers using poly-Si TFTs is introduced. The TFTs are located in a direction perpendicular to laser scan and divided to avoid self-heating degradation. Open-loop gain, offset voltage and cut-off frequency are systematically evaluated.

AMDp - 6 High Stability Amorphous Shift Register Circuit with Dual Gate Structure

*C.-Y. Wu, C.-Y. Yang, C.-Y. Huang, H.-L. Chen
AU Optronics, Taiwan*

A dual gate structure is introduced into the shift register to achieve high stability circuit. The output current of dual gate is noticeably improved. Therefore, a longer lifetime of the proposed shift register is obtained.

AMDp - 7 Power Consumption of Integrated a-Si:H Gate Driver Using Simplified Structure

C.-S. Wei, C. C. Tseng, S. C. Liu, P. M. Chen, J.-S. Chen, W.-M. Huang

AU Optronics, Taiwan

The integrated a-Si:H Gate Driver Circuits with the traditional structure for new operation have much benefit for power loss. The new terminal operation embedded on output TFT and stable TFT can reduce power loss of 25%, and stability improvement. The simulation results also get good agreement.

AMDp - 8 7.0-in. a-Si:H TFT-LCD with Stable Integrate Gate Driver

Y.-J. Chen, H.-C. Chang, C. Yen, W. Wu, C. Yu

HannStar, Taiwan

We proposed a new a-Si gate driver with stable circuits for high performance displays. The range of input signal can be decreased by employing bootstrapping method. The stable circuit reduces the coupling ripples of the output signal efficiently. That are used in HSD 7 inch panels (800*480).

AMDp - 9 A Repairing Method for the Interlaced Gate Driver In Array (GIA) Circuit

*Y. R. Fan^{***}, W. J. Dai^{***}, M. Lv^{***}, P. Liao^{***}, S. Chung^{***}, C. T. Lee^{***}, T. S. Jen^{***}*

^{}Inst. of Jiangsu (IVO) FPD Tech. & Res., China*

*^{**}InfoVision OptoElect., China*

A novel repairing method was successfully demonstrated on the 14.1 inch interlaced GIA TFT-LCD. Each GIA circuit unit has a corresponding redundant circuit for repairing the defective unit to improve the GIA introduced yield loss and maintain the same production yield as COG/COF type TFT-LCDs.

AMDp - 10 The Improvement of Photo-Leakage-Current for P-Type Low Temperature Poly-Si TFTs

Y.-J. Hsu, M.-H. Lee, J.-S. Chen, W.-M. Huang

AU Optronics, Taiwan

The divergence of subthreshold region due to backlight illumination was improved by channel doping method. Channel doping using phosphorous dopant can effectively suppress the photo-leakage current in subthreshold region, which is induced by high build-in potential between source and channel region. The divergence was reduced without complex process steps.

AMDp - 11 Influence of Grain Size on Voltage Swing and Threshold Voltage of Poly-Si Thin Film Transistors

*F. Oshiro, A. Sakamoto, T. Noguchi, T. Ohachi**
Univ. of the Ryukyus, Japan
**Doshisha Univ., Japan*

A model of defects in poly-Si film by using grain size was proposed. The gate voltage swing factor S which related to the threshold voltage was estimated to calculate I_d - V_g characteristics. The development of more precise simulation of TFT is expected based on the proposed model.

AMDp - 12 The Investigation of Reliability in the Short Channel SPC-Si TFT on the Glass Substrate

S.-G. Park, S.-H. Choi, Y.-J. Kim, M.-K Han
Seoul Nat. Univ., Korea

We have investigated the stability characteristics of short channel (3 μm) SPC-Si TFT. The threshold voltage of short channel SPC-Si TFT was increased considerably higher than that of long channel SPC-Si TFT under the constant bias stress. However the threshold voltage shift was reduced significantly employing AC-Bias stress.

AMD

AMDp - 13 Crystallization of Amorphous Silicon Utilizing a Line Plasma Scanning

N. Ohta, N. Imamura, H. Shimizu, T. Kobayashi**, H. Shirai*
Saitama Univ., Japan
**Saitama Ind. Tech. Ctr., Japan*
***Inst. of Physical & Chem. Res., Japan*

The novel crystallization technique of a-Si is presented utilizing a linear thermal plasma jet. The thermal plasma is confined linearly in a 10 cm width near the a-Si surface. The TFTs fabricated on a thermal SiO₂ coated n⁺-c-Si showed a mobility of 10-25 cm²/Vs and threshold voltage of 1-2V.

AMDp - 14 Hot Carrier Stress for Low-Temperature Poly-Si TFTs with Various Widths

J.-H. Ye, M.-H. Lee, J.-T. Peng, J.-S. Chen, W.-M. Huang
AU Optonics, Taiwan

We proposed comprehensive hot carrier characterization for poly-Si TFTs with various widths. Small and large width devices exhibit different electric behavior and degradation under hot carrier stress. For large width devices, self-heating was observed. Contour Plot of stress voltage response for on-current degradation was also provided in this paper.

AMDp - 15 Novel Self-Aligned Gate-Receded Structure for TFTs with Solid Phase Crystallization for AMOLED Display

*T.-M. Wang, L.-C. Lee, C. Hu, C.-Y. Chen, C.-S. Chuang
AU Optronics, Taiwan*

For P-type TFT device with a short offset distance from Pp region to Gate electrode, I_{on} is large enough ($>10^{-5}$) and I_{off} is suppressed ($<10^{-8}$). After long time stress (10^5 sec.) under room temperature, V_t shift is about 1V. Hot carrier effect and kink effect are also much improved.

AMDp - 16 Study on Capacitance-Voltage Characteristics of Poly-Silicon Thin-Film Transistors

*W. Choi, J. Jang
Kyung Hee Univ., Korea*

We studied the capacitance-voltage (C-V) characteristics of poly-silicon thin-film transistors (TFT). The capacitance can be explained by a model having three capacitance components for gate insulator of oxide, gate-to-source/drain overlap and source/drain lateral pn junction.

AMDp - 17 Mechanism of Bias Temperature Instability for a-Si:H Thin Film Transistors in Integrated Gate Driver Circuits

*K. C. Lin, J. C. Liao, J. J. Chang, H. T. Yang, Y. T. Hsieh,
Y. C. Chen, C. H. Liu, K. Wang, J. Lee, A. Wang
AU Optronics, Taiwan*

In order to clarify instability mechanism of a-Si TFTs for integrated gate driver, both the interface state densities (N_{it}) and trapped state densities (N_{trap}) should be taken into consideration, which are determined from current-voltage characteristic curve after the bias temperature stress.

AMDp - 18 Withdrawn

AMDp - 19 Withdrawn

AMDp - 20 Electrical Characteristics of Short Channel a-Si:H TFT with Cu Metal for Large-Size Panel

*Y.-S. Cho, K.-H. Moon, C.-K. Ha, T.-H. Kim, S.-K. Choi,
C.-G. Lee, S.-Y. Cha, S.-Y. Choi*
LG Display, Korea
Kyungpook Nat. Univ., Korea

We studied the electrical characteristics of the short channel hydrogenated amorphous silicon TFT with Cu metal for large-size panel. The ratio of on-current to off-current increases as the channel length is reduced between Cu source and drain. We also demonstrated the suppression of the off current by using back channel treatment.

AMDp - 21 Study of Short Channel Hydrogenated Amorphous Silicon TFTs for TFT-LCD

*Y.-H. Li, W.-Y. Lo, C.-H. Lin, Y.-C. Chen, C.-C. Chiu,
M.-S. Chen, W.-M. Huang*

AU Optronics, Taiwan

The study investigated the electrical characteristic of short channel length island-out structure a-Si:H TFT with field effect mobility of 0.54 cm²/Vsec, V_{th} of 1.2V and SS of 1.36 V/decade. The channel length below 2.2 μm decreased turn-on current and field effect mobility due to source-drain contact resistance.

AMDp - 22 Enhancement of a-Si:H TFT Performance by Well-Designed Structure

*C. Ha, Y.-S. Cho, T.-H. Kim, K.-H. Moon, C.-G. Lee,
S.-Y. Cha*

LG Display, Korea

A hydrogenated amorphous silicon (a-Si:H) thin-film-transistor (TFT) performance was improved by well-designed structure. The structure was designed to reduce the electrical resistance along the current path in a TFT with a phosphorous delta-doped layer and a relatively thin a-Si:H layer. More than 50% increase in mobility and transconductance was obtained.

AMD

AMDp - 23 Microcrystalline Silicon from a SiH₂Cl₂ and H₂ Mixture Using a High-Density Microwave Plasma Source Utilizing a Spoke Antenna

H. Shirai, K. Hamada, H. Matsui

Saitama Univ., Japan

The deposition study on microcrystalline silicon (μc-SiH:Cl) films is presented by using a high-density microwave plasma-enhanced chemical vapor deposition of a dichlorosilane, SiH₂Cl₂, and H₂ mixture. The thin-film transistors (TFTs) exhibited mobility of 2.6 cm²/Vs and threshold voltage of 0.27V at 27Å/s in μc-SiH:Cl films.

AMDp - 24 Device Characteristics of Nanoscale Organic Field-Effect Transistors

*T. Nagase, T. Hirose, S. Nishigami, T. Kobayashi,
R. Ueda*, A. Otomo*, H. Naito*

Osaka Pref. Univ., Japan

**NICT, Japan*

We investigate the device characteristics of organic field-effect transistors with nanometer scaled channels. It is found that the electrical characteristics of nanoscale organic transistors can be controlled via the ionization potential of organic semiconductors. The clear transistor operation can be achieved in organic transistors with 30 nm length channels.

AMDp - 25 Withdrawn

AMDp - 26 Withdrawn

AMDp - 27 Withdrawn

AMDp - 28 Solution-Processed Thin Film Transistors with Hafnium Indium Zinc Oxide for AMOLEDs Backplane

*W. H. Jeong, G. H. Kim, H. S. Shin, H. J. Kim
Yonsei Univ., Korea*

In this study, the effects of hafnium in InZnO system were investigated. We also have fabricated hafnium indium-zinc-oxide (HIZO) thin film transistors (TFTs) by solution process. The HIZO TFTs showed a field effect mobility of $2 \text{ cm}^2/\text{Vs}$, an on/off current ratio of 4.95×10^6 and a sub-threshold swing of 0.54 V/decade . These results could enable the fabrication of high performance HIZO TFTs for AMOLED backplanes with solution process.

AMDp - 29 Hysteresis Phenomenon of Oxide-Based TFTs under the Light Illumination

*T.-J. Ha, S.-J. Kim, J.-S. Lee, S.-Y. Lee, H.-S. Park,
M.-K. Han, W.-G. Lee*, K.-S. Yoon*, Y.-W. Lee*
Seoul Nat. Univ., Korea
Samsung Elect., Korea

We have investigated the of hysteresis characteristics in oxide-based thin film transistors (oxide-TFTs) under the dark and the illuminated conditions. A larger hysteresis window was observed under the illuminated state. Deep trapping events may increase under the light illumination, leading to the increase of quantities of initial trapped charges.

AMDp - 30 Development of Solution-Based IZO TFT with Organic Passivation and Laser Direct Writing Technology

*K.-H. Su, M.-C. Wang, C.-C. Yu, F.-W. Chang, Y.-C. Lai,
L.-Y. Lin, C.-Y. Ou, C.-Y. Chien, C.-H. Tsai, S. C. Chiang
Taiwan TFT-LCD Assn., Taiwan*

In this paper, IZO thin film transistors were fabricated by solution process and its passivation were directly patterned by laser. Field effect mobility and threshold voltage of IZO TFT with passivation layer were $0.4 \text{ cm}^2/\text{V-sec}$ and -3.8 V , respectively. Finally, a 4.1-inch QVGA a-IZO TFT-LCD with organic passivation by laser direct writing technology was successfully demonstrated.

AMDp - 31 Method of Adjusting Threshold Voltage in Indium Gallium Oxide Based Thin Film Transistors

*S.-L. Wang, H.-W. Kuo, L.-H. Peng
Nat. Taiwan Univ., Taiwan*

We report methods to adjust the threshold voltage in indium gallium oxide (IGO) based thin film transistors. The resulting TFTs exhibit good operating properties with threshold voltage 4.6V and current on/off modulation ratio (I_{on}/I_{off}) increased from $\sim 10^3$ to $\sim 10^7$. The subthreshold swing and field-effect mobility are 0.8V/dec and $1.27\text{cm}^2\text{V}^{-1}\text{s}^{-1}$, respectively.

AMDp - 32 Electrical Characteristics of ZnO Thin Film Transistors with Laser Annealing

*H.-S. Seong, J. H. Son, N. Jang, J. J. Kim, J. Y. Bak,
H. S. Kim, Y. Yun
Korea Maritime Univ., Korea*

We investigated the effects of laser annealing on ZnO TFTs. Unannealed ZnO-TFTs had a threshold voltage of 21.6V and a field-effect mobility of $0.004\text{ cm}^2/\text{Vs}$. Laser annealing of the ZnO-TFTs by 200 laser pulses reduced their threshold voltage to 0.6 V and increased their field effect mobility to $5.08\text{ cm}^2/\text{Vs}$.

AMD

AMDp - 33 Withdrawn

AMDp - 34 Oxide TFT Rectifier with RF Antenna

S.-H. Cho, S.-W. Kim, D. W. Ihm, B. S. Bae, D.-H. Cho,
C. W. Byun*, C. S. Hwang*, S. H. K. Park*
Hoseo Univ., Korea
ETRI, Korea

Rectifiers with oxide TFTs were developed. Oxide TFT rectifier showed good DC output with AC input. The source/drain and gate electrodes were Indium Thin Oxide (ITO), and active layer was also transparent material of IGZO (Indium Gallium Zinc Oxide). We verified the optimum condition for the maximum DC output.

AMDp - 35 Effect of Blocking Metal Layer on the Lateral Polysilicon PIN Photodiode for AMLCD

*S.-B. Ji, H.-S. Park, S.-H. Kuk, M.-K. Han
Seoul Nat. Univ., Korea*

We fabricate lateral PIN photodiode with blocking metal layer and investigate the dependence of the photocurrent on the intrinsic region length. The blocking metal layer forms additional parasitic capacitors with the active layer, so that it causes the distribution of the electric field to be changed.

AMDp - 36L Characteristic Comparison between Complementary Inverter Using Amorphous Oxide TFT and Polymer Organic TFT and N-Type Inverter Using Amorphous Oxide TFTs

T. Hasegawa^{}, T. Nakanishi^{*}, M. Sakemi^{*}, M. Kimura^{*,**},
K. Nomura^{***,****}, T. Kamiya^{***,****}, H. Hosono^{***,****},
T. Aoki^{*****}, T. Kawase^{*****}, S. Inoue^{*****}*

^{*}*Ryukoku Univ., Japan*

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

^{***}*Tokyo Inst. of Tech., Japan*

^{****}*ERATO-SORST, Japan*

^{*****}*Seiko Epson, Japan*

An input-output characteristic of a complementary inverter using an amorphous-oxide TFT and polymer-organic TFT is compared with an n-type inverter using amorphous-oxide TFTs. Although the transistor characteristic of the amorphous-oxide TFT is superior to the polymer-organic TFT, the input-output characteristic of the complementary inverter is sharper than the n-type inverter.

AMDp - 37L Investigation on Oxidation Effect of Doped Amorphous on Channel Region in TFT Array Process

*X. Liu, X. Chen, S. M. Rim, W.-Y. Zhang, Z.-Y. Xie,
W. Wang*

Beijing Orient Elect. OptoElect. Tech., China

Doped amorphous silicon oxidation is investigated to form TFT channel through matrix test. We analyzed the effect of oxidation conditions on the TFT electrical characteristics. Results indicated that power and pressure had great important on I_{off} of TFT. With optimized oxidations, we gained good I-V curve and high yield.

AMDp - 38L Layout Design on Self Heating Effect for Peripheral Circuit Application

*C.-S. Wei, G. R. Shen, C.-Y. Huang, P. M. Chen,
S.-C. Liu, J.-S. Chen, W.-M. Huang*

AU Optronics, Taiwan

The influence of layout design for excess self-heating reduction was investigated. Especially for charging requirement, the novel design for the peripheral circuit application such as integrated gate driver and data multiplexer shows the 25% and 60% improvement by our simulation results, respectively.

AMDp - 39L Degradation Evaluation of Poly-Si TFTs by Comparing Normal and Reverse Characteristics and Behavior Analysis of Hot-Carrier Degradation

T. Kasakawa^{}, H. Tabata^{*}, R. Onodera^{*}, H. Kojima^{*},
M. Kimura^{**}, H. Hara^{***}, S. Inoue^{***}*

^{}Ryukoku Univ., Japan*

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

*^{***}Seiko Epson, Japan*

We propose degradation evaluation of poly-Si TFTs by comparing normal and reverse characteristics. Since symmetrical normal and reverse characteristics indicate Joule-heating degradation whereas asymmetrical normal and reverse characteristics indicate hot-carrier degradation, they can clearly and easily be classified. Moreover, behavior of the hot-carrier degradation is analyzed.

AMDp - 40L The Effect of Annealing on Amorphous Indium Gallium Zinc Oxide Thin Film Transistors

*H. S. Bae, J. H. Kwon, S. Chang, M. H. Chung, T. Y. Oh,
J. H. Park, S. Y. Lee^{*}, B. K. Ju*

Korea Univ., Korea

^{}KIST, Korea*

AMD

This paper presents the post annealing effects, caused by rapid thermal annealing (RTA), on amorphous indium gallium zinc oxide (a-IGZO) thin film transistor (TFT)'s electrical characteristics, and analyzed its contact resistance (R_C) by using transmission line method (TLM) and atomic force microscope (AFM).

AMDp - 41L Fabrication and Characteristics of Poly Si TFT on Microsheet

S. Won, Y. Lee

Univ. of Seoul, Korea

We used thin flexible glass of 75 μm in average thickness. Glass substrates are so thin that they can be bent to radius of curvature as small as 3 inch. Glass substrate is borosilicate glass. We fabricated Poly Si TFT on this substrate and investigated characteristics of the TFT.

IDW Best Paper Award

This award will go to the most outstanding paper selected from those presented at IDW '09.

The 2009 award winners will be announced on the IDW website: <http://www.idw.ne.jp/award.html>

AMDp - 42L Top-Gate Type Oxide Semiconductor Based Self-Alignment Thin-Film Transistors Using Lift-Off Technique

*F. Takeda, S. Naka, H. Okada
Univ. of Toyama, Japan*

Top-gate type oxide-semiconductor based self-alignment thin-film transistors using lift-off technique were investigated. Using lift-off technique, overlapping length between source/drain and gate electrodes was dramatically minimized as 0.25 μm . Obtained field-effect mobility, on-off ratio, threshold voltage were 22 cm^2/Vs , 2×10^7 , and -0.2 V, respectively.

AMDp - 43L Influence of Grain Size Deviation for Channel Size on Device Parameters of Poly-Si Thin Film Transistors

K. Shirai, F. Oshiro, T. Noguchi, T. Ohachi^{}
Univ. of the Ryukyus, Japan
^{*}Doshisha Univ., Japan*

Influence of grain size deviation for channel size on thin film transistor (TFT) characteristics was evaluated using a defects model by varying grain size in poly-Si film. Results of calculations show grain size deviation and channel size strongly affects device characteristics such as S-factor and V_{th} .

AMDp - 44L TIPS-Pentacene Thin-Film Transistors with a Molecular Guest-Host System by a Polymer Binder in Different Solvents

*M.-H. Chung, J.-H. Kwon, T.-Y. Oh, H.-S. Bae, S. Chang,
J.-H. Park, D.-H. Choi, B.-K. Ju
Korea Univ., Korea*

This work presents the polymer binder and solvents effects on the TIPS-pentacene thin-film transistors. TIPS-pentacene solutions were prepared in different solvents, and poly(triarylamine) is added as a polymer binder. The device exhibits the best performance when the solution is prepared with anisole as the solvent and PTAA as the binder.

AMDp - 45L Fabrications of 6, 13-bis(Triisopropylsilylethynyl)-Pentacene Thin-Film Transistors via Metal Transfer Method Using a Polymer Stamp

*T.-Y. Oh, J.-H. Kwon, M.-H. Chung, H.-S. Bae, S. Chang,
J.-H. Park, K.-Y. Dong, B.-K. Ju
Korea Univ., Korea*

We fabricated 6,13-bis(triisopropylsilylethynyl) -pentacene thin-film transistors using direct metal transfer method. With different surface adhesion of substrates, patterns are formed from the relief region of the polymer mold. We obtained an electrical characteristic, including field-effect mobility of 0.008 $\text{cm}^2/\text{V}\cdot\text{s}$, current on/off ratio of 1.6×10^3 , and subthreshold slope of 0.59 V/dec.

AMDp - 46L The Characteristics of Bottom-Gate Thin Film Transistor Adapted Nanocrystalline Silicon as Active Layer by Catalytic CVD at Low Temperature ($\leq 200^{\circ}\text{C}$)

*Y.-J. Lee, K.-M. Lee, J.-D. Hwang, K.-S. No, S. Won,
J. Sok, K. Park, W.-S. Hong*

Univ. of Seoul, Korea

The Nanocrystalline silicon (nc-si) films indicated that field effect mobility and stability are better than amorphous silicon. We attempted modulation of hydrogen dilution ratio to achieve both the minimal incubation layer and high deposition rate. We fabricated the nc-si TFT as active layer.

AMDp - 47L Direct Deposition Poly-Si Thin Films by Hydrogen Diluted Silicon Sputtering Method

H. Chen^{}, W. Yeh, P. Huang, H. Chiang, P. Chen*

NTUST, Taiwan

^{}LYIT, Taiwan*

Based on optimization of deposition parameters, we prepared hydrogenated poly-Si films with 52.1% crystalline volume fraction by DC magnetron sputtering method. TFTs were fabricated based on this poly-Si film prepared at room temperature. The TFT showed transfer characteristics with a On/Off current ratio of $>10^5$.

AMD

----- Lunch -----

13:15 - 14:40

TENGYOKU

AMD7: Oxide TFT (1)

Chair: T. Kawamura, Hitachi, Japan

Co-Chair: H. Kumomi, Canon, Japan

AMD7 - 1: Invited Impact of Subgap States on Peculiar Characteristics of Amorphous Oxide Thin-Film Transistor

T. Kamiya^{,**}, K. Nomura^{**}, H. Hosono^{*,**}*

^{}Tokyo Inst. of Tech., Japan*

*^{**}JST, Japan*

Amorphous oxide semiconductor TFTs exhibit superior characteristics, e.g. mobilities $>10\text{ cm}^2/\text{Vs}$ even in an amorphous phase and low operation voltages. Here, we discuss their origins and importance based on subgap electronic structures of a-In-Ga-Zn-O. It is also closely related to recent issues, e.g. photoresponse of a-In-Ga-Zn-O TFTs.

**AMD7 - 2 Threshold Voltage Shift of Amorphous Oxide TFT
13:40 with Various Channel Length**

*J.-S. Lee, S.-J. Kim, H.-S. Park, S.-G. Park, D.-W. Kang,
M.-K. Han, W.-G. Lee*, K.-S. Yoon*, Y.-W. Lee**

Seoul Nat. Univ., Korea

**Samsung Electronics, Korea*

We have fabricated amorphous oxide-based TFTs and investigated electric characteristics such as threshold voltage shift with various drain voltage. Short channel effect for rather long channel in oxide TFTs comparing Si-Based TFTs and V_{th} variation could be explained with DIBL of back channel and band diagram of oxide TFTs, respectively.

**AMD7 - 3 IGZO TFTs with Good Environmental Stability and
14:00 Short-Range Uniformity**

*H.-H. Hsieh, J.-Y. Huang, W.-P. Huang, Y.-H. Lin,
C.-C. Wu**

AU Optronics, Taiwan

**Nat. Taiwan Univ., Taiwan*

As a strong candidate for AMOLED backplane, the novel oxide TFTs based on IGZO are fabricated and investigated. The devices reveal good environmental stability, good short-range uniformity, and moderate DC bias stress stability.

**AMD7 - 4 Amorphous In-Ga-Zn-O TFT-LCDs with High
14:20 Reliability**

*Y. Ohta, Y. Chikama, T. Aita, O. Nakagawa, T. Hara,
M. Suzuki, M. Takei, Y. Harumoto, Y. Mizuno, H. Nishiki,
N. Kimura*

Sharp, Japan

We have developed amorphous In-Ga-Zn-O (IGZO) TFTs with the inverted-staggered structure. The TFT performance is good enough for TFT-LCDs. In addition, we carefully evaluate the TFT reliability. The reliability of IGZO TFT-LCDs is also evaluated under high temperature ambient. In this report, we discuss our IGZO TFT process, performance and product-level reliability.

----- Break -----

14:50 - 16:20

TENGYOKU

AMD8: Oxide TFT (2)

Chair: T. Kamiya, Tokyo Inst. of Tech., Japan

Co-Chair: T. Noguchi, Univ. of the Ryukyus, Japan

AMD8 - 1: Invited Low Voltage Operating Amorphous Oxide TFTs

T. Kawamura^{,**}, H. Uchiyama^{*,**}, S. Saito^{*,**},
H. Wakana^{*}, T. Mine^{*}, M. Hatano^{*}*
^{*}Hitachi, Japan
^{**}JST, Japan

TFTs with a small subthreshold slope (SS) are required for low-voltage operating circuits on large and flexible substrates. Using In-Ga-Zn-O deposited at room temperature for a channel layer, we achieved 63 mV/dec, the smallest SS ever reported for oxide TFTs. To achieve the small SS, a fully-depleted off-state was employed.

AMD8 - 2: Invited Solution-Processed Indium Zinc Oxide Thin Film Transistors for AMOLED Operation

*J.-B. Seon, M.-K. Ryu, K.-B. Park, I. S. Kee, Y. G. Lee,
B.-W. Koo, S. Y. Lee, G. H. Kim^{*}, W. H. Jeong^{*}, H. J. Kim^{*}*
Samsung Advanced Inst. of Tech., Korea
^{}Yonsei Univ., Korea*

We introduce high-performance IZO thin films for use in TFTs and eventually for AMOLED operation. Spin-coated and annealed IZO thin films via sol-gel processing showed carbon-free and robust film properties. TFTs using these films exhibited n-channel characteristics with a field-effect mobility of $6.57 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$, which is enough for AMOLED driving.

AMD8 - 3 Solution Processed IGZO-TFTs with Various Gate Insulator Layers Applied to Active Matrix LCD

*Y.-C. Lai, C.-C. Yu, F.-W. Chang, L.-Y. Lin, M.-C. Wang,
H.-H. Gu, C.-Y. Huang, C.-C. Hsu, S.-C. Liu, Y.-H. Lai,
S.-H. Lai, S.-C. Chiang, S. Meyers^{*}, J. Anderson^{*},
A. Grenville^{*}, D. Keszler^{**}*
Taiwan TFT-LCD Assn., Taiwan
^{}Inpria, USA*
*^{**}Oregon State Univ., USA*

IGZO-TFTs with various gate insulators are fabricated via aqueous solution processing. The electrical stability and effect of illumination on IGZO-TFT devices is also investigated. In addition, a 4.1 inch QVGA AM-LCD driven by IGZO-TFTs is successfully demonstrated.

AMD8 - 4 Withdrawn**Author Interviews**

16:20 – 17:20

Supporting Organization:

Thin Film Materials & Devices Meeting

Workshop on FPD Manufacturing, Materials and Components

Wednesday, December 9

13:20 - 14:55

TENJU

FMC1: Manufacturing Technologies I

Chair: J. Koike, Tohoku Univ., Japan

Co-Chair: Y. Ukai, UDDI, Japan

FMC1 - 1 **Low-Temperature Growth of Si Film on Ytria-Stabilized Zirconia Stimulation Layer**

13:20

*S. H. Herman, T. Akahori, S. Horita
JAIST, Japan*

Poly-Si film was deposited directly on YSZ layer at 430 °C. However, the surface is relatively rough and Zr diffusion were found near the Si/YSZ interface. To solve these problems, solid phase crystallization of Si on YSZ was investigated. YSZ layer was found to be effective in both crystallization methods.

FMC1 - 2: **Invited Optimization of Source-Drain Contact Process with Cu-Mn Alloys**

13:40

*J. Koike, M. Sano, K. Hirota, Y. Sutou, K. Neishi
Tohoku Univ., Japan*

Cu-Mn alloy was deposited as a source-drain electrode on plasma-oxidized amorphous Si substrates. The oxidation conditions were optimized successfully to obtain a good diffusion barrier property, adhesion strength, and Ohmic contact.

FMC1 - 3: **Invited ZnO Thin Films Prepared by Plasma-Assisted Atomic Layer Deposition as an Active Channel Layer for Bottom-Gate TFT**

14:00

N. Hattori, K. Murata, N. Miyatake, Y. Kawamura,
Y. Uraoka*
Mitsui Eng. & Shipbuilding, Japan
Nara Inst. of S&T, Japan

In this study, we deposited ZnO thin film with PA-ALD as a TFT. We obtained highly-resistive ZnO films, being suitable for the active layer of the TFT at low deposition temperature. Radical oxygen contributes to reduce residual carrier concentration.

FMC1 - 4 TFT-LCD Panel by Using Soda-Lime Glass

14:20

*S. W. Chu, I. Yeh, J. N. Yeh, C. Y. Tu, H. W. Fan,
J. J. Lee, P. F. Yu, W. C. Tsai, C. H. Chen*

AU Optronics, Taiwan

Soda-lime glass with a lower material cost attracts its application in TFT LCD display. We has successfully demonstrated SLG, with a suitable barrier applied in both of array and color filter side, possibly manufactured in current standard process. This panel also passed 1000 hr THB and TST reliability test.

FMC1 - 5L Crystallinity of Microcrystalline Silicon ($\mu\text{c-Si}$) Deposited by ICP-CVD with Bipolar Pulse Substrate Bias

14:40

M. Furuta, T. Hiramatsu, H. Furuta, T. Hirao

Kochi Univ. of Tech., Japan

Microcrystalline silicon films were deposited by ICP-CVD with low frequency bipolar pulsed substrate bias. By applying the pulse bias to the substrate, crystallinity of the films considerably improved. The pulse substrate bias technique will be useful to improve $\mu\text{c-Si}$ crystallinity for large-area electronics.

----- Break -----

FMC

| | |
|--|--------------|
| 15:00 - 16:20 | TENJU |
| FMC2: Manufacturing Technologies II | |

Chair: T. Strutz, AKT, USA
Co-Chair: K. Dantani, ATMI Japan, Japan

FMC2 - 1: *Invited* Large Area Black/White Bistable Cholesteric Liquid Crystal Display and the Thermal-Addressing System

15:00

*P.-W. Liu, C.-C. Tsai, C.-H. Lee, W.-H. Huang,
C.-W. Chen, C.-Y. Wang, K.- C. Lee*

ITRI, Taiwan

A large area black/white bistable cholesteric liquid crystal display was made by a roll to roll process and the display area is 20cm X 100cm. The blended ChLC droplets with different wavelengths and black nano pigment was used in the display. This panel was written by a thermal-addressing system with high resolution and low cost.

FMC2 - 2: Invited Microbubble Effects in Dispense Trains

15:20

*G. Tom, W. Liu**ATMI, USA*

Bubbles in the dispensing system change the compressibility of the fluid in the pump. The time to reach equilibrium flow and the dispense volume accuracy are affected by the microbubbles, potentially resulting in non-uniform coating on the displays. A strategy to limit bubbles in dispense pump systems is presented.

FMC2 - 3 Novel RF Based Endpoint Detection for RPS Based CVD Chamber Cleaning

15:40

T. Strutz, T. Kitamura^{}, P. Lee^{*}, T. Kiyotake, T. Turner^{**},
E. Lu^{**}, J. Cannon^{**}**AKT, Japan**^{*}Appl. Materials, USA**^{**}Forth-Rite Tech., USA*

Monitoring of RF parameters of a localized plasma maintained in the exhaust line allows the identification of endpoint for PECVD chamber cleaning. The performance has been investigated for chamber cleaning after TFT and TEOS oxide depositions in an industrial type AKT CVD tool as used in display and solar industry.

FMC2 - 4 Low Cost LTPS Manufacturing Process with High Controllability Using Half Exposure Technology

16:00

*Y. Nakashima, H. Sera, T. Miyata, T. Umeno, T. Iwashita,
T. Matsumoto**Seiko Epson, Japan*

The high cost of LTPS TFTs is due to a complicated structure and, thus, a complex manufacturing process. To overcome this problem, we developed half exposure technology to reduce the photolithography steps, which account for the majority of the production cost.

----- Break -----

Call for Papers
**Special Section
on Electronic Displays**

IEICE Transactions on Electronics

Submission Deadline: Feb. 26, 2010

<http://ny7084.rie.shizuoka.ac.jp/eid/top-e.htm>

16:40 - 18:00

TENJU

FMC3: Environmental Friendly Technologies

Chair: R. Yamaguchi, Akita Univ., Japan

Co-Chair: T. Fujita, Univ. of Tokyo, Japan

FMC3 - 1: Invited Processing of Discarded Liquid Crystal Display for Recycling

16:40

*T. Fujita, G. Dodbiba**Univ. of Tokyo, Japan*

Two kinds of flow sheets for recycling of LCD have been proposed. The electrical disintegration of LCD under water is effective to split the two glasses at one time. If the LCD was crushed and incinerated, the vaporization method with chloride is effective for recovering ITO.

FMC3 - 2: Invited Business Model for Sustainable Society by Recycling Resources System

17:00

*M. Namura, M. Kohno**DOWA HOLDINGS, Japan*

The earth on which we live is in facing issues of global warming, depletion of natural resources and destruction of the environment. DOWA suggests one of solution to realize sustainable society by recycling resources system using renewal concept from established nonferrous smelting techniques.

FMC3 - 3: Invited Extraction of Lead from CRT Glass in Discarded TV Sets

17:20

T. Akai, H. Miyoshi, D. Chen, M. Yamashita**AIST, Japan***Shanghai Inst. of Optics and Mechanics, China*

We present a method for the extraction of lead from cathode ray tube glass, utilizing subcritical water. Lead in the glass can be removed by hydrothermal treatment followed by acid leaching. We also review other alternative methods to extract heavy metals, considering their practical feasibilities.

FMC3 - 4: Recycling Technology for Resist Stripper Ethylene Carbonate to Decrease the Environmental Load

17:40

H. Ota, H. Otsubo, M. Yanagi, Y. Kamimoto, H. Fujii***Nomura Micro Sci., Japan***Kanagawa Ind. Tech. Ctr., Japan*

The technology was examined to reuse "Ethylene Carbonate", a stripper for photo resist, by adding ozone gas and decomposing dissolved photo resist in the "Ethylene Carbonate". By using this technology for stripping photo resists, it is possible reduce the environmental load compared to the amine system stripper used today.

Thursday, December 10

9:00 - 12:00

3F Foyer

Poster FMCp: FPD Manufacturing, Materials & Components

FMCp - 1 Effect of Processing Variables on the Growth Behavior of Impurity-Doped GxZO Thin Films by DC-Magnetron Sputtering Method

K.-H. Seo, C.-W. Kim, Y.-W. Yoo, M. Park, K.-N. Lim, S.-J. Yu

LG Display, Korea

In the present study, impurities doped GxZO thin films were prepared by dc-magnetron sputtering on glass substrate and effect of processing variables on the growth behavior was investigated.

FMCp - 2 Local Deposition of SiO_x Using an Atmospheric-Pressure Microplasma Jet from a Tetraethoxysilane for a Gate Dielectric Layer of ZnO Thin-Film Transistors

T. Pang, Y. Ding, J. Jie, H. Jia, H. Shirai*

Saitama Univ., Japan

**AIST, Japan*

Local deposition of SiO_x was studied using an atmospheric-pressure microplasma jet (AP-MPJ) from a tetraethoxysilane ((Si(OC₂H₅)₄), TEOS) and O₂ mixture. Bottom-gated sputtered-ZnO thin-film transistors with a AP-MPJ SiO_x as a gated dielectric layer exhibited relatively high mobility of 24 cm²·V⁻¹s⁻¹, threshold voltage of 14 V and on/off current ratio of ~10⁴.

FMCp - 3 Characterization of AZOY Films Deposited at Room Temperature by RF Magnetron Sputtering

Y.-Y. Chen, R.-C. Chang, C.-H. Yang, C.-C. Chang***

Tatung Univ., Taiwan

**St. John's Univ., Taiwan*

***Chunghwa Picture Tubes, Taiwan*

AZOY films were deposited on glass and PET substrates at room temperature by RF magnetron sputtering, and then their optical, electrical, structural, and mechanical properties were measured to determine an optimal sputtering power.

FMCp - 4 Surface Morphology and Reliability Evaluation of Insulating Films on Stainless Steel Foil

*N. Yamada, T. Ogura, S. Ito, Y. Kubo
Nippon Steel, Japan*

We have developed three kinds of insulating films, i.e., HT, MT and HP. HT showed high heat-resistance. MT had a high resistance against cracks. HP showed an excellent planarization ability and negligibly small amount of moisture uptake under the conditions of 85%RH at 85°C.

FMCp - 5 Optical Properties Dependence of After-Rubbing Cleaning Process Conditions in TFT-LCD

*F. G. Xu^{***}, L. B. Mao^{**}, I. Yang^{**}, Y. W. Chiu^{**},
D. C. Chung^{**}
^{*}Inst. of Jiangsu (IVO) FPD Tech. & Res., China
^{**}InfoVision OptoElect., China*

The purpose of the research is to investigate the effect on optical properties from After Rubbing Cleaning (ARC) oven in TFT LCD processing. These information are used as guidelines to define the appropriate parameters for manufacturing process.

FMCp - 6 Development of High Productivity Ion Implanter MAGIC-i for Flat Panel Displays

M. Ogura, T. Ikoma, S. Harada, K. Shimamura, N. White^{}
Mitsui Eng. & Shipbuilding, Japan
^{*}ALBION, USA*

We developed a novel ion implanter with low cost of ownership such as maintenance, floor space and weight, by using new beam-line. Productivity of the ion implanter is 40% higher than that of previous model.

FMCp - 7 Withdrawn**FMCp - 8 Simulation Modeling of TFT-LCD Color Filter Fab**

*J. C. Chen, P. B. Huang, C.-J. Sun, K.-J. Chao,
G. C. Chao, J.-W. Chien, C.-C. Chen^{*}, C.-N. Mo^{*},
T.-W. Peng^{*}, Y.-Y. Wei^{*}, C.-H. Feng^{*}, Y.-C. Liu^{*},
M.-T. Chiang^{*}
Chung-Yuan Christian Univ., Taiwan
^{*}Chunghwa Picture Tubes, Taiwan*

This paper developed an AutoMod simulation model and conducted validation analysis for a real-world TFT-LCD Color Filter Fab. Based on the simulation model with animation, decision makers can conduct what-if analysis for the selection of order assignment and lot release alternatives.

FMCp - 9 Design and Implementation High Coupling Apparatus between LED and Light Guide*C.-W. Su, T.-Y. Li, C.-C. Chang**Chunghwa Picture Tubes, Taiwan*

We have designed high coupling apparatus between LED and light guide which is called T-type coupling. The structure of the T-type apparatus is very simple and the fabrication process more cost down. The high reflective-coupling apparatus can enhance optical efficiency, and then solve bright line question and thermal problem.

FMCp - 10 Withdrawn**FMCp - 11 Withdrawn****FMCp - 12 Integrated Light-Guided Plates (LGPs) with Optimized Pyramid-Like Microstructures***Y.-Y. Chang, W.-H. Yang, H.-C. Yeh, C.-J. Ting, H.-H. Lin, J.-H. Tsai**ITRI, Taiwan*

The illumination angle of LGPs is controlled by optimized pyramid-like microstructures, which can be fabricated by anisotropic etching technology with a tilted (100)-oriented silicon wafer. High on-axis brightness is achieved without using brightness enhancement films.

FMCp - 13 Characteristics of Microlens Array Optical Sheets with Apertures*S. H. Baek, S. K. Hwang, G. Park, J. S. Gwag, J. H. Kwon, W. T. Moon*, S. H. Kim*, B. K. Kim*, S.-H. Kang*, Y. S. Park****Yeungnam Univ., Korea***LG Display, Korea****ADMRC, Kyungbook Nat. Univ., Korea*

Optical sheets with microlens array and cone array with apertures are fabricated by the diffuse lithography. The simulation showed that the optical sheets with apertures have normal luminance compatible with the dual crossed prism sheets.

FMCp - 14 Withdrawn

FMCp - 15 Practical Model to Analyze the Characteristics of CCFL for Backlighting*K. Misono**Tsuruoka Nat. College of Tech., Japan*

We have developed a practical model to analyze the characteristics of CCFL for backlighting. This model predicts the energy balance and the radiation efficiency of 254(nm) with the accuracy of 10% or better for given design parameters. The design parameters to improve the radiation efficiency over 30% are obtained.

FMCp - 16 An Efficient Thermal Stress Estimation Using Block Adaptive Filtering*M.-L. Tai, P.-C. Chien**Chunghwa Picture Tubes, Taiwan*

We had proposed fast thermal stress estimation methodology for the components on FPD electronic system board within specific ambient temperature. Now, we will propose one more efficient estimation methodology for the FPD electronic system board.

FMCp - 17 Simulation Study of the Edge-Lit Backlight Unit for LCD Monitor Applications*J. H. Lee, Y. H. Ju, K.-B. Nahm, J.-H. Ko, J. H. Kim***Hallym Univ., Korea***Samsung Elect., Korea*

A simple edge-lit backlight model for LCD monitor was studied using a ray-trace technique. The obtained simulation results were compared with those from experiments carried out on the 17-inch edge-lit backlight. The simulation technique based on a simple model may be a useful method for estimating and improving backlight performances.

FMCp - 18 Transparent PC-Based Composite Display Substrate*G. Kim, S.-M. Yoon, H. Chun***ETRI, Korea***KITECH, Korea*

Transparent polycarbonate-based composite substrate for flexible display was developed. This composite substrate with good processability and optical properties shows a high potential for FPDs as a flexible display substrate.

FMCp - 19 Development of a Low Thermal Shrinkage Glass Substrate for LTPS TFT-LCD

*T. Kawaguchi, Y. Kato, S. Miwa, H. Yamazaki
Nippon Elec. Glass, Japan*

We developed a low thermal shrinkage glass substrate for LTPS TFT-LCD without polishing process. By optimization of forming condition in the overflow down-draw process, we can dramatically reduce the thermal shrinkage of glass substrate. This substrate is also suitable for OLED panel.

FMCp - 20 A Spy on Solid-State Photopolymerization: Real-Time FT-IR Spectroscopy to Watch the Photoreaction of a Negative-Type Photoresist

*S. C. Lee, C. Lee, K. W. Lee, S.-H. Kim, S. J. Oh
LG Chem, Korea*

Real-time Fourier-transform infrared spectroscopy has been used to monitor the photoreaction occurring in a negative-type photoresist. Effects of the thickness of a thin film, the concentration of a photoinitiator and the intensity of exposed ultraviolet light were investigated.

FMCp - 21 Proposals of a Curtailed Process for Manufacturing LC Panels with New-Type Sealants

*H. Sakurai, H. Takeda, Y. Ono
DIC, Japan*

We propose a novel ODF process for manufacturing LC panels with delayed cure sealants. In the novel process, the dispensed sealant on a substrate is irradiated by UV light before superposition of two substrates. The nonthermal process will generate shortening a total manufacturing time, cost reductions and accuracy improvements.

FMCp - 22 Synthesis of Fullerene/Polystyrene Composite Nanoparticles by Emulsion Polymerizations

*K.-J. Kim, S. Park, M.-H. Lee
Chonbuk Nat. Univ., Korea*

Fullerene/polystyrene nanoparticles having the average size of 300 nm ~ 1 μ m were prepared by emulsion polymerization in aqueous medium. The contents of fullerene in the nanoparticle were confirmed by IR-spectroscopy, thermogravimetric analyses. Further characterizations of the nanoparticles were performed by using DSL, SEM and TEM observation.

FMCp - 23 Reliability Improvement of a-Si TFT Using Low Water Absorption Type of Photosensitive Passivation Layer with Low Dielectric Constant

*K. Sugitani, A. Tanabe, M. Hanmura, H. Ohmori, T. Katoh
ZEON, Japan*

We developed low water absorption type of photoactive passivation layer with low dielectric constant (PPLD). We identified the correlation between the off-leakage current of a-Si TFT and the water absorption of the passivation layers. And hydrophobizing the passivation layer is effective in improvement the property of TFT devices.

FMCp - 24 Transfer of Graphene from HOPG to Substrates by Controlling Their Surface Properties

*K.-B. Kim, J. Choi
Kyung Hee Univ., Korea*

We studied the transfer behavior of graphene from highly oriented pyrolytic graphite (HOPG) to various substrates by investigating the surface properties of the substrates for the development of transparent conducting electrodes.

FMCp - 25 Ultrathin Nickel Metallic Layer on Glass as a Transparent Electrode

*C.-M. Lee, J. Choi
Kyung Hee Univ., Korea*

A very thin nickel film on glass was studied as a potential transparent electrode, that can be utilized in future electro-optic devices such as displays, solar cells and light emitting diodes.

FMCp - 26 Effect of Targets Used on Preparation of Impurity-Doped ZnO Transparent Electrodes by DC Magnetron Sputtering Deposition

*J. Oda, J. Nomoto, M. Konagai, H. Fukada, T. Miyata,
T. Minami
Kanazawa Inst. of Tech., Japan*

In preparation of transparent conducting Al- or Ga-doped ZnO thin films by conventional dc magnetron sputtering deposition, we investigate the key factors in the deposition conditions that are necessary for practical use in transparent electrode applications. Targets optimized to deposit thin-film transparent electrodes tend to exhibit lower oxygen content.

FMCp - 27 Preparation of Black Absorber Layer for Cholesteric Liquid Crystal Display

*C.-C. Weng, I.-J. Cheng, Y.-C. Lin, K. T. Hung
ITRI, Taiwan*

A novel black absorber layer for cholesteric liquid crystal display was disclosed. In this study we report that, the modified carbon black could be dispersed well in water solution and the black absorber layer presents O.D. $>2.0/1\mu\text{m}$ film and the surface resistivity will increase 3 orders from 10^5 to 10^8 .

FMCp - 28 Withdrawn**FMCp - 29 Preparation of Negative C-Type Optical Anisotropic Film with Embedded Positive A Layer**

*C.-M. Wu, M.-T. Wu, S.-Y. Lin, K.-T. Huang
ITRI, Taiwan*

The present article relates to a liquid crystal composition and a method for manufacturing the same, and in particular relates to manufacture a positive A film-embedded negative C optically anisotropic coating applied in a vertical alignment LCD.

FMCp - 30 Novel Coatable Negative C-Plate Retarder

A. Lazarev, A. Geivandov, I. Kasianova*
Crysoptix, Japan
Kontrakt, Russia

Crysoptix developed guest-host lyotropic liquid crystal material for manufacturing coatable LCD retarders. The biaxial BA-type birefringent films (retarders) contain, as host component, supramolecules based on Crysoptix sulfonated aromatic compound. We enhanced guest-host system by NZ-factor adjusting agents that allow producing retarders with desired optical and good mechanical properties.

FMCp - 31 A Novel High Retardation Polymer Film for Liquid Crystal Displays

D. Kobayashi^{,**}, A. Tagaya^{*,**}, Y. Koike^{*,**}
^{*}Keio Univ., Japan
^{**}ERATO-SORST/JST, Japan*

The high retardation polymer film (HRPF) device for liquid crystal displays using the interference color was proposed. The HRPF was prepared by uniaxially heat drawing polycarbonate. Consequently, the interference color through polycarbonate films which had retardation more than 8000 nm exhibited a similar spectrum to that of the light source.

FMCp - 32 Optical Performance of Polarizer Varied with Time

*M. Lee, Y.-L. Cheng, L.-C. Ling, C.-J. Chang, P.-H. Kuo,
H.-T. Li, C.-S. Chen*

Chunghwa Picture Tubes, Taiwan

Polarizer is made of several films laminated together by special adhesive. Recently, we placed LCD for a period of time. However, the results of LCD's contrast and view angle were getting worse. We eventually found the poor absorbent of polarizer is main reason.

FMCp - 33 Large Size of Multi-Touch Projected Capacitive Touch Panel

*M.-T. Hsieh, C.-M. Lin, H.-F. Yin, C.-C. Chen, H.-A. Li,
C.-N. Moon*

Chunghwa Picture Tubes, Taiwan

The projected capacitive multi-touch panel for large size in 10.1 inch has been developed successfully. It includes 26 x-traces with 16 y-traces also over 90% of transmittance and support multi-touch function. This suitable apply in netbook, notebook or MID etc.

FMCp - 34 Withdrawn**FMCp - 35 Optimizing Etching Parameters in High Density Plasma Etcher with Planar Coil**

C. Wei, Y.-H. Chen^{}, Y.-H. Chien*

Tatung Univ., Taiwan

^{}AU Optronics, Taiwan*

The high density plasma etcher is widely used in flat panel display. The planar coil configuration (N-slot) has the advantage of less footprint and more economical. This study investigates the etch conditions of SiO_x with Taguchi method. A high etching rate and good uniformity is achieved with this approach.

FMCp - 36L Enhanced Cell Filling Efficiency with Plasma Treated Flexible PET Cells Using a Roller-Pressing Technique

W.-T. Wu, C.-C. Liu, C.-M. Hsu, C.-C. Li^{}*

Southern Taiwan Univ., Taiwan

^{}ITRI, Taiwan*

A roller-pressing unit was employed to laminate plasma treated PET films and fill cholesteric liquid crystal into flexible cells in atmosphere. The plasma treatment enhanced the cell filling efficiency by a factor of 8 with the maximum speed of 40mm/s. This approach can potentially be integrated into a roll-to-roll system.

FMCp - 37L Manufacturing Method of New Optical Films for LCDs

T. Yosomiya, K. Watanabe

Dai Nippon Printing, Japan

We have been developing retardation-controlled polypropylene-based films. The Re value (in-plane retardation) of the new optical films made by water-cooling inflation extrusion is less than 10nm. These optical properties show high durability under accelerated conditions. The low Re value film can be used for protection films of LCD's polarizer.

FMCp - 38L PVA Polarizers Laminated with PET

A. Geivandov, P. Lazarev

Crysoptix, Japan

Conventional PET film (+A plate) when coated with Crysoptix Thin Birefringent Film TBF retarder can efficiently replace TAC substrate in LCD polarizer. New polarizer design for VA LCD and IPS LCD provides over 3 B USD cost reduction and improves durability.

FMCp - 39L Enhancement of Film-Compensated Twisted Nematic LCD by Using Cholesteric LC Retarder

P.-J. Hsieh, H.-L. Kuo

ITRI, Taiwan

Viewing angle of conventional film-compensated TN-LCD is greatly improved by a new optically compensated design. Simply a pair of additional cholesteric liquid crystal retarders is used in our design to give very high contrast ratio even over 70 degree viewing angle. Detailed optical modeling results are presented here.

FMCp - 40L Growth of Polycrystalline Si Film on Polycarbonate Substrate Prepared by Conventional Laser Annealing

N. Kawamoto, Y. Ono, T. Hanta, T. Imamura*, T. Miyishi*

Yamaguchi Univ., Japan

**Teijin, Japan*

This is the first report on growth of the poly-Si film on the polycarbonate substrate (PC) by conventional laser annealing. The grain size poly-Si grain on the PC was approximately 70 nm. We discuss the relationship between the damage of poly-Si film and the thermal property of the polymer.

FMCp - 41L Large-Grained Poly-Si Film Fabricated by Ni-SPC and Laser Recrystallization

*A. Hara, T. Sato, T. Sato
Tohoku Gakuin Univ., Japan*

A novel poly-Si substrate for SoG was designed by the selective fabrication of a large-grained poly-Si film in a Ni-SPC poly-Si film. The behavior of the Ni impurities was evaluated; it was found that Ni impurities stabilized by forming NiSi₂ at the triple junctions during low-temperature poly-Si TFT processes.

FMCp - 42L Optimum HTM (Half Tone Mask) Design Guide Applied by A-Si Gate Driver Circuit

*S. Choi, K. Kim, Y. Song, G. Hui, W. Lee, L. Huangfu,
J. Lee
BOE OptoElect. Tech., China*

Optimum HTM (Half Tone Mask) design applied by a-Si gate driver circuit had been established by simulation and experiments. We found that the transmittance of HTM was influenced by TFT channel length, size and shape. We proposed HTM design factor to improve process defects of TFTs in a-Si gate driver circuit area.

FMCp - 43L Influence of Hydrogen Annealing on Low Temperature (≤ 200 °C) Silicon Nitride Films for Display Devices

*K.-M. Lee, J.-D. Hwang, Y.-J. Lee, K.-S. No, W.-S. Hong
Univ. of Seoul, Korea*

The influence of hydrogen annealing on dielectric silicon nitride film and silicon nanocrystals embedded in silicon nitride film was investigated. These films were prepared by catalytic chemical vapor deposition technique at substrate temperatures below 200 °C. The optical and electrical properties of these films were improved by hydrogen annealing.

15:00 - 16:20

TENGYOKU

FMC4: Materials I

Chair: Pi.-C. Yeh , AU Optronics, Taiwan
Co-Chair: T. Unate, Sekisui Chem., Japan

FMC4 - 1: Invited Development of ITO Ink for Ink-Jet Printing: Evaluation of the Novel Ink

15:00

*O. Yamamoto
Akita Univ., Japan*

The ITO (Indium tin oxide) ink suitable to an ink-jet printing could be prepared successfully through an ozone treatment of the ethanol solution containing metal chlorides, which may give a high effective for fabricating displays and solar cells.

FMC4 - 2 Al/Ag/Al Thin Films Prepared by Sputtering for TFT Electrodes
15:20

*M. Kawamura, Y. Inami, Y. Abe, K. Sasaki
Kitami Inst. of Tech., Japan*

As a new material for TFT electrodes, modified Ag thin films (Al/Ag/Al films) were prepared by sputtering. By characterizations of the films before and after annealing, morphological stability, low electrical resistivity and ohmic contact with ITO films were confirmed.

FMC4 - 3 Fabrication of 15-in. XGA IPS Panel with Ga Doped ZnO Pixel Electrode
15:40

B. G. Choi, J. Kim, J. Lim, S. J. Lee*, J. Bang*, K. Park,
C.-D. Kim, Y. K. Hwang, I.-J. Chung
LG Display, Korea
LG Chem, Korea

Ga doped ZnO was used for transparent electrode of 15.0" XGA IPS AMLCD panel. The Ga concentration was determined to achieve low resistivity and high carrier concentration. Pixel patterning was conducted by using citric acid and the panel shows similar image quality to the panel with ITO electrode.

FMC4 - 4 Transmissive Low Outgassing Constructional Material for Organic Light Emitting Display
16:00

*T. Natsume, M. Hanmura, H. Ohmori, T. Katoh
ZEON, Japan*

For Organic Light Emitting Display (OLED), we developed Transmissive Low Outgassing Constructional Material (TLOC). TLOC has the high adhesion, the low outgassing characteristic, and the high transparency. For the characteristics, TLOC can be used as both planarization layers and partition walls for bottom-emission Active Matrix OLEDs (AM-OLED).

----- Break -----

16:40 - 18:00

TENGYOKU

FMC5: Materials II

Chair: X. Chu, Vitex Sys., USA
Co-Chair: K. Miyazawa, Chisso, Japan

FMC5 - 1: Invited LC Alignment Control Using Reactive Mesogen Mixed with Alignment Layers
16:40

Y.-J. Lee, Y.-K. Kim, S. I. Jo, C.-J. Yu, J.-H. Kim
Hanyang Univ., Korea

We proposed a new method for controlling alignment and orientation of liquid crystal molecules through surface modification using UV curable reactive mesogen mixed with alignment layers for high display performances.

FMC5 - 2 Alignment Properties of Reactive Liquid Crystals Affected by the Characteristics of a Rubbed Polyimide Film
17:00

P.-C. Yeh, C.-W. Chen, C.-H. Shih, W.-M. Huang
AU Optronics, Taiwan

Alignment properties of reactive liquid crystals affected by the characteristics of a rubbed polyimide are discussed. The density of rubbed grooves of alignment layers is the key factor to influence the alignment of reactive liquid crystal.

FMC5 - 3 A Simple Correction to Thin Panel Strength Value from 4-Point Bend Test
17:20

T. Ono, G. Pai, S. Gulati***
Corning Tech. Ctr., Japan
**Corning Display Tech., Taiwan*
***Corning, USA*

Panel strength value converted from failure load measured by a bending test might be significantly lower than actual strength if the converting equation is inappropriate. This paper describes a simple method to correct the strength value.

FMC5 - 4 Properties of Silplus Films Constructed from Organic-Inorganic Hybrid Materials, Containing Cage-Type Silsesquioxane Structures
17:40

T. Saito, T. Morimoto, M. Isozaki, H. Ando, K. Hayashi
Nippon Steel Chem., Japan

Silplus, new organic-inorganic hybrid materials containing cage-type silsesquioxane structures, possess several unique properties in optical, thermal, and mechanical. Silplus films have potential to be applied to substrates of flexible displays for its high heat resistance, transparency, and low-birefringence.

Author Interviews

18:00 – 19:00

Friday, December 11

9:00 - 10:20

TENJU

FMC6: Backlight I

Chair: D. den Engelsen, Brunel Univ., UK
 Co-Chair: Y. Yang, Sony, Japan

FMC6 - 1 Does a Field Emission Backlight Make Sense?

9:00

*D. den Engelsen, J. Silver, R. Withnall, T. G. Ireland,
 P. G. Harris
 Brunel Univ., UK*

We review the principles for maximizing lumen efficacy and luminance of field emission backlights with diode and triode emitter structures. In order to suppress phosphor saturation it is recommended that the field emission backlight is driven at least two times faster than the LC-panel; so either at 120 or 240Hz.

FMC6 - 2 Optical Design for an Ultra-Thin, LED Based, 2D Dimmable Backlight

9:20

E. Onac, S. Bierhuizen, G. Eng*
 Philips Res. Eindhoven, the Netherlands
 Philips Lumileds Lighting, USA

A novel architecture for realizing thin, 2D dimmable backlights is introduced. Light emitting diodes (LEDs) are distributed over the backlight surface and can be individually controlled to illuminate different areas of the display. Mixing light from more LEDs makes the system robust against differences in LED efficiencies and color points.

FMC6 - 3 Ultra Thin LED Backlight System Using Tandem Light Guides for Large-Size LCD-TV

9:40

*T. Masuda, Y. Ajichi, T. Kubo, T. Yamamoto,
 T. Shinomiya, M. Nakamura, T. Shimizu, N. Kasai,
 H. Mouri, X.-F. Feng*, M. Teragawa
 Sharp, Japan
 Sharp Labs. of America, USA

We developed an ultra thin RGB-LED backlight system for 52" and 65" LCD-TV. It is constructed by pairs of RGB-LED and a tandem light guide (TLG). In this paper, we describe novel improvements of the TLG, correction of device-to-device variations of RGB-LED, and adequateness for local dimming techniques.

FMC6 - 4 Short-Afterglow CCFL for Blinking Backlight

10:00

*T. Igarashi, T. Kusunoki**Sony, Japan*

A novel CCFL backlight-unit with a short afterglow has been developed, which improves image quality under blinking operation. The backlight unit consists of CCFLs with only blue- and red-emitting phosphors in combination with a green-emitting diffuser plate.

----- Break -----

10:40 - 12:20

TENJU

FMC7: Backlight II

Chair: K. Kälantär, Nipponleiz, Japan

Co-Chair: M. Shinohara, Omron, Japan

FMC7 - 1 Colour Separation Module Realized by Roll-to-Roll

10:40

Imprinting for Green TFT-LCD*C.-H. Lee, H. H Lin, C.-H. Liao**ITRI, Taiwan*

A colour separation module consists of an aspheric lens array and a blazed grating was fabricated by the roll-to-roll imprinting to replace the dye colour filter. Its measured transmission efficiency was three times more than that of conventional colour filter.

FMC

FMC7 - 2 Micro-Blazed Grating Fabricated by Roll-to-Roll

11:00

Imprinting for LCD Applications*C.-H. Lee, H.-H. Lin, C.-H. Liao**ITRI, Taiwan*

A blazed grating with a period of $4\mu\text{m}$ was fabricated by the roll-to-roll imprinting to split colour. Its process challenging parameters, including the control of temperature variation, the diamond tool's lifetime, the UV exposure energy and the UV resin's feeding rate.

FMC7 - 3 A Novel LCD Using a High Definition Scattering Film

11:20

T. Saruta^{,**}, A. Tagaya^{*,**}, Y. Koike^{*,**}**^{*}Keio Univ., Japan**^{**}ERATO-SORST/JST, Japan*

We proposed a novel liquid crystal display (LCD) using a high definition scattering film and a directional backlight. The novel LCD showed the equivalent luminance properties to those of a commercial one with simple structure without using precisely controlled phase difference films.

FMC7 - 4 Micro-Lens Array Formation by Offset Printing
11:40*A. Kishioka, S. Sekiguchi, T. Sugita, S. Komura*,
M. Sasaki***Hitachi, Japan***Hitachi Displays, Japan*

A new MLA formation technology on LCDs by offset printing has been described. We fabricated a VGA transmissive LCD combining the MLA formed by this technology and a collimated backlight. The LCD offers 2.4 times higher on-axis luminance as that of a conventional device and was suitable for mobile displays.

FMC7 - 5 Design and Fabrication of a Multifunctional Light
12:00 **Guide Plate for LCDs***K. Kim, M. Kubota, K. Nakatsuka**Sumitomo Chems., Japan*

We developed a two step design method that optimizes angular range of output light and polarization splitting ratio separately. Using this method, we designed and fabricated multifunctional light guide plate which integrates various optical functions together. Optical characteristics of the fabricated multifunctional light guide were close to the design targets.

----- Lunch -----

13:20 - 14:55**TENJU****FMC8: Optical Films I**

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

Co-Chair: H. Yoshimi, Nitto Denko, Japan

FMC8 - 1 New Clear-AR Film by Wetting Process Suitable for
13:20 **Surface Film of Large Size LCD-TVs***T. Oikawa, K. Inoue, T. Suzuki, Y. Mitsumori, S. Yasuda,
Y. Suga, K. Mihayashi**FUJIFILM, Japan*

We have succeeded in the development of a new surface film "New Clear-AR-Film" having AR-multi-layers by wetting process, that shows both low reflectance ($\leq 0.5\%$) and color neutrality of reflected light. This excellent optical characteristic has been realized by unique multi layers optical design.

**FMC8 - 2 Micropillar Array Hybrid Antireflection Structure for
13:40 Prevention of Newton's Rings in Mobile Displays**

*K. Sanari, T. Minobe, Y. Takagi, Y. Yamamoto, Y. Ito
OMRON, Japan*

To prevent the formation of Newton's rings between mobile displays and transparent covers, we developed a micropillar array hybrid antireflection structure (ARS). The micropillar (height 2.5 μm , diameter 5 μm) is arranged on the ARS surface. Newton's rings were successfully prevented with only a slight change in the reflectance.

**FMC8 - 3 Novel Nano-Scale Multi-Layered Compensation Film
14:00 for IPS-LCDs**

*Y. Ono, A. Uchiyama, S. Kitazawa, J. Matsuo, T. Shiro
Teijin, Japan*

We have developed a novel Z-plate compensation film with nano-scale multi-layered structure. The optically biaxial characteristics ($n_x > n_z > n_y$) of this Z-plate are controlled by the combination of the form birefringence and the molecular orientation birefringence. This Z-plate exhibits some superior properties as a compensation film for IPS-LCDs.

**FMC8 - 4 Manufacturing of Coatable Guest-Host Retarder for
14:20 LCD**

A. Geivandov, E. Kharatiyan, A. Lazarev, P. Lazarev
Crysoptix, Japan
Kontrakt, Russia

Crysoptix developed a guest-host lyotropic liquid crystal material for manufacturing coatable LCD retarders. The biaxial B_A -type birefringent films (retarders) contain, as a host component, supramolecules based on Crysoptix sulfonated aromatic compound. We enhanced guest-host system by NZ-factor adjusting agents that allow producing retarders with desired optical and good mechanical properties.

**FMC8 - 5L Large-Area Seamless Motheye Films by Roll-to-Roll
14:40 Process**

*S. Endoh, O. Shigehisa, K. Hayashibe, H. Tazawa,
S. Kajiya, H. Takahashi
Sony, Japan*

We've developed seamless large-area nanoimprint display films by roll-to-roll manufacturing process. Fabricating Motheye nano-structures on the display film, we can reduce the residual reflectance to 0.04% or less. By forming such structures on 3-faces of display panel components, we've obtained quite low glare device whose transmittance is increased by 12%.

----- Break -----

15:00 - 16:20

TENJU

FMC9: Optical Films II

Chair: T. Miyashita, Tohoku Univ., Japan

Co-Chair: T. Uchiyama, Teijin, Japan

FMC9 - 1 Large Area Fabrication of Periodic Microstructures Using "Nano-Buckling System"

15:00

*T. Okayasu, Y. Mori, K. Muto, C. Yoshimura, Y. Nishikori
Oji Paper, Japan*

Combination of a top layer and a heat shrinkable film enabled to form periodic microstructures on the surface of the top layer over a large area. The length scale of the structures produced by this technology that we named "Nano-buckling" ranges from 50nm to 10,000nm.

FMC9 - 2 The Performances of Collimated Backlight and Front Diffusing Systems about Several LC Modes

15:20

*H. Takemoto, T. Fuchida, S. Shutou, M. Miyatake
Nitto Denko, Japan*

We compared the effects of enhancing contrast ratio by the collimated backlight and front diffusing systems on several LC modes. We composed the display system using conventional optical components and confirmed the benefits of the system. We designed target properties of these optical components.

FMC9 - 3 Use of Polarization-Scrambling Filter for Secure Display

15:40

*H. Yamamoto, K. Kajimoto, T. Imagawa, S. Suyama
Univ. of Tokushima, Japan*

We propose a new secure display that prevents eavesdropping of display signal and peeping at the secret. We have fabricated a polarization-scrambling filter, which randomly rotates polarization angles. By utilizing the developed filter as a decoding key of optical encryption, the viewing zone of the decoded image is limited three-dimensionally.

**FMC9 - 4 2-D Birefringence Measurement System Using
16:00 Photonic Crystal Technology**

*T. Kawashima, F. Laurent, H. Yoh, T. Chiba , T. Sato,
S. Kawakami*

Photonic Lattice, Japan

We have developed a 2-D high-speed birefringence measurement system having a polarization image sensor, using a 384 × 288 segmented photonic crystal waveplate array. The system can measure retardation data in 0-3000 nm range in 10 seconds.

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

EXHIBITION

12:00–18:00 Wednesday, Dec. 9, 2009

10:00–18:00 Thursday, Dec. 10, 2009

10:00–14:00 Friday, Dec. 11, 2009

4F Foyer

World Convention Center Summit

Free admission with your registration name tag.

Workshop on Plasma Displays

Thursday, December 10

13:20 - 16:20

3F Foyer

Poster PDPp: Plasma Displays

PDPp - 1 **Influence of an Impurity Gas on the Discharge Characteristics of an AC PDP**

Y. Kamiya, Y. Hirano^{}, O. Akinori^{**}, K. Ishii^{*},
Y. Murakami^{*}, H. Hiramoto*

Nihon Univ., Japan

^{}NHK, Japan*

*^{**}Nagoya Inst. of Tech., Japan*

We used 3-D fluid simulation to investigate the discharge characteristics of a Ne/Xe and impurity mixture gas confined to an ultra-high-resolution PDP. Our calculations revealed a small amount of impurity gases increase energy transfer rates. Oxygen delays discharge by reducing the wall-charge but hydrogen does not delay discharge so much.

PDPp - 2 **Optimum Gas Mixtures for Xe Gas Excitation in a PDP**

A. Khorami, S. Ghanbari^{}*

IRIB Univ. and Univ. of Appl. Sci., Iran

^{}Univ. of Essex, UK*

This paper investigates Xe gas excitation efficiency through different gas compositions. It is demonstrated that by adding He or Ar partial pressure to the Ne-Xe mixture for a given pressure of He, Ne, Xe and Ar enhances excitation efficiency in comparison with Ne-Xe and He-Xe mixtures.

PDPp - 3 **Luminous Efficiency Increase through Uneven Surfaces in a Microcell Discharge of PDP**

A. Khorami, S. Ghanbari^{}, M. Mofidi^{**}*

IRIB Univ. and Univ. of Appl. Sci., Iran

^{}Univ. of Essex, UK*

*^{**}Univ. of Azad, Iran*

In this paper the microcell structure of plasma display panels (PDP) is investigated to enhance luminous efficiency. Due to the limitation in increasing Xe partial pressure, the luminous efficiency in PDPs is relatively low. This paper investigates the effect of an uneven surface on the luminance efficiency without increasing breakdown voltage.

PDPp - 4 Fabrication of PDP Barrier Ribs by Microtransfer Molding using Glass Fiber Reinforced PDMS Soft Mold and Demoldable UV Curable Paste

S. M. Ryu, D. Y. Yang, J. Y. So^{}, L. S. Park^{*}*

KAIST, Korea

^{}Kyungpook Nat. Univ., Korea*

Barrier ribs for PDP were fabricated by a micro-transfer molding process that used a soft mold and a UV curable paste. Glass fibers were reinforced in PDMS matrix. Mold release agents were employed in the paste in order to demold the barrier ribs easily from the soft mold.

PDPp - 5 Moved to FMCp - 35

PDPp - 6 Electro-Optical Characteristics of Functional Layer in AC PDP

C. G. Son, Y. G. Han, Y. H. Kim, B. S. Cho, Y. J. Hong, K. B. Song, E. H. Choi

Kwangwoon Univ., Korea

We have studied that the electro-optical characteristics of functional layers which have different kinds of MgO sub-micrometer size powder in AC-PDP.

PDPp - 7 Efficiency Improvement Characteristics Under Exhaust Method and Xe Gas Contents in AC PDP

T.-J. Kweon^{,**}, E.-Y. Jung^{**}, C.-S. Park^{*}, J.-N. Heo^{*}, H.-D. Park^{*}, J.-H. Kim^{*}, H.-S. Tae^{*}, E.-G. Heo^{**}*

^{}Kyungpook Nat. Univ., Korea*

*^{**}Samsung SDI, Korea*

In this paper, two experiments were performed. One is changed a Xe gas content to increase luminance, the other is changed exhaust method to decrease discharge voltage. As a result, if a Xe gas content is increased, discharge efficiency is improved. But, discharge voltage was increased. In order to improve this discharge voltage rise, high temperature exhaust method was employed by raising 20°C then conventional exhaust temperature.

PDPp - 8 Analysis of Power Reduction Effect in Applying Adiabatic Charge Circuit to PDP Driver Circuit

W.-F. Chen, Y. Sano

Toyo Univ., Japan

Square waveform driving current has been proved being able to minimize power consumption, 81% of energy recovery circuit. Proposed pseudo adiabatic charge circuits can reduce power consumption to about 0.9 of conventional circuit. We analyzed the power consumption caused by both resistance loss and discharge loss of parasitic capacitance.

PDPp - 9 Improvement of Address Discharge Time-Lag with a Positive Scan-Bias in Negative Waveform*W. H. Park, S. J. Lee, J. Y. Lee^{*}, J. Kang**Dankook Univ., Korea**^{*}Myongji Univ., Korea*

A negative waveform having inverted polarity of conventional waveform during reset and sustain periods was proposed to improve the driving characteristics. In order to control the negative wall-charge distribution, a positive bias voltage on the scan electrode was applied during reset period. Compared to 0V scan-bias condition, at 8V scan-bias the formativetime lag was improved about 23.95% and the average time lag was improved about 14.91 %.

PDPp - 10 Study on Priming Ramp Discharge of Self-Priming Addressing Driving Scheme in AC PDPs*H. N. Kim, T. S. Kim, B. J. Shin**Sejong Univ., Korea*

The self-priming addressing driving scheme could be significantly reduced the address discharge time lag using the self priming effect. In this study, the basic characteristics of the priming ramp discharge have been investigated with the various generation conditions and optimized the self-priming driving scheme.

PDPp - 11 IR Emission Characteristics during Negative Reset Period in HD and Full-HD Resolution PDPs*S. J. Lee, W. H. Park, J. Kang**Dankook Univ., Korea*

Comparative experiments were performed with 7 inch HD and full-HD resolution panels to improve the driving characteristics during reset period in ac PDPs. During ramp-up period IR emissions from the weak discharge generated by the negative waveform started earlier and more than emissions by the conventional positive waveform.

PDPp - 12 Color Image Data Processing with Single-Memory Group in PDPs*J.-F. Huang^{*}, X.-N. Zhang^{* **}, Z.-T. Tu^{*}, X.-L. Ding^{**}**^{*}Xi'an Jiaotong Univ., China**^{**}Tech. Ctr. of IRICO Group, China*

The data processing with single-memory is proposed in PDPs. The usage factor of memory and the time efficiency can be increased by 13% and 22%, respectively, while the number of memories is reduced by half.

PDPp - 13 Recent Progress in Color Plasma-Sphere Displays

*C. Wedding, E. Peters, J. Guy, O. Strbik, J. Davis,
D. Wedding**

Imaging Syss. Tech., USA

**Univ. of Toledo, USA*

IST has achieved significant progress in color Plasma-sphere displays. To date IST has demonstrated red, blue, and green Plasma-spheres that produce a peak white of 1700cd/m². Color Plasma-spheres have a good memory margin and priming. They will be used to make low cost large area displays for digital billboards.

PDPp - 14L Thermoluminescence Spectroscopy of Undoped MgO Exposed to Vacuum Ultraviolet (VUV) Radiation

M. Kitagaki^{,**}, C. L. Wang^{***}, K. Suesada^{*}, Z. L. Guo^{***},
J. Jue^{***}, X. Y. Zhang^{***}, C. L. Liu^{***}, S. L. Wu^{***},
H. Kajiyama^{*}*

**Hiroshima Univ., Japan*

***Tateho Chem. Inds., Japan*

****Xi'an Jiaotong Univ., China*

Thermoluminescence (TL) spectra of undoped MgO thin film exposed to VUV radiation are measured at the temperatures between 50 and 300 K. We observe a strong red emission at 700 nm. Secondly, Using Hoogenstraaten's heating rate method, the activation energy of the electron trap is estimated to be 58 meV.

16:40 - 18:00

TENJU

PDP1: Novel PDPs

Chair: L. F. Weber, Consult., USA
Co-Chair: M. Uchidoi, Panasonic, Japan

PDP1 - 1: *Invited* Extra Large Area Film Display with Plasma Tube Array Technology

16:40

*K. Shinohe, G. Bingang, H. Hirakawa, M. Ishimoto,
K. Awamoto, T. Shinoda*

Shinoda Plasma, Japan

The plasma tubes array is the film display which has wonderful characteristics such as emissive, ultra-thin, light-weight, flexible and low power consumption. In this paper, the basic structure and advantages of PTA are described. We had developed a prototype display of 3 m x 2 m screen size.

PDP

PDP1 - 2 **Progress on Development of Low Temperature Processing of Low-Cost ITO-Free PDP Using Soda-Lime-Silica Glass Substrate**
17:00

M. Samanta, A. K. Srivastava, S. Sharma, H. C Matpal, H. K. Dwivedi

Samtel Color, India

Novel dielectric compositions with processing temperature at 510C have been developed facilitating usage of soda-lime-silica (SLS) glass substrate for realizing an ITO-free PDP. This opens up a possibility of fabricating PDP with significant cost reduction in terms of materials and process over the PDP made using conventional PD-200 glass.

PDP1 - 3L **Address Characteristics and Hybrid Write- and Erase-Addressing of Ultra-High-Resolution PDP**
17:20

R. Mihara, T. Shiga, K. Ishii, Y. Murakami**

Univ. of Electro-Commun., Japan

**NHK, Japan*

Write and erase address characteristics of the ultra-high-resolution PDP are investigated. Gray scale expression is achieved with the hybrid write- and erase-addressing, contiguous-subfield driving scheme. Scan pulse widths of write and erase addressing are 1.0 μ s and 0.5 μ s, respectively when the data voltage is 55 V.

PDP1 - 4L: *Invited* Analysis of the Display Characteristics of a Large-Screen Ultra-High-Definition PDP by a New Plasma Array Simulation
17:40

Y. Hirano, Y. Murakami, M. Kumoi, R. Murai**

NHK, Japan

**Panasonic, Japan*

We propose a new plasma array simulation method in which discharge and circuit simulation are coupled to investigate the display characteristics of a PDP. In this paper, we introduce the calculation method and explain how it is used to predict the properties of a 100-inch-diagonal PDP with 3840 x 2160 pixels.

Author Interviews

18:00 – 19:00

Friday, December 11

9:00 - 10:20

TENYO

PDP2: MgO

Chair: H. Tolner, South East Univ., China
 Co-Chair: H. Kajiyama, Hiroshima Univ., Japan

PDP2 - 1 **Investigation of MgO:Al,N Films on Electron**
9:00 **Emission Properties**

*M. Nishitani^{***}, Y. Morita^{*}, M. Terauchi^{*}, Y. Yamauchi^{**},
 K. Yoshino^{*}, M. Sakai^{**}, Y. Takata^{**}, Y. Yamauchi^{***}*

^{*}Osaka Univ., Japan

^{**}Panasonic, Japan

^{***}NIMS, Japan

We tried to develop the high γ material in this study with the material surface characterization technique. Our material design concepts are to raise the top of the electron energy of the valence band, and to obtain the surface stability by introducing Al, N into MgO.

PDP2 - 2 **Discharge Property of MgO Thin Film as the**
9:20 **Protecting Layer of PDPs**

L.-Y. Chen, Y. Tanaka, A. Ide-Ektessabi

Kyoto Univ., Japan

This study focuses on the MgO protecting layer of PDPs for the reduction in their power consumption. MgO thin film was deposited at various temperatures, using IBAD, and doped with metallic elements. The relationships between the discharge property and other properties are discussed.

PDP2 - 3 **Analytical and Numerical Investigations of Diffusion-**
9:40 **Sticking Processes in MgO Sputtering**

T. Tamakoshi, M. Ikeda, S. Ho, K. Suzuki

Hitachi, Japan

A model of the diffusion-sticking processes in MgO sputtering is investigated. The Green function of the model is shown to have a Cauchy-type distribution. Using this function, the net-sputter distribution calculated numerically well reproduces the qualitative features of sputtering erosion on MgO surface observed by AFM measurement.

PDP2 - 4L 10:00 Influence of Initial Size Distribution of MgO Seed Particles on Reconstruction and Discharge Characteristics in AC-PDPs

S.-K. Kwon, J.-K. Choi, S.-Y. Park, C.-H. Choi*,
H.-S. Sim*, J.-S. Kwon*, J.-H. Kim*, J.-H. Lee*,
G.-S. Kim*, Y.-G. Kang*, K.-H. Park, S.-S. Han,
H.-S. Kim**

LGEARI, Korea

**LG Elect., Korea*

S. K. Kwon, et al. Influence of initial size distribution of MgO seed particles on reconstruction and discharge characteristics in AC-PDPs were investigated. Reconstruction behavior and exaggerated grain growth (EGG) were closely correlated with the initial size distribution of MgO seed particles on protective layer, which strongly affect discharge characteristics in AC-PDPs.

----- Break -----

10:40 - 12:00

TENYO

PDP3: High γ Materials

Chair: Y.-S. Kim, Hongik Univ., Korea

Co-Chair: R. Murai, Panasonic, Japan

PDP3 - 1 10:40 Discharge Characteristics of PDPs with High γ Protective Layer Manufactured by Using "All-in-Vacuum" Process

*T. Yano***, G. Uchida**, K. Uchida*, N. Awaji**,
T. Shinoda**, H. Kajiyama***

**ULVAC, Japan*

***Hiroshima Univ., Japan*

The SrCaO-PDP is perfectly manufactured by using the "all-in-vacuum" process without exposing a protecting layer to ambient air. The SrCaO-PDP(Xe:20%) shows 2.3 times larger luminous, 1.7 times larger luminous efficacy, and almost same discharge time-lag compared with that of MgO-PDP(Xe:4%).

**PDP3 - 2 Analysis of Xe Excimer Radiation in High γ AC PDP
11:00 with High Xe Contents**

G. Uchida, N. Awaji, T. Akiyama, S. Uchida**,
H. Kajiyama, T. Shinoda*

Hiroshima Univ., Japan

**Advanced PDP Dev. Ctr., Japan*

***Tokyo Metropolitan Univ., Japan*

We present analysis of excimer radiation in AC-PDP ignited by high γ_i cathode such as SrCaO. Temporal behavior of excimer radiation changes with Xe concentration, and decay time constant becomes as fast as a few hundred nsec in Xe discharge. Experiment shows that excimer radiation increases linearly with Xe pressure.

**PDP3 - 3 Air Stable High γ Discharge Protective Layer Covered
11:20 with Barrier Material**

M. Hasegawa, S. Fukuta, K. Betsui

Hitachi, Japan

We propose a double protective layer which consists of barrier layer for deterioration and high- γ material. The high- γ material covered with the appropriate barrier layer did not deteriorate when it was handled under air atmosphere, and PDP with the double protective layer showed low discharge voltage characteristic.

**PDP3 - 4 Discharge Properties and Chemical Stability of SrZrO
11:40 Films**

*Y. Fukui, Y. Honda, Y. Yamauchi, M. Okafuji, M. Sakai,
M. Nishitani, Y. Takata*

Panasonic, Japan

SrZrO films have superior chemical stability because of having few adsorption-sites due to their amorphous structure, and the firing voltage is 60 V lower than that of MgO films under a discharge gas of Ne/Xe=85/15, 60 kPa.

PDP

----- Lunch -----

SID 2010

International Symposium, Seminar and Exhibition
May 23–28, 2010

Seattle, Washington, USA

13:20 - 14:40

TENYO

PDP4: Electron Emission Mechanism

Chair: G. Oversluizen, Philips. Res. Labs., the Netherlands
 Co-Chair: Y. Murakami, NHK, Japan

PDP4 - 1 Computational Study for Designing High γ Protecting Layer: Development of Novel γ Estimation Method Based on Quantum Chemistry

K. Serizawa, H. Onuma, H. Kikuchi, K. Suesada^{},
 M. Kitagaki^{*}, I. Yamashita, A. Suzuki, H. Tsuboi,
 N. Hatakeyama, A. Endou, H. Takaba, M. Kubo,
 H. Kajiyama^{*}, A. Miyamoto
 Tohoku Univ., Japan
^{*}Hiroshima Univ., Japan*

For the good estimation of γ_{Xe} , we additionally introduced two reasonable characters of surface traps into the computational γ estimation method. The estimated γ values agreed with experimental results quantitatively and showed that larger number of trapped electrons can increase the γ value.

PDP4 - 2 Withdrawn

PDP4 - 4L Performance of the Efficacy Enhancement Layer Using Nano-Particles in PDPs

*S. Nagano, S.-H. Jang, J.-W. Kang, Y.-M. Yu, C.-G. Lee,
 D.-H. Choe
 Samsung SDI, Korea*

A nano-particle layer was experimentally applied in-between the conventional dielectric layer and the MgO thin film. This remarkably reduces the discharge current and then enhances high luminous efficacy. Moreover, the layer significantly improves the statistical delay of address discharge by its affection on the MgO thin film growth.

PDP4 - 3 Trap Level Design of MgO Protective Layer for High-Speed Address Discharge in AC PDPs

*S. Mori, T. Kusunoki, S. Ho, T. Miyake, Y. Mikami,
 M. Shiiki, K. Suzuki
 Hitachi, Japan*

An advanced technique for trap level design of MgO is proposed to achieve high-speed address discharge. This technique is verified using doped MgO. Sc-doped MgO is effective for high-speed address discharge because its density of energy states of electron emission source is distributed widely in the effective energy region.

PDP4 - 5L High-Frequency Sustain for the High Efficiency PDP
14:20*J.-P. Choi, J.-W. Kwak, K.-C. Cho, B.-N. Ahn, S.-H. Moon*
LG Elect., Korea

This paper examines the high-frequency sustain-driving which can increase efficiency by about 10%. This effect considers energy recovery operations and display load for the real driving in PDP. Also, power consumption is reduced by about 5% using the optimized method.

----- Break -----

15:00 - 16:20

TENYO

PDP5: Essentials of PDP PhysicsChair: S. Mikoshiba, APDC, Japan
Co-Chair: Y.-S. Kim, Hongik Univ., Korea**PDP5 - 1: Invited PDP Gas Discharge Physics**

15:00

K.-W. Whang, H.-Y. Jung, O. Kwon
Seoul Nat. Univ., Korea

We analyzed the discharge characteristics of high γ cathode material PDP with 2-D computer simulation. When Xe content varies from 10% to 30% for two secondary electron emission coefficients representing the values of MgO and SrO, the discharge mechanisms of voltage reduction and discharge efficacy improvement in high γ case have been studied in detail. The high γ case shows high secondary electron flux near the electrode gap region.

PDP5 - 2: Invited Progress of PDP Protective Layers

15:40

H. Kajiyama
Hiroshima Univ., Japan

The development of high γ protective layer is the urgent issue for PDP. The band engineering approach for high γ and the electron emission dynamics are discussed.

Author Interviews

16:20 – 17:20

Sponsor:

Plasma Display Technical Meeting

Workshop on EL Displays and Phosphors

Wednesday, December 9

13:20 - 16:20

3F Foyer

Poster PHp: Phosphors

PHp - 1 Luminescence and Compositional Analysis of $Y_3Al_5O_{12}:Ce^{3+}$ Films Fabricated by Pechini-Type Sol-Gel Deposition

J. R. Oh, E. K. Seo, Y. R. Do

Kookmin Univ., Korea

YAG:Ce (Ce^{3+} -doped $Y_3Al_5O_{12}$) thin film phosphors (TFPs) were deposited using a Pechini-type sol-gel spin-coating method on sapphire substrates to form uniform thin films that were then crystallized by annealing. This process can overcome most of the difficulties and disadvantages that frequently occur in the alkoxide-based sol-gel processes.

PHp - 2 Preparation of $SrY_2S_4:Eu$ Phosphors by Flux-Aided Solid-State Reaction Using Quartz Ampule

J.-H. Oh, Y.-R. Do

Kookmin Univ., Korea

Eu-doped SrY_2S_4 red phosphors were synthesized from SrS, Y_2S_3 , EuS, S and various fluxes in flux-aided solid-state reactions. $SrY_2S_4:Eu$ phosphors were calcinated in a quartz ample at $950^\circ C$ for 6 hours. The optical properties of the $SrY_2S_4:Eu$ shows a red emission located at $\sim 630nm$ with excitation at $365nm$.

PHp - 3 Synthesis and Luminescence Properties of a Green-Emitting $CsSrPO_4:Eu^{2+}$ Phosphor for near UV LED Excitation

D. S. Kang, H. S. Yoo, D. Y. Jeon

KAIST, Korea

Luminescence properties of a green-emitting $CsSrPO_4:Eu^{2+}$ phosphor were investigated for the first time. The phosphor shows a bright green emission under near UV excitation. The main emission wavelength was 500 nm and could be controlled by changing Eu^{2+} contents.

**PHp - 4 Synthesis of Monolith Using
Tetramethylammoniumsilicate as Matrix Doped
YAG:Ce³⁺ Nanophosphor with Citric Acid by
Glycothermal**

*H. K. Kim, B. K. Park, Y. R. Do
Kookmin Univ., Korea*

YAG:Ce³⁺ nanophosphor was synthesized by a glycothermal. The reaction yielded yttrium aluminum garnet having a particle size about 34nm. A monolith was produced in a simple sol-gel process by creating a gel. This study shows that transparent film doped with YAG:Ce³⁺ nanophosphor is possible when using tetramethylammoniumsilicate.

**PHp - 5 Synthesis of Blue Emitting BaMgAl₁₀O₁₇:Eu²⁺ Thin
Film Phosphors by Sputtering Method**

*D. H. Kim, J. Y. Han, D. Y. Jeon
KAIST, Korea*

BaMgAl₁₀O₁₇ : Eu²⁺ (BAM) thin film phosphors deposited on sapphire substrate by RF magnetron sputtering have been studied. We obtained BAM thin film phosphors of good crystallinity and high luminescence via RF sputtering, using a single multicomponent stoichiometric target.

**PHp - 6 An Investigation of 3D Silica Photonic Crystal Effects
on Luminescence Properties of YVO₄:Eu³⁺ Thin Film
Phosphor**

*J. Y. Han, H. S. Yoo, D. H. Kim, D. Y. Jeon
KAIST, Korea*

YVO₄:Eu³⁺ thin film has been sputtered on silica photonic crystal (PC) layers and its optical properties were investigated by photoluminescence (PL). The enhanced PL intensity of YVO₄:Eu³⁺ thin film with PC layers was obtained due to the photonic crystal band gap (PBG) and scattering by the PC layer.

**PHp - 7 Green Emissions of M-Ga₂S₄ :Eu²⁺ (M: Zn, Ca, Sr)
Thiogallates**

Y. J. Kim, J. W. Kim^{}, J. S. Lee
Kyonggi Univ., Korea
^{*}GALAXIA PHOTONICS, Korea*

Cathodoluminescence (CL) of divalent europium ions doped (M, M')-thiogallate (M_{1-x}M'_xGa₂S₄:Eu²⁺, M, M': Zn, Ca, Sr) phosphors was investigated. The CL spectra exhibited strong green emissions around 535 - 560 nm. Their positions and the intensities depended on the ratio of M/M'.



PHp - 8 Nitrido-, Oxonitrido- and Alumonitridosilicate Phosphor Materials Extending the Structural Boundaries

*C. Hecht, M. Zeuner, W. Schnick
Univ. of Munich, Germany*

This paper gives a brief overview concerning recent nitridoalumosilicate host lattices for Eu doping with luminescent properties and their structural similarities. Additionally information about solid solution experiments of SrMAISi₄N₇:Eu with M = Ca, Ba and Eu are given in more detail.

PHp - 9 Cathodoluminescence of Small Particle Gd₂O₂S:Pr X-ray Phosphor

*J. Silver, R. Withnall, T. Ireland, G. Fern, X. Yan
Brunel Univ., UK*

A small particle (ca. 120 nm size) Gd₂O₂S:Pr x-ray phosphor has been synthesized and its cathodoluminescence (CL) properties have been investigated. Green and red emission lines were observed in the CL spectra and their intensity ratio was shown to be dependent on both Pr³⁺ activator concentration and firing temperature.

PHp - 10 The Problems with Eu³⁺ Activated Red Emitting Phosphors with Blue LEDs to Generate White Light; Luminous Efficiency Measurements of Red Emitting Phosphors Based on the Formula Li(Eu_xY_{1-x})(MoO₄)_y(WO₄)_{2-y}

*R. Stone, J. Silver, R. Withnall, G. Fern
Brunel Univ., UK*

Data are presented that highlight the problems of using Eu³⁺ red emitting phosphors as colour convertors for blue LEDs. The drawbacks with using such phosphors are discussed, and methods to partially overcome these are suggested.

PHp - 11 Ceramic-Insulating-Type EL Devices Fabricated by Using Y₂O₃:Eu Nanophosphor

*K. Ueda, J. Ishino, T. Miyata, T. Minami
Kanazawa Inst. of Tech., Japan*

Red-emitting EL devices with a Y₂O₃:Eu nanophosphor emitting layer and a thick BaTiO₃ ceramic sheet insulating layer were developed. A luminance of 21 cd/m² was obtained in EL devices driven by ac sinusoidal wave voltage at 1 kHz.

PHp - 12 Blue-Emitting Bi-Activated ($\text{La}_2\text{O}_3\text{-Ga}_2\text{O}_3$) Multicomponent Oxide Phosphor and EL Device Applications

*J. Ishino, K. Sahara, H. Fukada, T. Miyata, T. Minami
Kanazawa Inst. of Tech., Japan*

Blue-emitting Bi-Activated $(\text{La}_2\text{O}_3)_{1-x}\text{-(Ga}_2\text{O}_3)_x$ multicomponent oxide phosphor thin films were newly developed by optimizing the composition (Ga content) using a combinatorial rf-magnetron sputtering deposition method. High PL intensity and luminance in blue emission were obtained in postannealed $((\text{La}_2\text{O}_3)_{0.9}\text{-(Ga}_2\text{O}_3)_{0.1})\text{:Bi}$ phosphor thin films and TFEL devices fabricated using postannealed $((\text{La}_2\text{O}_3)_{0.85}\text{-(Ga}_2\text{O}_3)_{0.15})\text{:Bi}$ thin films, respectively.

PHp - 13 PL and EL Characteristics in Other Activator-Co-Doped $\text{La}_2\text{O}_3\text{:Bi}$ Phosphor Thin Films

*H. Fukada, K. Sahara, J. Ishino, T. Miyata, T. Minami
Kanazawa Inst. of Tech., Japan*

Photoluminescence (PL) and electroluminescence (EL) characteristics were investigated in various activator-co-doped $\text{La}_2\text{O}_3\text{:Bi}$ phosphor thin films prepared using a combinatorial r.f. magnetron sputtering deposition. Multicolor emissions in PL and EL were observed from the prepared phosphor thin films; the observed emission spectra were dependent on the kind and content of the coactivators.

PHp - 14 The Study of Color Conversion Method for Inorganic-Organic Hybrid Electroluminescence Devices by Using PL Quantum Yield Measurement

*T. Uchida, S. Kawamura, M. Kobayashi, T. Satoh
Tokyo Polytech. Univ., Japan*

We report an organic dye-dispersed inorganic hybrid electroluminescence (Hyb_EL) device that can emit sharp green and red spectra. The color-conversion mechanism is clarified by studying the photoluminescence (PL) from inorganic phosphor (host) to organic dye (guest). We estimate the PL quantum efficiency of Hyb_EL by using an integrated sphere.

PHp - 15 The Development of Red Emitting $\text{ZnS:C}_2\text{O}_3\text{,Cl,Mn,Te}$ AC Powder Electroluminescent (ACPEL) Phosphor

*B. J. Park^{***}, J. Y. Han^{*}, D. Y. Jeon^{*}, H. S. Seo^{**},
J. T. Ahn^{**}, D. K. Oh^{**}
^{*}KAIST, Korea
^{**}ETRI, Korea*

$\text{ZnS:C}_2\text{O}_3\text{,Cl,Mn,Te}$ red powder was synthesized by wet synthesis and sealed vessel methods. The EL luminance of $\text{ZnS:C}_2\text{O}_3\text{,Cl,Mn,Te}$ powder was considered with various Te concentration, and through the Raman spectra new peaks at 121 cm^{-1} and 141 cm^{-1} related to Te aggregation was investigated.

PHp - 16 The Effects of Post-Annealing on the Crystallinity and the Optical Properties of SrGa₂S₄:Eu Nanoparticles

*S. Hamaguchi, T. Yamamoto, M. Kobayashi
Waseda Univ., Japan*

SrGa₂S₄:Eu has been recently widely studied. Annealing treatment in a vacuum and a H₂S atmosphere is used for the improvement of the crystallinity and optical properties. H₂S annealed nanoparticles showed better characterizations than vacuum annealed ones. Good samples in optical property indicate also good data in crystallinity.

PHp - 17 Preparation of Perovskite-Type Stannate Phosphors by Polymerized Complex Method

M. Shima, T. Nakamura, M. Yasukawa, K. Ueda
Kyushu Inst. of Tech., Japan
Kochi Nat. College of Tech., Japan

Powder of an alkaline-earth stannate phosphor, CaSnO₃:Tb-Mg, with perovskite-type structure was prepared by polymerized complex method. The obtained powder consisted of small uniform grains and showed intense green photoluminescence. The luminescence intensities of the samples prepared by the polymerized complex method were higher than those prepared by solid-state reaction method.

PHp - 18 Optical Degradation Characteristics of Sub-Micrometer Sized Eu-Complex Encapsulated by Sol-Gel Derived Silica Glass

*S. Kato, T. Fukuda, E. Kin, Z. Honda, N. Kamata
Saitama Univ., Japan*

We demonstrated a sub-micrometer sized Eu-complex encapsulation by a sol-gel derived silica glass. The optical degradation characteristics were measured by changing the composition ratio of a sol-gel starting solution. We found that the composition of deionized water is important parameter for the efficient encapsulation around Eu-complex.

PHp - 19 Luminance Uniformity of Organic-Dye-Dispersed Hybrid Powder-Type Electroluminescent Device

*Y. Noguchi, Y. Masakura, T. Tamura, T. Uchida, T. Satoh
Tokyo Polytech. Univ., Japan*

The luminance uniformity of conventional powder-type electroluminescent (EL) and hybrid EL devices was compared using a high-resolution camera. More details were revealed using a low-resolution camera. It was confirmed that the emitting region of the phosphor particle broadened because it distributed the organic dye by using the high-resolution camera.

PHp - 20 DC-Driven Hybrid n-ZnO Nanocrystal/P-Pentacene Heterojunction EL Devices

*H. Takeuchi, H. Kawasaki, T. Toyama, H. Okamoto
Osaka Univ., Japan*

We demonstrate DC-driven hybrid EL devices composed of sol-gel derived n-ZnO nanocrystal emission layers and p-pentacene hole-transport layers. The EL emission, consisting of sharp ultraviolet (~380 nm) and broad green-yellow (~560 nm) spectral components, was observed. We also arranged pentacene at the cathode side, and found that the green-yellow component decreased.

PHp - 21 EL Devices Using Inorganic Phosphor Synthesized by Vacuum Microwave System

N. Taguchi, Y. Kobayashi, Y. Uraoka*
Image Tech, Japan
Nara Inst. of S&T, Japan

We investigated the characteristics of ZnS phosphor-powders synthesized by vacuum microwaves (VMW) and that of EL emission using the phosphors. It was found that the powders showed strong PL of peak wavelength of 450 nm without ZnO structures, and EL devices using those with a Cu activator gave uniform emissions.

PHp - 22L Optimized Process Condition for Transparent Zn₂SiO₄:Mn²⁺ Phosphor Layer via Spray Pyrolysis

*K. Kim, Y.-M. Moon, S. Choi, H.-K. Jung
Korea Res. Inst. of Chem. Tech., Korea*

Transparent Zn₂SiO₄:Mn²⁺ luminescent layer is realized by spray pyrolysis method. The obtained film is transparent under visible spectral range and exhibits strong green emission upon vacuum ultraviolet excitation. Using controlled spray conditions, we can easily obtain a film-type phosphor layer without additional organic-based printing process.

PHp - 23L Fabrication of Wavelength Converting Plastic Films Comprised of Organic Dyes for the Application to LED-Based Planar White Light Source

*S. W. Kim, Y. H. Kim, S. H. Hwang, H. S. Yoo, D. Y. Jeon
KAIST, Korea*

For the application to LED-based planar white light source, we fabricated wavelength converting plastic films comprised of organic dye by using a simple roll printing laminator. The wavelength converting films have shown the possibility as large size flexible wavelength converter for forming LED-based planar white light source.

PHp - 24L Optical Properties of the $\text{Sr}_2\text{SiO}_4:\text{Eu}^{2+}$ Phosphor Coated with Al_2O_3 Nano-Particles for White Light Emitting Diodes

*S. J. Han, S. M. Lee, S. H. Sohn
Kyungpook Nat. Univ., Korea*

The surface of $\text{Sr}_2\text{SiO}_4:\text{Eu}^{2+}$ phosphor was coated with Al_2O_3 nano-particles in a simple surface treatment way, a kind of the modified sol-gel method. It was found that the surface coating of $\text{Sr}_2\text{SiO}_4:\text{Eu}^{2+}$ phosphor with Al_2O_3 nano-particles leads to an increase in the luminance intensity.

PHp - 25L High-Brightness Barium Silicate Phosphor Film through Spin-Coating Process

*P. K. Shon, J. H. Park, J. S. Kim, S. N. Lee
Pukyong Nat. Univ., Korea*

Eu^{2+} -doped BaSi_2O_5 film phosphors on quartz substrates are fabricated by spin-coating process. The $\text{BaSi}_2\text{O}_5:\text{Eu}^{2+}$ film phosphor shows 500 nm green emission from the f-d transition of the Eu^{2+} ions, and in particular the best sample shows a green photoluminescence brightness comparable to 5% of a $\text{BaSi}_2\text{O}_5:\text{Eu}^{2+}$ powder phosphor screen.

PHp - 26L Photoluminescent Properties of $\text{Zn}_{1-x}\text{Cd}_x\text{O}$ Particles Fired under the High-Pressure

*T. Sano, H. Kominami, Y. Nakanishi, K. Hara
Shizuoka Univ., Japan*

Liquid phase synthesis of ZnCdO powder fired under the high-pressure has been investigated for aim to the preparation of multi-layered ZnO/ZnCdO particles. As the result, the ZnCdO powder showed stronger emission of exciton and suppressed the emission from oxygen-vacancies.

PHp - 27L Effect of 355 nm Laser Annealing for Preparation of $\text{SrGa}_2\text{S}_4:\text{Eu}$ Thin Film Phosphors

T. Yamasaki, T. Seino^{}, H. Kominami, Y. Nakanishi,
Y. Hatanaka^{**}, K. Hara
Shizuoka Univ., Japan
^{*}Japan Steel Works, Japan
^{**}Aichi Univ. of Tech., Japan*

$\text{SrGa}_2\text{S}_4:\text{Eu}$ thin film phosphors were prepared in view of the application for FEDs. The films showed green emission peaked at 530 nm based on Eu^{2+} luminescence center by laser-annealing of Nd:YAG 355 nm. It was obtained that the laser-annealing of 355nm is quite effective for the treatment of whole film.

PHp - 28L On the Large Threshold Voltage Shifts of Nano-Structured Thin Film Electroluminescent Device

S. H. Choi, H. S. Moon, S. G. Lee^{}, S. H. Sohn*
Kyungpook Nat. Univ., Korea
^{*}*Korea Basic Sci. Inst., Korea*

A large threshold voltage shift ΔV_{th} seen in the nanostructured-thin film electroluminescent device (NS-TFELD). The estimates of ΔV_{th} in NS-TFELD are in good agreement with the experimental data, implying that NS-TFELD operating at very low voltages will be realized.

PHp - 29L A Novel Organic Dye as an Efficient Color Converter for White LEDs

S. H. Hwang, S. W. Kim, H. S. Yoo, D. Y. Jeon
KAIST, Korea

In this study, a yellow-emitting dye, 3-(4-(diphenylamino)phenyl)-1-(naphthalene-2-yl)prop-2-en-1-one (DPNO) was synthesized. Its PL excitation spectrum was well matched with InGaN blue LED and its PL emission intensity was higher than the existing structure. Also, the CIE color coordinates of were suitable to obtain white light which has high CRI value.

PHp - 30L Transparent ZnSe/ZnS QD-PMMA Nanocomposite Films and their Luminescent Properties

B.-H. Kwon, S. W. Kim, H. S. Jang^{}, H. S. Yoo,*
*S. G. Lee^{**}, D. Y. Jeon*
KAIST, Korea
^{*}*Purdue Univ., USA*
^{**}*Korea Minting & Security Printing, Korea*

ZnSe quantum dots showing quantum confinement effect are synthesized by an organometallic method. The hybrid material composed of PMMA and ZnSe/ZnS quantum dot is fabricated using a radical polymerization process. The transparent nanocomposite films have two sharp emission that is different from the emission shape of ZnSe/ZnS QDs.



Thursday, December 10

9:00 - 10:25

KAIHO

PH1: Phosphors in General

Chair: D. Y. Jeon, KAIST, Korea
 Co-Chair: S. Okamoto, NHK, Japan

**PH1 - 1: Invited Impurity-Doped Semiconductor Nanocrystals
 9:00 as Novel Luminescence Materials**

*A. Ishizumi, Y. Kanemitsu**
Nara Inst. of S&T, Japan
**Kyoto Univ., Japan*

Semiconductor nanocrystals doped with optically active impurities become novel efficient nanophosphors under UV-light and electron-beam excitation. Unique interactions between impurities and electrons confined in nanocrystals markedly improve efficiency and stability of impurity luminescence.

**PH1 - 2 Development of Calculation Method for Excited
 9:30 Energy Distribution in Photo-Excitation Equilibrium
 State**

H. Onuma, I. Yamashita, K. Serizawa, H. Tanno,
 A. Suzuki, H. Tsuboi, N. Hatakeyama, A. Endou,
 H. Takaba, M. Kubo, H. Kajiyama*, A. Miyamoto*
Tohoku Univ., Japan
**Hiroshima Univ., Japan*

We developed a new simulation method for excited energy distribution in photo-excitation steady state. It was applied on SrS:Eu²⁺ phosphor. Excited electron and hole states strongly reflected the Eu 5d and 4f orbitals. We also investigated the effects of structural defects on the excited energy distribution.

**PH1 - 3 Development of Novel Nanoprobes for Biological
 9:50 Submicroscopic Multicolour Imaging**

J. Silver, R. Withnall, T. Ireland, G. Fern, I. Morrison,
 P. O'Toole*, P. Reip**, A. Godfrey***
Brunel Univ., UK
**Univ. of York, UK*
***Intrinsiq Materials, UK*

Nanocrystal (ca. 10-40 nm size) monoclinic Y₂O₃:Eu phosphor has been synthesized and the effect of the monoclinic to cubic phase transformation on its cathodoluminescence and photoluminescence properties has been investigated after annealing the phosphor in the temperature range of 850 to 1000°C.

PH1 - 4L **Low Temperature Annealing Effects on ZnO Thin Films Sputtering Deposited on [100] Silicon Substrate**
10:10

C. Li, T. Matsuda, T. Kawaharamura, Y. Nakanishi, K. Ichinomiya**, H. Furuta, T. Hiramatsu, M. Furuta, T. Hirao*

Koichi Univ. of Tech., Japan

**Shizuoka Univ., Japan*

***Nichia, Japan*

ZnO thin film phosphors were successfully prepared by annealing in reducing gas under low temperature. The formation of fluted hexagonal cone nano-structures was attributed to self-catalyzing effect. It was found that annealing time was a critical parameter influencing the photoluminescence and the structural properties of the ZnO thin films.

----- Break -----

10:40 - 12:10

KAIHO

PH2: Phosphors for LEDs 1

Chair: R. Withnall, Brunel Univ., UK
 Co-Chair: T. Kusunoki, Sony, Japan

PH2 - 1: ***Invited* Nitrido- and Oxonitridosilicate Phosphor Materials -- A Synthetic and Structural Point of View**
10:40

M. Zeuner, W. Schnick

Univ. of Munich, Germany

This paper covers the talk by Zeuner and the supplementing poster by Hecht, giving an overview of our recent findings concerning the basic search for new nitridic phosphors. Also recent developments regarding synthesis improvements of established excellent phosphor compounds as well as material property optimizations will be summarized and discussed.

PH2 - 2 **Luminescent Properties of Eu²⁺-Doped Ca- α -SiAlON Phosphors Synthesized by Spark Plasma Sintering**
11:10

S.-W. Choi, S.-H. Hong

Seoul Nat. Univ., Korea

Eu²⁺-doped Ca- α -SiAlON phosphors with compositions of Ca_{m/2-x}Eu_xSi_{12-(m+n)}Al_{m+n}O_nN_{16-n} were successfully prepared by spark plasma sintering (SPS). The phase, compositions, and luminescence properties of Eu²⁺-doped Ca- α -SiAlON phosphors were investigated in detail. In this study, the influences of Ca and Eu doping concentration and matrix composition on the luminescence performance have been focused.

PH2 - 3 **Stability Improvement in Eu-Complex Encapsulated
11:30** **by Sol-Gel Derived Silica Glass Using Catalyst**

*T. Fukuda, S. Yamauchi, Z. Honda, N. Kamata, N. Kijima**
Saitama Univ., Japan
**Mitsubishi Chem., Japan*

An organic-inorganic emitting film with Eu-complex was realized via a sol-gel process using phenyltrimethoxysilane and diethyldimethoxysilane as encapsulating agents. In addition, the improvement in stability was achieved by adding acetic acid as the catalyst.

PH2 - 4 **Effect of Si-Codoping on Crystallographic and
11:50** **Photoluminescent Characteristics in CuAlS₂:Mn Red
Phosphor for Near-UV Excitation**

Y. Miyamoto^{,**}, K. Ohashi^{**}, K. Ohmi^{**}, H. Yoshida^{***}*
**TEDREC, Japan*
***Tottori Univ., Japan*
****NEC Lighting, Japan*

Effects of Si-codoping on crystallographic and photoluminescent characteristics have been investigated in CuAlS₂:Mn phosphor. Results suggest that Si relieves lattice distortion, and enhances Mn incorporation into host lattice, resulting in increase of luminescence. PL excitation characteristics for 400 nm excitation has been improved by employing the mixed crystal compound Cu(Al,Ga)S₂.

----- Lunch -----

13:20 - 14:40

TENJU

PH3: Phosphors for LEDs 2

Chair: R.-J. Xie, NIMS, Japan
Co-Chair: M. Shiiki, Hitachi, Japan

PH3 - 1: ***Invited* Advantages of Phosphor Sheet Structure in
13:20** **LED Backlight System**

*R. Kasegawa, Y. Ito, T. Tsukahara, A. Ono, N. Nada,
Y. Oshima, T. Kusunoki, T. Igarashi, T. Izawa*
Sony, Japan

The thermal quenching and saturation characteristics of luminance from phosphors excited by blue light were measured. Backlight units with blue LEDs and a phosphor sheet that is remote from the LEDs were demonstrated to have higher phosphor efficiencies than backlight units that use conventional white LEDs.

PH3 - 2: 13:50 *Invited* **UV Excitable $\text{KSrPO}_4\text{:Eu}$ (blue) and $\text{Sr}_3(\text{Al}_2\text{O}_5)\text{Cl}_2\text{:Eu}$ (orange-yellow) Phosphors for White Light Emitting Diodes**

R. S. Liu, C. C. Lin, Y. S. Tang, S. F. Hu**
Nat. Taiwan Univ., Taiwan
**Nat. Taiwan Normal Univ., Taiwan*

KSrPO_4 and $\text{Sr}_3(\text{Al}_2\text{O}_5)\text{Cl}_2$ phosphors doped with Eu^{2+} emit a blue and orange-yellow luminescence under ultraviolet (UV) excitation at ~ 400 nm, respectively, which can be used for making white light emitting diodes.

PH3 - 3 14:20 **Improvement in Luminescent Properties of Emissive LCD Consisting of RGB Patterned Phosphors and Near-UV LED**

*T. Yata',***, Y. Miyamoto',**, K. Matsumoto****, J. Nishiura****, N. Koma***, K. Ohmi**
**Tottori Univ., Japan*
***TEDREC, Japan*
****Epson Imaging Devices, Japan*
*****LEIZ LINE, Japan*

A novel emissive liquid crystal display (e-LCD) consisting of RGB patterned phosphors and near-UV LED has been proposed. A light utilization efficiency is more than 2 times higher compared to conventional LCDs. The e-LCD enables to achieve high power efficiency and wide viewing angle, while maintaining broad color reproduction range.

----- Break -----

15:00 - 16:10

TENJU

PH4: Phosphors in EL and PDP

Chair: K. Wani, Tazmo, Japan
 Co-Chair: K. Ohmi, Tottori Univ., Japan

PH4 - 1: 15:00 *Invited* **Recent Development of Oxyfluoride Phosphors for Plasma Display Panels**

*T. Kunimoto, K. Ohmi**
Tokushima Bunri Univ., Japan
**Tottori Univ., Japan*

Recent progress of the oxyfluoride phosphor material for Plasma Display Panels have been reported. Tb-doped $\text{Ba}_4\text{Gd}_6\text{Si}_6\text{O}_{24}\text{F}_2$ and YOF have been proposed as novel green phosphors for vacuum-UV excitation. Chemical processing of $\text{Ba}_4\text{Gd}_6\text{Si}_6\text{O}_{24}\text{F}_2\text{:Tb}$ phosphor and relation between the crystal structure and photoluminescence properties of YOF:Tb phosphor are discussed.

PH

PH4 - 2 **Low-Electric-Field-Driving Electroluminescence in**
15:30 **$((\text{Ca}_{0.6}\text{Sr}_{0.4})_{0.997}\text{Pr}_{0.002})\text{TiO}_3$ and SrTiO_3 Perovskite**
Films

H. Takashima, N. Miura^{}, Y. Inaguma^{**}, K. Ueda^{***},
M. Itoh^{****}*

AIST, Japan

^{}Meiji Univ., Japan*

*^{**}Gakushuin Univ., Japan*

*^{***}Kyushu Inst. of Tech., Japan*

*^{****}Tokyo Inst. of Tech., Japan*

Electroluminescence(EL) in a perovskite thin-film with double phosphor layers of $((\text{Ca}_{0.6}\text{Sr}_{0.4})_{0.997}\text{Pr}_{0.002})\text{TiO}_3$ sandwiched by insulating layers of SrTiO_3 were obtained. Red color was produced. The equivalent circuit of a thin-film EL device is simply five series-connected capacitors. The electric field of the phosphor layer at 20 V is about $7.5 \times 10^4 \text{ Vcm}^{-1}$.

PH4 - 3 **High Flexibility Powder ACEL Displays**
15:50

R. Withnall, J. Silver, P. Harris

Brunel Univ., UK

High flexibility electroluminescent displays find applications in many areas, such as keypads where the device may need to be flexed many times during its lifetime, or alternatively for situations where they need to be shape conformable. This paper describes a low cost route for producing bright, highly flexible ACEL devices.

Author Interviews

18:00 – 19:00

Friday, December 11

10:40 - 11:50

KAIHO

FED2/PH5: Phosphors for FEDs

Chair: M. Nakamoto, Shizuoka Univ., Japan

Co-Chair: H. Shimawaki, Hachinohe Inst. of Tech., Japan

**FED2/
PH5 - 1: Invited Nanostructure Carbon for FED and White LED
Application**

10:40

*Z. Sun, T. Feng, L. Pan, Z. Zhang, Y. Chen, L. Lin,
S. Huang, P. Guo, H. Li**East China Normal Univ., China*

Nanostructure carbon films including diamond and carbon nanotubes (CNTs) have been attracting considerable attentions both from scientists and engineers, and related applications in high power light emitting diode (LED) and field emission display (FED) devices are reviewed. A new kind of nitride phosphors for white LED was introduced.

**FED2/
PH5 - 2 Stimulated Emission from ZnO Micro Crystal with
Cavity Structures for Field Emission Display**

11:10

Y. Neo, Z. Xiao, G. Han, M. Okada, T. Aoki, H. Mimura**Shizuoka Univ., Japan***NIMS, Japan*

The optical properties of ZnO micro structures, fabricated by using liquid and vapor phase growth techniques, were investigated. The hexagonal thin disks and three legs tetrapod were obtained, respectively. The cavity modes could be observed under strong irradiation conditions. Further, the peaks intensities showed non-leaker characteristics, considered as stimulated emission.

**FED2/
PH5 - 3L Electrostatic Focusing for FEA Image Sensor with
HARP Target**

11:30

Y. Honda, M. Nanba**, Y. Takiguchi**, K. Kikuchi*,
H. Seo*, S. Aihara*, T. Watabe*, H. Ohtake*, N. Egami*,
Y. Saishu***, K. Nakamura***, M. Taniguchi*******NHK, Japan****Shizuoka Univ., Japan*****Futaba, Japan*

A new electrostatic focusing Spindt-type FEA was simulated and fabricated for it to be applied to a compact FEA image sensor. The experimental results show that the emission current of the double-gated FEA can be improved without focusing characteristics deteriorating by increasing the thickness of the first gate electrode.

Author Interviews

16:20 – 17:20

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

Workshop on Field Emission Display and CRT

Friday, December 11

| | | |
|-------------|----------------|-------|
| 9:00 - 9:10 | Opening | KAIHO |
|-------------|----------------|-------|

Opening Remarks

9:00

M. Takai, Osaka Univ., Japan

| | | |
|--------------|------------------------------|-------|
| 9:10 - 10:20 | FED1: CNTs & FEDs | KAIHO |
|--------------|------------------------------|-------|

Chair: H. Mimura, Shizuoka Univ., Japan

Co-Chair: M. Nagao, AIST, Japan

FED1 - 1: *Invited* High Performance Carbon Nanotube Field Emitters for Backlight of Liquid Crystal Display

9:10

Y. Kim, H. Kim, J. Heo, I. Han, W. Cho, B. Ju*, Y. Kim, J. Kim*

Samsung Advanced Inst. of Tech., Korea

**Korea Univ., Korea*

We present recent progress in CNT field emitters for the application in backlight unit of LCD. Formulation of CNT paste has been optimized to form cracks automatically during firing process, leading to exposure of CNT networks in between the cracks.

FED1 - 2 Influence of CNT Diameters of Screen-Printed Cathode on Field Emission Characteristics

9:40

T. Takikawa, H. Oki, Y. Matsuura, K. Murakami, S. Abo, F. Wakaya, M. Takai

Osaka Univ., Japan

The relationships between the field emission characteristics of screen-printed carbon nanotube (CNT) cathodes and the diameters of CNTs were investigated. The CNT cathode with a smaller CNT diameter showed lower turn-on field. The field emission lifetimes of CNT cathodes after laser irradiation were long enough regardless of the CNT diameter.

**FED1 - 3
10:00 Development of Large-Size MIM-Cathode-Arrays for
FEDs Application**

*T. Kusunoki, M. Sagawa, M. Suzuki, E. Nishimura,
M. Ikeda, K. Tsuji
Hitachi, Japan*

We developed large-size MIM-cathode-arrays for FEDs. Resistances of scan electrodes decreased to 1/20, and emission efficiency increased to 3%. An FED using the cathode array showed high peak brightness (832cd/m²) and luminous efficiency (9.11 lm/W).

FED

----- Break -----

10:40 - 11:50

KAIHO

FED2/PH5: Phosphors for FEDs

Chair: M. Nakamoto, Shizuoka Univ., Japan
Co-Chair: H. Shimawaki, Hachinohe Inst. of Tech., Japan

**FED2/
PH5 - 1: Invited Nanostructure Carbon for FED and White LED
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PH5 - 2 Stimulated Emission from ZnO Micro Crystal with
Cavity Structures for Field Emission Display**

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**FED2/
PH5 - 3L
11:30**

Electrostatic Focusing for FEA Image Sensor with HARP Target

Y. Honda^{}, M. Nanba^{*,**}, Y. Takiguchi^{*,**}, K. Kikuchi^{*},
H. Seo^{*}, S. Aihara^{*}, T. Watabe^{*}, H. Ohtake^{*}, N. Egami^{*},
Y. Saishu^{***}, K. Nakamura^{***}, M. Taniguchi^{***}*

^{*}*NHK, Japan*

^{**}*Shizuoka Univ., Japan*

^{***}*Futaba, Japan*

A new electrostatic focusing Spindt-type FEA was simulated and fabricated for it to be applied to a compact FEA image sensor. The experimental results show that the emission current of the double-gated FEA can be improved without focusing characteristics deteriorating by increasing the thickness of the first gate electrode.

----- Lunch -----

13:20 - 14:40

KAIHO

FED3: Field Emitters (1)

Chair: M. Takai, Osaka Univ., Japan

Co-Chair: H. Nakane, Muroran Inst. of Tech., Japan

**FED3 - 1
13:20** **FEA Based on Ion-Induced Bending (IIB) Technology for Large-Sized FED**

*T. Yoshida, M. Nagao, S. Kanemaru
AIST, Japan*

A simple field-emitter-array (FEA) fabrication process based on ion-induced bending (IIB) technology was developed. The procedural advantages of IIB are that it uses small quantities of material and non-specialized equipment. IIB would therefore be compatible with standard TFT fabrication processes and could produce large-sized FEDs.

**FED3 - 2
13:40** **Developing Vertical Thin Film Field Emitter Array for CdTe X-ray Imaging Sensor**

*Y. Tsunekawa, M. Nakagawa, Y. Neo, H. Morii, T. Aoki,
H. Mimura, M. Nagao^{*}, T. Yoshida^{*}, S. Kanemaru^{*}*

Shizuoka Univ., Japan

^{*}*AIST, Japan*

We have demonstrated the CdTe X-ray imaging device consists of a Schottky CdTe diode and a VTFFEA matrix. The output signals were successfully detected by the recombination of holes with electrons from the FEA, and depended on the X-ray tube voltage, indicating the signals were promotional to the X-ray intensity.

FED3 - 3 **Intensity Distribution of Electron Emission from nc-Si MOS Cathode**
14:00

H. Shimawaki^{,***}, K. Murakami^{***}, Y. Neo^{**}, H. Mimura^{**},
 F. Wakaya^{***}, M. Takai^{***}*

^{}Hachinohe Inst. of Tech., Japan*

*^{**}Shizuoka Univ., Japan*

*^{***}Osaka Univ., Japan*

A planar-type cold cathode composed of a thin film diode structure produces highly directional emission in contrast with a field emission cathode. Emission uniformity in nanocrystalline silicon based MOS planar cathodes prepared by pulsed laser ablation was investigated by a Faraday-cup with a probe hole of 20 μm in diameter.

FED3 - 4 **Surface-Conduction Electron Emission from Nb-Si-N Thin Film**
14:20

*S. Xiong, Z. Song, S. Wu, L. Zhao, J. Wang, H. Wu,
 C. Liu*

Xi'an Jiaotong Univ., China

We propose to sputter a new ternary material Nb-Si-N as the conductive film. With this ternary film composition, the film's sheet resistance can be adjusted easily to satisfy the requirement of the electro-forming process. The experiment results show that Nb-Si-N can be a kind of conductive film material for SCEs.

----- Break -----

15:00 - 16:00

KAIHO

FED4: Field Emitters (2)

Chair: M. Sasaki, Univ. of Tsukuba, Japan

Co-Chair: Y. Neo, Shizuoka Univ., Japan

FED4 - 1 **Fabrication of Titanium-Oxide Nanowires on Glass Substrate and Their Field-Emission Properties**
15:00

*F. Wakaya, T. Takikawa, M. Miki, C. Fukuyama,
 K. Murakami, S. Abo, M. Takai*

Osaka Univ., Japan

Titanium-Oxide nanowires were successfully fabricated directly on a glass substrate. This is profitable in realizing large-diagonal field-emission displays and backlight units. Field-emission current from the titanium-oxide nanowires fabricated directly on a glass substrate was first observed.

**FED4 - 2 Field Emission Characteristics of Boron Carbon
15:20 Nitride Films Deposited on Patterned Substrate**

*S. Kawai, N. Ooi, E. Kubo, C. Kimura, H. Aoki, T. Sugino
Osaka Univ., Japan*

An influence of the series resistance of the field emitter on the emission current is investigated for BCN films. The series resistance decreases with increasing density of the emission spots. In order to increase emission spots, BCN film is grown on the patterned substrate and field emission characteristics are measured.

**FED4 - 3 Analysis of Field Emission Characteristics of Field
15:40 Stabilized Liquid Cone**

*Y. Gotoh
Kyoto Univ., Japan*

Electron emission characteristics of field stabilized liquid cone were analytically derived with an improved model of liquid cone on a base needle emitter. The obtained characteristics showed a better agreement with the experimental results.

Author Interviews

16:20 – 17:20

Sponsor:

JSPS 158th Committee on Vacuum Nanoelectronics

Supporting Organizations:

Technical Group on Information Display, ITE
Technical Committee on Electronic Information Displays, Electronics
Society, IEICE

BANQUET

Wednesday, December 9, 2009
19:30–21:30

Room “TENZUI” (4F)
World Convention Center Summit

See page 9 for details

Workshop on Organic LED Displays

Wednesday, December 9

13:20 - 14:40

TENYO

OLED1: OLED Material and Device

Chair: S. Sakai, Seiko Epson, Japan

Co-Chair: T. Wakimoto, Merck, Japan

OLED1 - 1: *Invited* Future Trend of AMOLED Technology

13:20

S. C. Kim, C. H. Lee, J. H. Lee

Samsung Mobile Display, Korea

This article reviews current technological issues of mobile display and unique applications of AMOLED such as foldable, bendable and transparent displays. In addition, the key technologies that should be developed for large-sized AMOLED TV are also reviewed. For large-sized AMOLED TV, TFT, color patterning and encapsulation are technological issues.

OLED1 - 2: *Invited* Novel Transport Materials for High

13:45

Performance OLEDs

E. Böhm, C. Pflumm, F. Voges, H. Heil, A. Büsing,

A. Parham, R. Fortte

Merck KGaA, Germany

We show that efficiency, voltage and lifetime cannot be optimised simultaneously in blue fluorescent OLEDs. With novel ETMs, any desired trade-off in performance can be obtained. In an optimised system, 8.5% EQE were achieved. With thick ETLs, we obtain low driving voltage and improved color purity in green phosphorescent OLEDs.

OLED1 - 3 High Efficiency and Long-Lived Green

14:10

Phosphorescent OLEDs

H. Yamamoto, V. Adamovich, B. Ma, J. Fiordeliso, S. Xia,

R. Kwong, M. Weaver, J. Brown

Universal Display, USA

We demonstrate a new high efficiency and long-lived green phosphorescent OLED. A non-cavity bottom emission device shows a luminous efficiency of 66 cd/A at 1000 cd/m² with 1931 CIE = (0.33, 0.62), and record lifetime of 500,000hrs to LT50 from 1000cd/m².

**OLED1 - 4 Development of Novel Method Based on Quantum
14:25 Chemistry Calculation for Analysis of Carrier
Transfer in Light Emitting Layers**

*I. Yamashita, K. Serizawa, H. Onuma, A. Suzuki,
H. Tsuboi, N. Hatakeyama, A. Endou, H. Takaba,
M. Kubo, M. Williams*, A. Miyamoto*

Tohoku Univ., Japan

**Univ. of Utah, USA*

We developed a novel method for analysis of carrier transfer in light emitting materials by using quantum chemistry calculation and Monte Carlo method. We applied it to analysis of electron transfers in blue light emitting polymers. We investigated the effects of atomistic scale morphologies on electron transfers in polymer films.

----- Break -----

15:00 - 16:20

TENYO

OLED2: OLED Technologies

Chair: E. Böhm, Merck KGaA, Germany

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

**OLED2 - 1: *Invited* Inkjet Technology Enables Uniform Light
15:00 Emission for Large-Screen OLED TVs**

*S. Sakai, S. Takei, A. Kitabayashi, H. Hanaoka,
K. Shinohara, M. Goto, N. Mitsuo, S. Seki, S. Miyashita
Seiko Epson, Japan*

The Ink volume in each pixel was equalized within a range of 0.4% deviation. The relation between the ink volume and light emission was quantified on a specially designed test substrate. The developed technology was applied to a large screen OLED TV and uniform light emission was demonstrated.

**OLED2 - 2: *Invited* Light Extraction Techniques in High Efficiency
15:25 200-lm/W Organic Light Emitting Devices Coupled
with High-Refractive-Index Substrate**

A. Mikami

Kanazawa Inst. of Tech., Japan

Light extraction efficiency has been successfully enhanced by using high refractive index substrate and textured micro-lens array coupled with weak micro-cavity structure. For phosphorescent CBP:Ir(ppy)₃ based green OLEDs, power efficiencies over 200-lm/W were obtained with an external quantum efficiency of 57%. Device design process will be discussed from the optical viewpoint.

OLED2 - 3 Microplasma Current Switch and Its Characteristics
15:50*J. Y. Cai, M.-M. Kim, C.-H. Moon, S.-Y. Lee, S. Yi*
Hoseo Univ., Korea

A microplasma current switch for a device operated in a current mode like organic light-emitting diodes, which features matrix addressability and current switching, is presented as well as its current-voltage characteristic and analysis. The dependence of the current-voltage characteristic on voltage signal elements for plasma generation is also described.

OLED2 - 4 Increasing PMOLED Efficiency by Decimating the Charging/Discharging Power Loss
16:05*C. Xu, C. Codrea, M. Buczek*
Saarland Univ., Germany

The capacitive power dissipation in PMOLED display drivers is considerably reduced by means of a state-dependent charge-controlled driving scheme. The charge stored by the intrinsic OLED capacitances is not dissipated but reused to maximize the light output efficiency. This driving method is easy to implement and assures the high visual quality of OLED displays.

----- Break -----

OLED

16:40 - 17:40

TENYO

OLED3/AMD3: AM-OLED (1)Chair: A. Mikami, Kanazawa Inst. of Tech., Japan
Co-Chair: T. Inoue, TDK, Japan**OLED3/
AMD3 - 1 An OLED-on-Silicon Pixel Structure for
Microdisplays**
16:40*B.-C. Kwak, H. Kim, H.-S. Lim, O.-K. Kwon*
Hanyang Univ., Korea

In this paper, we propose an organic light emitting diode on silicon (OLEDoS) pixel structure for microdisplays with 6-bit gray scale. The "ON" time pulse width of the pixel emission current for representation of gray scale is determined by switching operation of p-MOSFET and ramp signal.

**OLED3/
AMD3 - 2
16:55** **A Low Mask Count Top Gate Process for AMOLED Displays Based on Amorphous or Polymorphous Silicon**

P. Schalberger, H. Baur, T. Buergestein^{}, N. Fruehauf
Univ. Stuttgart, Germany
^{*}Robert Bosch, Germany*

We have developed a top gate a-Si:H process for AMOLED displays which requires only four mask steps for the realization of passivated TFTs. Furthermore we have successfully processed pixel circuits, gate drivers and AMOLEDs.

**OLED3/
AMD3 - 3
17:10** **Three-Dimensional Organic Field-Effect Transistors**

M. Uno^{,**}, K. Nakayama^{*}, J. Takeya^{*}
^{*}Osaka Univ., Japan
^{**}TRI-Osaka, Japan*

We have developed easy MEMS-based processes that realize three-dimensional organic field-effect transistors with multiple vertical channels on plastic platforms. The devices present outstanding current and on-off ratio which sufficiently drive pixels of organic light-emitting diodes.

**OLED3/
AMD3 - 4L
17:25** **Development of an Industrial Compatible Process for BG OTFTs Using Solution Processable Organic Semiconductors**

*M. Carrasco-Orozco, C. Leonhard, P. Brookes, T. Cull,
D. Mueller, G. Lloyd, F. Meyer, S. Tierney, J. Canisius,
M. Heckmeier, J. Nakanowatari^{*}
Merck Chems., UK
^{*}Merck, Japan*

We present our newly developed materials compatible with industrial process in an effort to bring the use of solution processable organic semiconductors closer to mass production. We demonstrate OTFTs with mobilities over 1.5 in BG architecture and (sputtered) silver electrodes.

Author Interviews

18:00 – 19:00

Thursday, December 10

9:00 - 10:10

TENGYOKU

AMD4/OLED4: AM-OLED (2)

Chair: Y. Matsueda, Matsueda Consulting, Japan
 Co-Chair: S. Utsunomiya, Seiko Epson, Japan

AMD4/ OLED4 - 1: Invited Top Emitting White OLED Technology for Small and Medium-Sized AMOLED Displays
 9:00

D. Peng, R. Nishikawa

TPO Displays, Taiwan

A 3.5" nHD AMOLED display has been developed with top emitting WOLED + CF technology. It features high-resolution, low power, and extended lifetime. Moreover, to improve the uniformity for high-resolution AMOLED, a module compensation approach has been applied. With these technologies, a high-resolution AMOLED display with better front-of-screen performance could be achieved.

OLED

AMD4/ OLED4 - 2: Invited Development of 4.0-in. AMOLED Display with Driver Circuit Using Amorphous In-Ga-Zn-Oxide TFTs
 9:25

J. Sakata, H. Ohara, M. Sasaki, T. Osada, H. Miyake, H. Shishido, J. Koyama, Y. Oikawa, H. Maruyama*, M. Sakakura*, T. Serikawa, S. Yamazaki*

Semiconductor Energy Lab., Japan

**Advanced Film Device, Japan*

We have developed a 4.0-inch QVGA AMOLED display integrated with gate and source driver circuits using amorphous In-Ga-Zn-Oxide TFTs. And we have successfully developed the world's first 3.4-inch QHD AMOLED display integrated with driver circuits.

AMD4/ OLED4 - 3: Sample and Hold DeMUX Method for Threshold Voltage Compensation Pixel Circuits of AMOLEDs
 9:50

S. Choi, C. Kang, S. Hwang, K. Kim, B. Kim

Samsung Mobile Display, Korea

In this paper, a new demultiplexing method is proposed to ensure adequate time for compensation of threshold voltage variation in a LTPS TFT. An AMOLED panel has been successfully developed and driven at 120Hz frame frequency using the proposed method.

----- Break -----

10:40 - 11:35

TENJU

OLED5: OLED Lighting

Chair: Y. Kijima, Sony, Japan
 Co-Chair: S. Naka, Univ. of Toyama, Japan

**OLED5 - 1: *Invited* High-Performance and High-CRI OLEDs for
 10:40 Lighting and Their Fabrication Processes**

T. Komoda, H. Tsuji, T. Nishimori, N. Ide, T. Iwakuma,
 M. Yamamoto***

Panasonic Elec. Works, Japan

**Idemitsu Kosan, Japan*

***Tazmo, Japan*

A high-CRI, highly efficient white OLED is developed as a two-unit structure with a fluorescent deep blue emissive unit and a phosphorescent green and red emissive unit. A thin encapsulation structure is developed for large area, high luminance OLEDs. High-speed wet-coating and deposition processes are investigated to improve their productivity.

**OLED5 - 2 High-Performance White OLEDs for Lighting
 11:05 Application**

H. Tsuji, N. Ito, Y. Matsuhisa, S. Houzumi, N. Ide

Panasonic Elec. Works, Japan

A high performance multi-unit OLED device having excellent emission characteristics of luminous efficacy of 37 lm/W and color rendering index of 95 and very small variation of chromaticity in different directions is developed. Stable emission at high luminance and long storage stability are realized with a heat radiative thin encapsulation.

**OLED5 - 3 Visualization Technique and Evaluation of Meniscus
 11:20 Shape in Slit Coat Method for Uniform Coating of
 Nano-Meter Film under Atmospheric Environment**

T. Kawaguchi, Y. Ikagawa, M. Yamamoto

Tazmo, Japan

Slit coat method makes it possible to form uniform coating of nano-meter film for OLED's to substrate under atmospheric pressure. By evaluating it with Visualization technique of meniscus shape and CAE analysis, it was found stabilizing the meniscus shape is important.

----- Lunch -----

13:20 - 16:20

3F Foyer

Poster OLEDp: OLED Poster**OLEDp - 1 Efficient Energy Transfer of Red Organic Light Emitting Devices Using Two Species of Donors in Emissive Layer**

*L. Lin, J. Zhang, B. Wei, H. Zhang, H. Xu**
Shanghai Univ., China
**SVA Electron, China*

We have investigated the characteristics of red OLEDs with two donors and one dopant in emissive layer. The electroluminescence efficiency of the device increased two folds compared to devices with single host materials while the peak emission kept unchanged.

OLED

OLEDp - 2 High Efficiency and Large Energy Band-Gap Host Materials for Blue Phosphorescent Emitters

H.-L. Huang, C.-J. Lin, C.-H. Cheng*, M.-R. Tseng*
ITRI, Taiwan
**Nat. Tsing Hua Univ., Taiwan*

The blue phosphorescent OLED with high efficiency, high thermal stability and high brightness will be illustrated in this paper. Applying new high energy gap host materials can easily trap the recombination energy of holes and electrons within emitting layer and effectively transfer to blue phosphorescent emitters to emit blue light.

OLEDp - 3 Long Lifetime and High Efficiency Electron Transporting Materials for Green Phosphorescent Emitters

H.-L. Huang, T.-C. Chao, J.-S. Lin, M.-R. Tseng
ITRI, Taiwan

The green phosphorescent OLED with long lifetime, high efficiency, high thermal stability and high brightness will be illustrated in this paper. Applying new electron transporting materials(ETL-C4) can help the electron injection from electrode and exhibit much longer lifetime than conventional BPhen materials.

OLEDp - 4 OXD Derivative as the Host Material of the Blue Phosphorescent OLED

*C.-L. Huang, C.-H. Hsiao, J.-H. Lee, C.-C. Yang,
C.-C. Chao, M.-K. Leung, S.-T. Yeh**

Nat. Taiwan Univ., Taiwan

**ITRI, Taiwan*

In this paper, we demonstrated a blue phosphorescent organic light-emitting device with lower driving voltage and higher efficiency based on conventional iridium(III)bis(4,6-(di-fluorophenyl)-pyridinato-N,C2') picolinate emitter doped in our new-synthesized electron-transporting host material, 2,2'-bis[5-phenyl-2-(1,3,4)oxadazolyl]biphenyl.

OLEDp - 5 High Efficiency Deep Blue Electro-Phosphorescent OLEDs Based on Bipyridinated Iridium Complex

*C. H. Lee, S. G. Yang, H. Y. Kim, Y. K. Kim, S. H. Hwang,
H. J. Ko, D. Y. Shin, J. H. Lee, S. C. Kim*

Samsung Mobile Display, Korea

A series of new blue-phosphorescent iridium(III) complexes with ligand of 2,3'-bipyridine(bipy) derivatives were designed, synthesized, and electro-luminescent (EL) properties were investigated. To obtain pure blue emission, we introduced Fluorines at the position of 2' and/or 6' of 3'-pyridine. Blue electro-phosphorescent device was fabricated with 2',6'-difluoro-2,3'-bipyridine iridium (III) picolinate.

OLEDp - 6 All Wet Processed OLED Directly Electron Injection from Al Cathode with New n-Doped ETL Material

*Y. Goto, M. Noto**

Kyushu Elec. Power, Japan

**Dyden, Japan*

We demonstrated that the all wet processed yellow OLED using new n-type doped ETL directly injected electron from Al cathode without alkaline earth metal cathode or buffer layer. The OLED using DYETM-17:nDQD-1(10wt%) as ETL exhibited low driving voltage evaluated to be 2.6V at luminance of 100cd/m².

OLEDp - 7 Mechanistic Analysis for Low-Voltage and Long-Lifetime Operation of the OLEDs with New Electron Transport Materials

*T. Tanaka, Y. Honma, M. Abe, Y. Miyashita, N. Arai,
A. Ogata*, Y. Hisamatsu*, H. Aihara**

Tosoh, Japan

**Sagami Chem. Res. Ctr., Japan*

We demonstrated low voltage and long lifetime in organic light-emitting diode (OLED) devices using newly synthesized electron transport materials (ETMs). The relationships between chemical and physical properties of ETMs and the device performance were discussed.

OLEDp - 8 Determination of Localized-State Distributions in Polyfluorene-Based Light-Emitting Layer by Impedance Spectroscopy

*H. Hase, T. Okachi, T. Nagase, T. Kobayashi, H. Naito
Osaka Pref. Univ., Japan*

We propose a method for the determination of localized-state distributions in organic light-emitting diodes by impedance spectroscopy. The applicability of the method is demonstrated in poly(9,9-dioctyl-fluorene-co-N-(4-butylphenyl)-diphenylamine) (TFB). We show that the measurements are powerful tool for the determination of localized-state distributions in organic light-emitting diodes.

OLEDp - 9 Optimization of SLS Based-TFT Performance for AMOLED

*S. Jin, J.-H. Oh, Y. J. Chang, C. H. Park, I.-D. Chung,
K.-H. Lee, J. B. Choi, J.-T. Jung, S. Jeong, W. S. Choi,
S. Y. Cho, H. Min, S. C. Kim, S. S. Kim
Samsung Mobile Display, Korea*

A 2.8" WQVGA AMOLED has been developed based on a two-shot sequential lateral solidification process. Leakage current of the poly-Si TFTs was effectively reduced and made more uniform by applying electrical off-bias stress to create negative charges near the drain region. By adapting this method, image quality was significantly improved.

OLEDp - 10 Effect of the Triplet Energy and Exciton Blocking Property of the Hole-Blocking Layer of PHOLEDs

*Y. W. Park, Y. M. Kim, J. H. Choi, T. H. Park, J. W. Jeong,
B. K. Ju
Korea Univ., Korea*

This paper reports on the relationship between the triplet exciton quenching at the emissive layer/hole blocking layer interface and the triplet energy of the HBL in phosphorescent organic light-emitting diodes. The device performance of PHOLEDs significantly depended on the triplet energy level of HBL.

IDW Tutorial in Japanese

Tuesday, December 8, 2009

Room "TENRAN" (4F)

World Convention Center Summit

Detailed information will be announced in October at
<http://www.sidchapters.org/japan/>

OLEDp - 11 High Contrast Blue Organic Light-Emitting Diodes Using Inorganic Multi-Layer of Al and ZnSe

*Y.-H. Kim, S. Y. Lee, W. Song, M. Mong, J.-H. Kim,
B. S. Seo, A. R. Cho, B. Y. Yun, W. Y. Kim*

Hoseo Univ., Korea

High contrast blue organic light-emitting diodes were fabricated using inorganic metal multi layer composed of NPB / MADN / Alq₃ / LiF / Al / ZnSe / Al and then compared optical and electrical characteristics with polarizer attached and conventional OLEDs. Ambient light reflection of OLED using inorganic metal multi-layer, polarizer and conventional metal layer were 24.0, 31.1 and 82.5% respectively. OLEDs including inorganic metal multilayer was improved its contrast ratio of 135:1 comparing with polarizer attached blue OLED as 104:1.

OLEDp - 12 Determination of Charge Carrier Mobility in Tris(8-hydroxyquinoline) Aluminum (Alq₃) by Means of Impedance Spectroscopy (IS) Measurements

S. Ishihara^{,***}, T. Okachi^{*}, H. Naito^{*,**}*

^{}Osaka Pref. Univ., Japan*

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

*^{***}Hitachi, Japan*

The hole mobilities of tris(8-hydroxyquinoline) aluminum (Alq₃) thin films and 4,4'-bis[N-(1-naphthyl)-N-phenyl-amino]-biphenyl (NPB) /Alq₃ multilayer thin films have been determined using impedance spectroscopy (IS) measurements. We employed the NPB thin film as a buffer layer to reduce the hole injection barrier between the injection electrode and the Alq₃ thin film.

OLEDp - 13 Efficiency Improvement of Phosphorescent White Organic Light-Emitting Devices Using Codoped Method

*C.-H. Hsiao, C.-L. Huang, Y.-T. Chang, J.-H. Lee,
S.-T. Yeh^{*}*

Nat. Taiwan Univ., Taiwan

^{}ITRI, Taiwan*

White OLED with a codoped emitting layer consisting of Ir(ppy)₃ and red emitter were investigated. The coexistence of hole-transporting Ir(ppy)₃ and low-concentration red emitters eliminated hole-trapping effect, thus reducing driving voltage by 0.8 V, improving external quantum efficiency by 5.1%, and reaching 20.7 cd/A and 13.7 lm/W at 95 cd/m².

OLEDp - 14 Deposition of Thin Film by RF-Plasma Polymerization Using Monomer of Benzene or Its Derivatives for Organic Light Emitting Device

*R. Koyama, S. Ojira, Y. Sato, S. Yoshikado
Doshisha Univ., Japan*

Thin film applicable to organic light emitting device (OLED) was deposited using plasma polymerization of benzene, toluene or p-xylene monomer by discharge at radio frequency (RF) (13.56 MHz). Thin film of benzene deposited at RF-frequency emitted strongest luminescence.

OLEDp - 15 Polarized OLED on a Flexible Optical Giant Birefringent Optical (GBO) Substrate

*M.-N. Kim, M.-Y. Han, C. H. Park, Y. H. Huh, H. G. Jeon,
Y. I. Lee, E. H. Choi, Y. H. Seo, G. S. Cho, B. Park
Kwangwoon Univ., Korea*

OLED

We present highly polarized light emissions from an OLED on a flexible photonic giant birefringent optical (GBO) substrate. Electroluminescence over 4,500 cd/m² was produced with high peak efficiency and high polarization ratio over 25. Furthermore, it was also found that the polarization direction corresponded to the ordinary-axis of the anisotropic substrate.

OLEDp - 16 Large-Area OLED Lighting Fabricated by Screen Printing

*H.-C. Shin, K.-H. Lee, D.-H. Lee, S. M. Cho
Sungkyunkwan Univ., Korea*

We have successfully fabricated large-area OLED lighting using screen printing method. The fabricated OLED devices are in the size of 10cm × 10cm and 20cm × 20cm and fabricated with screen printing method except metal cathode. We think that it is possible to realize the large-area OLED lightings using full wet-processes such as screen printing. Also we report the effect of organic salt doping.

OLEDp - 17 Efficient Electro spray Deposition of Organic Thin Film Using Cylindrical Acryl Pipe

*H. Asaki, T. Asano, T. Fukuda, Z. Honda, N. Kamata
Univ. of Saitama, Japan*

We proposed a novel fabrication method for organic devices using the electro spray deposition process in combination with an acryl pipe. The charged acryl pipe can control the direction of organic spray, resulting in the selective deposition area and high deposition rate. The surface morphology and optical characteristics were investigated.

OLEDp - 18 Direct Encapsulation of Heat-Dissipation Layer on White Organic Light-Emitting Diode by Atomic Layer Deposition*H. Yang**Nat. Taipei Univ. of Tech., Taiwan*

A novel encapsulation technique for heat dissipation of white organic light-emitting diode (WOLED) was proposed and demonstrated. A layer of alumina was directly deposited on a WOLED by atomic layer deposition (ALD) at room temperature. This direct encapsulated WOLED could operate approximate the same condition as that with class-cap encapsulation.

OLEDp - 19 Patterning of Organic Insulator Using Self-Assembled Monolayers for Organic Light-Emitting Diodes by Micro-Contact Printing*T. H. Park, Y. M. Kim, Y. W. Park, J. H. Choi, J.-W. Jeong,
H. J. Choi, K. C. Choi*, B.-K. Ju**Korea Univ., Korea***KAIST, Korea*

A self-assembled microarray (SAMA) of organic light-emitting diodes (OLEDs) has been fabricated using self-assembled monolayers (SAMs) by micro-contact printing (μ CP). The hydrophobic SAMs allow to form self-assembled micro-arrays spontaneously on the patterned SAMs.

OLEDp - 20 Photo-Thermal Deflection Spectroscopy for Surface Study of Laser Irradiated Donor Plate*K. Lee, K. Lee, J. H. Kwon, L. S. Park*, J. Yi**Yeungnam Univ., Korea***Kyungpook Univ., Korea*

The variation of surface morphology was studied by sending probe laser on the laser irradiated donor plate, which is used for laser thermal printing. The variation of reflected laser power from donor plate was detected after pinhole.

OLEDp - 21 Organic Light-Emitting Diodes with Contact-Printed Emissive Layer*J.-H. Jou, S.-H. Peng, S.-Z. Chen, B.-S. Wu,
C.-Y. Chang, P.-H. Chiang**Nat. Tsing Hua Univ., Taiwan*

We use contact-printing method to imprint the emissive layers of R-, G-, and B-OLED. The preliminary results prove contact-printing to be a good approach to fabricate OLED with various chromaticities especially useful to achieve high color rendering index.

OLEDp - 22L The Accelerating WVTR Evaluation of Multilayer Gas Barriers in Flexible OLED Application

*J.-Y. Liao, M.-R. Tseng
ITRI, Taiwan*

The WVTR of single layer barrier PET films are measured at different conditions of 25°C/60%RH, 40°C/90%RH, and 85°C/85%RH. The acceleration factors of 6.5 (40°C/90%RH) and 37.5 (85°C/85%RH) are obtained compared with 25°C/60%RH. By applying these factors, the WVTR of the multilayer gas barrier can be extracted at an accelerating speed.

OLEDp - 23L High-Efficiency Blue Dendrimer for Full Color Flat-Panel Displays

*L. Wang, J. Wang, L. Lan, W. Xu, J. Peng
South China Univ. of Tech., China*

High-efficiency and color stable blue OLEDs with CIE coordinates of (0.155, 0.086) are obtained utilizing a solution-processible fluorescent π -conjugated dendrimer G0. The highest efficiency reaches 5.3 cd A⁻¹. By doping G0 with phosphorescent dyes, Ir(mppy)₃ or Ir(piq)₂acac, efficient green and red OLEDs have been developed with a success.

OLEDp - 24L High-Efficiency Phosphorescent Orange OLED with Double Emission Layers

*J.-H. Jou, K.-Y. Tseng, C.-H. Chiu, W.-B. Wang, Y.-M. Lai
Nat. Tsing Hua Univ., Taiwan*

A highly efficient orange organic electrophosphorescent device was fabricated by using double emission layers of 2,7-Bis(9-carbazolyl)-9,9-spirobifluorene and 4,4'-Bis(9-carbazolyl)-biphenyl as hosts and both doping 4 wt% orange emitter, tris(2-phenylquinoline)iridium(III). Efficiency of 29.5 lm/W at 100 cd/m² was obtained by adjusting the emission layers thicknesses at 19 nm and 5 nm, respectively.

OLEDp - 25L Sunlight-Style Color-Temperature Tunable OLEDs

*H.-C. Wang, J.-H. Jou, M.-H. Wu, S.-M. Shen,
S.-Z. Chen, S.-H. Chen, C.-R. Lin, Y.-L. Hsieh
Nat. Tsing Hua Univ., Taiwan*

We demonstrate a series of man-made lighting device of organic light-emitting diodes (OLEDs) capable of yielding sunlight-style illumination. The resulting color-temperature ranges between 2300 and 8200 K, or much greater, depending on the number of employed carrier-modulating-layer, fully covering those of the entire daylight at different times and regions.

Author Interviews

18:00 – 19:00

Workshop on 3D/Hyper-Realistic Displays and Systems

Thursday, December 10

13:20 - 16:20

3F Foyer

Poster 3Dp: 3D/Hyper-Realistic Display Systems

3Dp - 1 **3D/Hyper Realistic Display Systems as Futuristic Facades**

N. Y. Abo-Moussallam

Helwan Univ., Egypt

Image become more realistic and more interactive, that is because many new Systems in produce and display images. The paper discusses the applications which evolving utilizing of 3D/hyper realistic Display systems as a futuristic façade In the Field of Environmental Decoration.

3Dp - 2 **Evaluation of 3D Displays in Terms of Literacy Learning**

H. Ikeshita(Yamazoe), T. Kawai, M. Ishii, H. Yamagata*,
K. Niinuma*, Y. Ono*, M. Miyao***

Waseda Univ., Japan

**Bandai Namco Games, Japan*

***Nat. Ctr. for Child Health & Dev., Japan*

The authors have developed a literacy learning system for children with developmental dyslexia. We compared the comprehensibility of 3D characters presented on a depth fused 3D display and on a fractional view display. These results indicate that a fractional view display can make the structure of large characters understandable.

3Dp - 3 **Stereoscopic View Image Generation Based on the Horopter**

J.-H. Jung, Y. Kim, S. Kim, B. Lee

Seoul Nat. Univ., Korea

In the human vision, the stereoscopic displays have the depth distortion problem because of the horopter. We propose a method for view image generation for stereoscopic display based on the horopter. The method is depth remapping process using the horopter curve of each depth plane.

3Dp - 4 Using Psychometric Method to Find the Optimal Disparity on Stereoscopic Display System

J.-H. Su, C.-H. Juan, Y.-C. Jian^{}, C.-N. Mo^{**}, M.-C. Fu^{**},
J.-C. Lun^{**}*

Nat. Central Univ., Taiwan

^{}Nat. Taiwan Normal Univ., Taiwan*

*^{**}Chunghwa Picture Tubes, Taiwan*

In this study authors used psychophysical methods to gauge the optimal parameters for 3D perception in a multi-view display. A rapid method was developed to acquire disparities to accommodate the specifications of a certain monitor.

3Dp - 5 Using Large-Size 2D Displays to Create 3D Hyper-Realistic See-Through Experiences

C. Yuan

Sharp Labs. of America, USA

This paper describes a novel approach for creating hyper-realistic 3D see-through experiences on large-size 2D displays. Viewers moving in front of the display can observe real-time updated ultra-high-resolution images which appear originating from different parts of a virtual 3D world placed behind the display.

3D

3Dp - 6 Multispectral Polarization Analysis of Circular Polarizer Stereoscopic 3D Display

*P. Boher, T. Leroux, T. Bignon, V. Collomb-Patton
ELDIM, France*

Polarization based stereoscopic 3D display is characterized by measuring the polarization state of its light emission versus angle and wavelength using Fourier optics viewing angle instrument. In depth analysis of the results allow full characterization of its stereoscopic properties and the origin of its main imperfections.

3Dp - 7 Evaluation Method of Residual Image Caused by Liquid Crystal Reponse Delay for Frame-Sequential Stereoscopic Display

*A. Sakai, A. Hayashi, T. Kometani, H. Ito
Eizo Nanao, Japan*

Residual image caused by slow response of LC panel is a big problem in development of frame-sequential stereoscopic display. Therefore, to establish an evaluation method of residual image is very important. We devised a quantitative evaluation method.

3Dp - 8 A Glasses-Free Multi-View 3D Monitoring System*S.-C. Yen, T.-C. Shen**Chunghwa Picture Tubes, Taiwan*

Based on barrier panel technology that precisely aligns left and right eye images simultaneously, these displays offer true glasses-free 3D viewing without any optical aids. The real-time multi-view monitoring system has the distinct advantage of providing a perfect and instant spatial image.

3Dp - 9 Distortion in Liquid-Crystal Varifocal Lens for Volumetric Three-Dimensional Display*K. Kikuchi, T. Inoue, H. Yamamoto, S. Suyama**Univ. of Tokushima, Japan*

We evaluate distortion of 3-D image at different focal length of liquid-crystal (LC) varifocal lens. Volumetric 3-D image is constructed by using LC varifocal lens. As a result, 3-D image using LC varifocal lens has a small difference in distortion compared with distortion without LC varifocal lens.

3Dp - 10 Continuous Control of Depth of Field Using Stereoscopic Lens-Tilt Imaging*N. Kaneko, S. Suyama, H. Yamamoto**Univ. of Tokushima, Japan*

To provide images that are easily viewable on large stereoscopic display, we propose a method of continuously controlling depth of field by lens-tilt configurations. The depth of field of stereoscopic cameras is analyzed and demonstrated.

3Dp - 11 Converting 2D Outdoor Photographs to Stereoscopic 3D Images Based on Image Analysis*P.-L. Sun, J.-Y. Huang***Nat. Taiwan Univ. of S&T, Taiwan***Shih Hsin Univ., Taiwan*

A method to generate stereoscopic 3D images from typical outdoor portrait photographs is proposed. It first segments a photo into major image elements and then assigns reasonable depth to each of the regions. Relief-like depth is assigned to bodies to improve their naturalness.

3Dp - 12 Optical Ray Control for Orthoscopic/Pseudoscopic Image Conversion

J. Hong, K. Hong, S.-W. Min^{}, B. Lee.
Seoul Nat. Univ., Korea
^{*}Kyung Hee Univ., Korea*

We propose a novel optical system that is capable of orthoscopic/pseudoscopic image conversion. The system is composed of three step lens arrays. With carefully designed parameters, it converts target object into pseudoscopic image with reversed depth. The quality of resultant image was improved than two lens array system because of reduced power loss and crosstalk.

3Dp - 13 Withdrawn**3Dp - 14 High Resolution Autostereoscopic 3D Projection Display with Spatially Divided Iris Plane Shutter**

*T. Ishinabe, T. Kawakami, N. Takahashi, T. Uchida
Tohoku Univ., Japan*

We proposed the novel autostereoscopic 3D projection display with a spatially divided iris plane shutter. The stereo images are time sequentially sent to the viewer's positions by iris shutter. This display has advantages of the capability of multi-view images, 2D/3D switchable, high resolution, no crosstalk between left and right viewing zones.

3Dp - 15 GPU Implementation of Signal Processing in a 3D Image System with Multi Vision Imaging and Wavefront Reconstruction

*T. Kurahashi, K. Nitta, O. Matoba
Kobe Univ., Japan*

Signal processing in a 3D image system with multi vision capturing and wave front reconstruction is implemented on a Graphic Processing Unit. We present the processing for area based matching and triangulation in the GPU. It is confirmed that the GPU is effective for the proposed system.

3Dp - 16L Lobe Analysis of Integral-Type 3D Display Based on Luminance Profiles

*M. Tsuboi, T. Horikoshi
NTT DOCOMO, Japan*

We propose a methodology to analyze the lobe profile of integral-type 3D display based on the luminance profile. By using proposed method, the area of lobe, which causes pseudoscopy and decrease of image quality, can be assessed quantitatively considering both crosstalk and overlap.

3Dp - 17L Perceived Depth Change by Decreasing Visual Acuity in a Dominant Eye on Binocular Stereoscopic Imaging

*T. Inoue, H. Yamamoto, S. Suyama
Univ. of Tokushima, Japan*

Perceived depth of 3-D image is found to decrease continuously to single-eye level, when image blurring of a dominant eye is increased. We evaluate perceived depth change by blurring an image of a dominant eye on binocular stereoscopic imaging. Perceived depth is measured using method of adjustment.

3Dp - 18L A Development of Glass-Less Wide-Viewing Angle 3D LCD Monitor Driving Using Eye-Tracing Method

Y. Hong, S. B. Kwon, K. S. Min*, S.-H. Park*, J. Ying,
S. Seo*, D. Jeong*
Hoseo Univ., Korea
Ndis, Korea

A display system that don't need special glass to see 3D images is a useful technology. Conventional 3D monitor don't have a large viewing angle. We have developed a wide-viewing 3d LCD monitor driving system by controlling barriers.

Friday, December 11

| | |
|----------------|-------|
| 9:00 - 9:05 | ZUIYO |
| Opening | |

Opening Remarks

9:00

I. Yuyama, Utsunomiya Univ., Japan

| | |
|------------------------------|-------|
| 9:05 - 10:25 | ZUIYO |
| 3D1: 3D Display Image | |

Chair: J.-Y. Son, Daegu Univ., Korea

Co-Chair: T. Mishina, NICT, Japan

3D1 - 1: Invited Integral 3D Television: A Real-Time Imaging System Based on Integral Photography

9:05

M. Okui, J. Arai*, M. Kawakita*, F. Okano*,**
*NHK, Japan
**NHK Eng. Service, Japan*

Integral photography is highly effective at allowing observers to see natural and realistic 3D images without any special glasses. We have been making continuous research into integral 3D television based on integral photography. The paper reports a progress in recent years on the development of the prototypes.

3D1 - 2: 9:25 Invited 3D-TV: Are Two Images Enough? How Depth Maps can Enhance the 3D Experience*C. Vazquez, W. Tam, F. Speranza**Commun. Res. Ctr., Canada*

For 3D-TV viewing the two images provided by stereoscopic imaging systems offer very little control on the perceived 3D experience. However, depth maps allow for improved depth visualization, through disparity customization and new view-point generation.

3D1 - 3 9:45 Switchable 3D/2D Display Using LC GRIN Lenticular Lens*C. H. Chiu, C. W. Chen, C. H. Shih, W. M. Huang**AU Optronics, Taiwan*

Switchable 3D/2D displays using LC GRIN lens with low Xtalk were fabricated. By optimizing LC material parameters, patterned ITO, relationship between lens cell and image cell, Xtalk of less than 5% for 2-view was achieved.

3D1 - 4 10:05 A Novel Real-Time 2D to 3D Conversion Technique Using Depth Based Rendering*M.-C. Kao, T.-C. Shen**Chunghwa Picture Tubes, Taiwan*

A faster algorithm of generating depth map of 2D image has been developed by grayscale analyzing, and spatial relative setting. This novel technology was successfully implemented in our 26" and 37" Barrier-type, 4-view, 3D LCD.

----- Break -----

3D

10:40 - 12:00

ZUIYO

3D2: 3D Display & Acquisition

Chair: I. Yuyama, Utsunomiya Univ., Japan

Co-Chair: M. Hashimoto, NTT, Japan

3D2 - 1: 10:40 Invited Ray-Based Acquisition and Reproduction of 360-degree 3D Images*T. Yendo, T. Fujii*, M. P. Tehrani, M. Tanimoto**Nagoya Univ., Japan***Tokyo Inst. of Tech., Japan*

We introduce a cylinder-shaped 3D display that allows viewers to see 3D images from 360-degree and a novel 3D image acquisition system. The acquisition system acquires multiview images from all horizontal directions around an object with narrow view interval, which the display needs as light ray data.

3D2 - 2 **Viewing Zone Interpolation for Multi-View 3D Displays Using Depth Fused 3D (DFD) Effect**
11:00

M. Date, Y. Andoh, H. Takada, Y. Ohtani
NTT, Japan

A DFD display consists of a stack of two transparent emitting screens. It can produce motion parallax for small change of observation angle. Applying such stacked structure to multi-view 3D displays, density of viewing zone can be reduced. We confirmed it by experiment and calculation.

3D2 - 3 **An Interactive Zoetrope for the Animation of Solid Figurines and Holographic Projections**
11:20

L. Smoot, K. Bassett, S. Hart^{}, D. Burman^{*}*
Disney Res., USA
^{*}*Holorad, USA*

We describe an interactive zoetrope that can animate holographic images, solid figurines, or other still-frame images. Unlike previous zoetropes, it is capable of aperiodic, interactive behavior. For example, we have used it to animate a talking character's mouth in real time in response to human speech.

3D2 - 4 **Robust Pattern Matching Paradigm for Multi-View Imaging**
11:40

S. Gurbuz, S. Yano
NICT, Japan

A fundamental approach of stereoscopic image formation for glasses-free autostereoscopic displays is to utilize parallel or toed-in multi-cameras, and pre-process the multi-view images before feeding them to a display system. In this paper, we describe a novel pattern matching paradigm for alignment of multi-view images captured by multi-camera configurations.

----- Lunch -----

13:20 - 14:40

ZUIYO

3D3: 3D Display Performance (1)

Chair: H. Ujike, AIST, Japan
 Co-Chair: S. Yano, NICT, Japan

3D3 - 1: 13:20 *Invited* Accommodation and Vergence in Natural and Virtual Environments

T. Mihashi^{,**}, M. Kobayashi^{*}, T. Fujikado^{**}*
^{*}*Topcon, Japan*
^{**}*Osaka Univ., Japan*

We will discuss problems of accommodation, vergence, and blur in a virtual environment and introduce the methods to measure accommodation, vergence, pupil diameter, and aberrations.

3D3 - 2 13:40 *Dependence of Displayed Image Resolution on Displayed Depth and Observer's Position in Autostereoscopic Displays*

T. Saishu, K. Taira, R. Fukushima, Y. Momonoj, M. Kashiwagi, Y. Hirayama
Toshiba, Japan

We evaluated the dependence of displayed image resolution on displayed depth and observer's position in autostereoscopic 3D displays. In discrete viewpoint type displays, depth dependence does not appear as long as observer's position is correct. In continuous viewpoint displays, depth dependence appears, but observer's position dependence is small.

3D

3D3 - 3 14:00 *Factors for Crosstalk*

J.-Y. Son, M.-C. Park^{}, Y. Vashpanov^{**}, D.-S. Lee, S.-H. Kim, G. Volodymyr*
Daegu Univ., Korea
^{*}*Korea Inst. of S&T, Korea*
^{**}*Hanyang Univ., Korea*

The crosstalk in the multiview 3 dimensional imaging system depends on discrepancy amount in the design parameters of the system. The crosstalk appears not even between immediate view images but also with the next view images, when there are large discrepancies between actual parameter values and the designed.

3D3 - 4 14:20 *An Image Processing Method for the Elimination of the Ghost Image and Improvement of the Image Quality in Stereoscopic Display*

M.-C. Tsai, C.-W. Chen, C.-H. Shih, W.-M. Huang
AU Optronics, Taiwan

We disclose a image processing method to eliminate the light leakage of stereoscopic display from the signal for the other eye. This Method can reduce ghost image on stereoscopic display and improve 3D image quality.

----- Break -----

15:00 - 16:20

ZUIYO

3D4: 3D Display Performance (2)

Chair: C. Vazquez, CRC, Canada

Co-Chair: M. Hashimoto, NTT, Japan

3D4 - 1: 15:00 *Invited* Development in Performance Characteristics of 3D Displays: Ergonomic Approach

H. Ujike^{*,*2}, *S. Uehara*^{*,*3}, *G. Hamagishi*^{*,*4}, *K. Taira*^{*,*5},
T. Koike^{*,*6}, *C. Kato*^{*,*6}, *T. Nomura*^{*,*7}, *T. Horikoshi*^{*,*8},
K. Mashitani^{*,*9}, *A. Yuuki*^{*,*10}, *K. Izumi*^{*,*11},
Y. Hisatake^{*,*12}, *N. Watanabe*^{*}, *Y. Nakano*^{*,*13}

* Japanese Ergonomics Nat. Committee, Japan

*²AIST, Japan*³NEC LCD Techs., Japan*⁴Epson I. D., Japan*⁵Toshiba, Japan*⁶Hitachi, Japan*⁷Sharp, Japan*⁸NTT DOCOMO, Japan*⁹Sanyo Elec., Japan*¹⁰Mitsubishi Elec., Japan*¹¹3D Consortium, Japan*¹²Toshiba Mobile Display, Japan*¹³YOSH Consultancy, Japan

To achieve Image Safety for 3D displays, it is important how to determine qualified viewing space, especially for autostereoscopic displays. For the space, we, here, introduce discussions of motion parallax smoothness and image blur, which are closely linked to crosstalk issues and “continuous/discrete views” of multi-view autostereoscopic displays.

3D4 - 2 15:20 Measurement for Viewing Space and Image Resolution of Enhanced Integral Photography 3D Display

T. Koike, H. Sakai, K. Utsugi, C. Kato, M. Oikawa,
M. Yamasaki

Hitachi, Japan

We have measured and analyzed the viewing space and the image resolution of a superposed integral 3D display with multi projectors. The 3D display is with full parallax feature, thus the viewing space is very complicated. We use computer vision and computational geometry techniques to measure the complicated viewing space.

3D4 - 3
15:40**Polarized Based Stereoscopic 3D Display
Characterization Using Fourier Optics Instrument
and Computation in the Observer Space***P. Boher, T. Leroux, V. Collomb-Patton, T. Bignon
ELDIM, France*

A method to characterize polarization based stereoscopic 3D displays using Fourier optics viewing angle measurements is proposed. Luminance measurements in the full viewing cone across the two glasses filters are used to calculate contrast for each eye and combined 3D contrast. Direct comparison with auto-stereoscopic 3D displays becomes possible.

3D4 - 4
16:00**Stereoscopic Viewing Space Analysis Based on
Optical Measurements for Two-View and Multi-View
Stereoscopic Displays***G. Hamagishi^{*,2}, K. Mashitani^{*,3}, S. Uehara^{*,4},
T. Koike^{*,5}, T. Horikoshi^{*,6}, A. Yuuki^{*,7}, N. Watanabe<sup>*,
Y. Hisatake^{*,8}, K. Taira^{*,9}, H. Ujike^{*,10}</sup>***Japanese Ergonomics Nat. Committee, Japan**²Seiko Epson, Japan**³Sanyo Elec., Japan**⁴NEC LCD Techs., Japan**⁵Hitachi, Japan**⁶NTT DOCOMO, Japan**⁷Mitsubishi Elec., Japan**⁸Toshiba Mobile Display, Japan**⁹Toshiba, Japan**¹⁰AIST, Japan*

This paper presents an analysis of the stereoscopic area of glasses-free, two-view and multi-view 3D displays where the viewer can see full-screen stereoscopic images free from 2D and pseudoscopic images anywhere in the screen.

Author Interviews

16:20 – 17:20

Call for Papers
**Special Section
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IEICE Transactions on Electronics

Submission Deadline: Feb. 26, 2010

<http://ny7084.rie.shizuoka.ac.jp/eid/top-e.htm>

Workshop on Applied Vision and Human Factors

Wednesday, December 9

13:20 - 14:40

ZUIYO

VHF1: Moving Image Quality

Chair: T. Kurita, NICT, Japan
Co-Chair: T. Wake, Kanagawa Univ., Japan

VHF1 - 1 **Perceived Sharpness for Different Moving-Edge Profiles on LCDs**

13:20

X. Li, W. Song, Y. Zhang, G. San, K. Teunissen^{},
I. Heynderickx^{**}*

Southeast Univ., China

^{}Philips Consumer Lifestyle, the Netherlands*

*^{**}Philips Res. Labs. & Delft Univ. of Tech., the Netherlands*

Novel techniques to improve the LCD motion portrayal may result in the perception of irregularly shaped moving-edge profiles. Perception studies show that the perceived sharpness can be predicted by combining two parameters: one related to the edge slope and the other related to the over/under-shoot part of the edge profile.

VHF1 - 2 **Analysis of Factors Affecting Moving Picture Performance of Display Considering Fast Motion and High-Resolution Content**

13:40

I. Kawahara^{,**}*

^{}Panasonic, Japan*

*^{**}Advanced PDP Dev. Ctr., Japan*

Factors affecting moving picture performance including hold time, device response, and persistency of illuminant were analyzed quantitatively by using spatial resolution as a common reference scale. MTF-based analysis proved to be more efficient than response-time measurement considering fast motion or high-resolution contents, being sensitive to essential difference of waveforms.

VHF1 - 3 Correlation of Color Aberration and MPRT in the Flat Panel Display
14:00

J. Hanne, S. A. Park, J. W. Jang, M. J. Lim, H. H. Shin
LG Display, Korea

To search for a simple method to characterize color aberration occurred in the moving picture for the flat panel display, the correlation of color aberration and MPRT values was investigated. Two different plasma displays which show strong, or weak color aberration were analyzed. Thus, it was found that the strength of color aberration can be described by different MPRT values of R, G, and B colors.

VHF1 - 4 Optimal Overdriving Look-up Table Based on the Perceived Image Quality for The LCD TV Module
14:20

J.-H. Hahm, H.-I. Baek, J.-U. Kwon, M.-C. Byun,
J.-W. Lee, H.-M. Moon, H.-H. Shin
LG Display, Korea

The relations of the OD values and the degree of the perceived OD artifacts have been studied by the subjective evaluation. Throughout multiple subjective evaluations and statistical analysis, OD look-up table (LUT) minimizing OD artifacts can be derived. Consequently, the 120Hz LCD TV module having both fast response time and minimum OD artifacts can be fabricated.

----- Break -----

VHF

15:00 - 16:30

ZUIYO

VHF2: Dynamic Range and Gray Scale Expression

Chair: I. Heynderickx, Philips Res. Labs., the Netherlands
Co-Chair: K. Masaoka, NHK, Japan

VHF2 - 1: *Invited* High Dynamic Range Image Appearance
15:00

A. Yoshida
Sharp, Japan

As the need for high dynamic range (HDR) technology has increased, knowledge of the human visual system (HVS) has been actively introduced in computer graphics besides HDR technology development. In this paper, we present a brief review over researches on HDR and HVS-based image processing models.

VHF2 - 2 Novel Method for Digital Image Enhancement
15:30*M. Chen, W. Zhang, G. Qiu***LED Sys., Hong Kong***Univ. of Nottingham, UK*

In this paper, we proposed a novel method for digital image enhancement by both global brightness adjustment and local contrast enhancement. Compared with other methods of image enhancement, our method provides optimized brightness and more local details with few artifacts.

VHF2 - 3 Study of Improving the Gradation Quality of Displays
15:50 Receiving Noise-Added Signals*N. Nakano, A. Nagase, M. Asamura, J. Someya,**H. Sugiura**Mitsubishi Elec., Japan*

We developed the new gradation expansion algorithm for displays. We confirmed that gradation could be corrected effectively even over video picture signals on which noise that made wrong processing with the conventional method was superposed.

VHF2 - 4 Display Panel Measurement Using Dark Sphere and
16:10 Spectrophotometer Calibration by a Double
Integrating Sphere Reference Light Source*T. Matsumoto** , S. Kubota* , T. Shimura* , S. Haga** ,**T. Nakatsue** , J. Ohsako*****Univ. of Tokyo, Japan****Sony, Japan*

We calibrated the spectrophotometer using a double integrating sphere reference light source, and made measurements in the ultra low luminance range of displays using a dark sphere to suppress the influence of the surround.

----- Break -----

IDW Best Paper Award

This award will go to the most outstanding paper selected from those presented at IDW '09.

The 2009 award winners will be announced on the IDW website: <http://www.idw.ne.jp/award.html>

16:40 - 18:00

ZUIYO

VHF3: Display Human Factors

Chair: T. Wake, Kanagawa Univ., Japan
 Co-Chair: K. Tomizawa, Sharp, Japan

VHF3 - 1 **Comparison in Sharpness Evaluation Performance
 16:40** **between Improved Conventional Methods and
 Cooperative Vision-Model-Based Method**

*T. Matsui, T. Fujita
 Gunma Univ., Japan*

We clarified that the sharpness evaluation metric developed based on the cooperative human vision model is superior in performance to conventional metrics and their improved ones. Judging from the difference between them, this result suggests that the image observing mechanism can be a factor of the vision-model-based method's high performance.

VHF3 - 2 **Effect of Contrast Ratio Angular Profile on Perceived
 17:00** **Contrast of LCDs**

*H.-I. Baek, J.-H. Hahm, J.-U. Kwon, M.-C. Byun,
 H.-M. Moon, H.-H. Shin
 LG Display, Korea*

The perceived contrast on the LCDs with different angular contrast ratio (CR) profile and front-view CR were subjectively compared. The performance of the LCD having lower front view CR and broader angular CR profile was found to show same degree of perceived CR performance to the LCD having higher front view CR and narrower angular CR profile.

VHF3 - 3 **Optimal Value and Allowable Limits of Surface Haze
 17:20** **and Illuminance**

Y. Hisatake^{,**}, S. Uehara^{*}, K. Taira^{*,**}, T. Koike^{*,**},
 I. Kawahara^{**}, S. Katoh^{*,**}, N. Asai^{**}, K. Takizawa^{**},
 I. Takahashi^{*,**}, G. Hamagishi^{*}, N. Umedu^{*}, H. Haga^{**},
 T. Sumino^{**}, K. Tomizawa^{**}, A. Yuuki^{*,**}, K. Yanagawa^{*},
 M. Uchidoi^{*}, K. Mashitani^{*}, T. Miyazaki^{*}, N. Watanabe^{*},
 Y. Nakano^{*}*

^{}Japanese Ergonomics Nat. Committee, Japan*

*^{**}JEITA, Japan*

We studied optimal and allowable limits to the haze value of the TV-panel surface and illuminance for beautifulness and unwanted reflection. Correlations between illuminance and evaluated scores for beautifulness and unwanted reflection were opposite relation.

**VHF3 - 4 Investigation of Legibility and Subjective Visual
17:40 Fatigue in Electronic-Paper Displays under Low
Ambient Illumination**

Y.-T. Lin, S.-L. Hwang, S.-C. Jeng^{}, R. J. Koubek^{**}*

Nat. Tsing Hua Univ., Taiwan

^{}Nat. Chiao Tung Univ., Taiwan*

*^{**}Pennsylvania State Univ., USA*

The intent of this study is to determine the minimum ambient illumination requirement for legible electronic-paper display through the method of character-search tasks. As electronic-paper display technology applications gradually expand, the results in this study indicated that the ambient environment for reading electronic-paper display should exceed at least 62 lux.

Author Interviews

18:00 – 19:00

Thursday, December 10

9:00 - 12:00

3F Foyer

Poster VHFp: Applied Vision and Human Factors

**VHFp - 1 Correction of Color-Matching Functions Using
Genetic Algorithm and Gaussian Approximation:
Discussion of Individuality**

S. Ozaki, G. Ohashi, Y. Shimodaira

Shizuoka Univ., Japan

The objective is to examine the proposed correction method of color-matching functions for individuality. Color sensitivity was collected from ten subjects and individuality of color-matching functions was examined. Results show that color-matching functions have dependence on individuality and color difference is small when using corrected color-matching functions specialized with individuality.

**VHFp - 2 Color Perception Characteristics for Spectrally Mixed
Colors in the Mesopic Condition**

N. Ishikawa, G. Ohashi, Y. Shimodaira, Y. Shibata^{},*

H. Serizawa^{}*

Shizuoka Univ., Japan

^{}Koito Manufacturing, Japan*

The sensitivity of a discrimination of spectrally different mixed colors from a gray background was examined to clear color perception characteristics in the mesopic condition. As a result, the sensitivity of the discrimination for colors mixed with blue is higher than that of mixed light with other colors except blue.

VHFp - 3 Study of Color Conversion Based on Matrix Switching Method Exhibiting on the Three-Primary Color LCD

*B. S. Huang, Y. C. Wang, C. R. Sheu, Y. G. Fuh
Nat. Cheng Kung Univ., Taiwan*

Matrix switching algorithm is used to study color conversion on the LCD. We have succeeded in color conversion by checking characteristics of spectrums between three-primary and four-primary colors. But, the brightness of simulated four-primary color patterns must be multiplied by a factor in order to consist with three-primary color patterns.

VHFp - 4 High Efficient Gamut Mapping in xvYCC Space for Wide Gamut Displays

*P.-L. Sun
Nat. Taiwan Univ., Taiwan*

Unlike most gamut mapping algorithms (GMAs) working in CIELAB space, an xvYCC-based GMA for sRGB to wide gamut color mapping is proposed. It features low computation cost and smooth color distribution.

VHFp - 5 Investigation of Image Quality Evaluation Using Psychophysical Methods

Y.-Y. Lai, C.-M. Tsai, S.-S. Guan*
Taiwan TFT-LCD Assn., Taiwan
Nat. Yunlin Univ. of S&T, Taiwan

VHF

A psychophysical experiment was conducted to examine the difference at each physical attribute by visual assessment. 10 standard images with four trials in the experiment process included the assessment of the image quality for lightness, chroma, hue angle, and contrast. Results of ANOVA showed a significant effect of physical attribute.

VHFp - 6 Estimation of Overall Image Quality with the Mahalanobis-Taguchi System Focusing on Gamma, Maximum Luminance and Minimum Luminance

K. Sawada, G. Ohashi, T. Hoshino, Y. Shimodaira
Shizuoka Univ., Japan
Hitachi, Japan

A new method is proposed for evaluation of overall image quality using image parameters on the basis of the Mahalanobis-Taguchi system in the quality engineering. The image parameters are gamma, maximum luminance and minimum luminance. Good relation between estimated and subjective image quality is obtained.

VHFp - 7 Ambient Contrast Ratio Measurement by Using Sampling Integrating Sphere

*S.-Y. Pan, S.-C. Lin, L.-C. Lin, K.-S. Wang, C.-C. Kao,
P.-C. Yeh, C.-Y. Lee*

AU Optronics, Taiwan

To differentiate the ambient contrast ratio performance of different surface-treated LCDs, the sampling-integrating sphere will be the better way to simulate ambient light. We introduce the without-specular port method to complement the insufficiency that with-specular-port method can't distinguish between different levels of only-haze-surface-treated film type LCDs.

VHFp - 8 System Design of Ambient Light Compensation for Flat Panel TV

J.-C. Huang, H.-S. Chen, J.-F. Lee

Nat. Taiwan Univ., Taiwan

A TV system can release the visual fatigue by automatically adjusting LED luminance set on TV back. The light amounts emitted from LED sets are adaptive to illumination and TV image content according to building the database of ambient light compensation. It's expected to have a comfortable TV watching environment.

VHFp - 9 Mean Based Dynamic Range Separated Histogram Equalization for Infrared Imaging System

B.-H. Hwang, G.-H. Park^{}, M.-R. Choi*

Hanyang Univ., Korea

^{}Samsung Thales, Korea*

In this paper, an effective contrast enhancement method for infrared imaging system is proposed. Proposed method fixes the low frequency histogram components as threshold level. And then reacquire the histogram for histogram equalization. Experimental results show that proposed method preserved naturalness of an image than conventional method and computation complexity might be significantly reduced in software/hardware implementation.

VHFp - 10 Using Simulation and Human Vision Evaluation to Illustrate Why "G-center" Pixel Unit Exhibiting the Best Image Quality on a Stripe Sub-Pixel LCD

Y. C. Wang, Y. C. Lee, C. R. Sheu

Nat. Cheng Kung Univ., Taiwan

We study the effects on rendering images with various RGB stripe sub-pixel arrangements. Simulation results show that different RGB arrangements have significant difference on rendering images. Both simulation and human vision evaluation have proven that it obviously shows that "G-center" sub-pixel arrangements have the best images.

VHFp - 11 A Lightweight Wide HMD by Separated Three Displays for an Aging Society*T. Miyachi, S. Watanabe, J. Jantr, T. Suzuki***Tokai Univ., Japan***Kanagawa Pref. Hiratsuka School for the Visually Impaired, Japan*

We developed a prototype of a light-weight three displays HMD (150-inch display 2.5 m ahead)) for CCTV, digital camera, and electronic magazine to enjoy the delightful mobility and examined ways to utilize it. We found the synergy between universal designs and human.

VHFp - 12 Brightness Uniformity and Color Uniformity Equalizing Method of LCD Panel Modules*Y. Bamba, Y. Suzuki, M. Kita**Eizo Nanao, Japan*

Brightness uniformity and color uniformity of LCD panel modules change with change of input color balance such as color temperature. We propose brightness uniformity and color uniformity equalizing method of LCD panel modules corresponding to any color balance.

VHFp - 13 Mura Grade Evaluation of Electronic Displays by Visual Contrast*Y. Morimoto, Y. Takagi, T. Asano, J. Yao*, W. Liu***Hiroshima Inst. of Tech., Japan***Fast, Japan*

A method that can evaluate mura grades automatically has been developed. The original image is filtered using the contrast sensitivity function. The average stimulus value of visual contrasts is used to estimate the mura grades. The validity is shown by experiments using real FPD monitors.

VHFp - 14 Quantification of Hot Spot Mura of LED Backlight Based on Visual Contrast Thresholds*W.-J. Chang, Y.-P. Lan, H.-H. Hsu***ITRI, Taiwan***Keio Univ., Japan*

In this study, we used a calibrated CCD camera to capture the LED backlight, and an analysis method based on the visual contrast threshold was used to evaluate the hot spot. The profile, positions and sizes of hot spots can be easily defined and determined.

VHFp - 15 A Quantitative Evaluation Method for Indistinct Mura of LED Backlight

Y. Masakura, T. Tamura, K. Nagamine^{}, S. Tomioka^{*},
M. Ueda^{*}, Y. Shimpuku^{*}*

Tokyo Polytech. Univ., Japan

^{}Sony, Japan*

We conducted an experiment that subjectively evaluated artificial indistinct Mura images that simulated luminance non-uniformity of LED backlights. It was revealed that three numerical indexes based on measured luminance of Mura image would be significant for predicting the subjective evaluation value of indistinct Mura.

VHFp - 16 Human Preference Based Metrics for Video Quality on LCD Displays

S.-T. Kuo, K.-P. Chen, K.-N. Wu

ITRI, Taiwan

We designed a human preference based metrics for video quality on LCD displays. According to the two alternative force choice (2AFC) paradigm and Quest threshold finding algorithm, we can assess LCD quality by human observers.

VHFp - 17 Studies of Human Vision Model on Image Recognition

B.-W. Wu, Y.-C. Fang^{}, L.-S. Chang, S.-F. Wang^{*}*

Yuanpei Univ., Taiwan

^{}Kaohsiung First Univ. of S&T, Taiwan*

This study is based on the limitation of human eye recognition, of image recognition through the experiment. Those aspects that have been explored focus on human eye modeling, including creative model of human eye, human vision recognition characteristics and various mathematical modeling verify, thermal image modeling of human vision.

VHFp - 18L Measurement of Cerebral Blood Flow Volume While Viewing 3D Images

H. Isono, J. Yamaguchi

Nippon Inst. of Tech., Japan

In order to clarify the effects of 3D images on brain activity in humans, we used near-infrared spectroscopy, which is capable of noninvasively monitoring human brain activity, and measured cerebral blood flow while subjects viewed a moving 3D image immediately after viewing a moving 2D image as a reference stimulus.

VHFp - 19L Virtual Histogram Equalization

H.-W. Kang, G.-H. Park, M.-R. Choi*
Hanyang Univ., Korea
**Samsung Thales, Korea*

In this paper, Virtual Histogram Equalization (VHE) is proposed for contrast enhancement. . VHE prevent the merging of low histogram components while in the process of Histogram Equalization. Experimental results show that proposed method suppresses side effects such as detail loss or washed out appearance.

VHFp - 20L From Luminance to Illuminance: The Evaluation of Color Rendering on Reflective Display

Y.-H. Lu, C.-H. Li, C.-H. Tien
Nat. Chiao Tung Univ., Taiwan

An evaluating procedure has been proposed and demonstrated to reveal the impact of color appearance induced by ambient illumination for reflective LCDs. The results showed that the colorimetric performance of reflective LCD was strongly dependent on various LED spectra and the CQS methodology was proper for evaluating LED lighting.

----- Lunch -----

| | |
|-----------------------------|--------------|
| 13:20 - 15:00 | KAIHO |
| VHF4/DES4: Color (1) | |

VHF

Chair: K. Sekiya, Tohoku Univ., Japan
 Co-Chair: T. Matsumoto, Sony, Japan

VHF4/ DES4 - 1: Invited Measuring Light and Color: An Introductory Talk to Photometry

13:20
N. Ohta
Rochester Inst. of Tech., USA

Photometry is used for measuring light quantities based upon our spectral luminous efficiency function established in 1924. In my talk, I will describe the basis of photometry. I will also mention the limitation of, and the improvement of modern photometry.

**VHF4/
DES4 - 2: 13:50** **Invited Extending Applications of Multi-Primary Color
LCDs**

*K. Tomizawa, K. Nakamura, S. Ueki, Y. Yoshida, T. Mori,
M. Hasegawa, A. Yoshida, Y. Narutaki, Y. Itoh,
Y. Yoshida, M. Teragawa
Sharp, Japan*

We developed a five-primary color (5PC) LCD which can reproduce real-surface colors; however, multi-primary color LCDs have relatively lower luminance for 'bright green' than TV broadcasting standards. This paper introduces new algorithms reproducing bright green and simultaneously keep its fidelity in chromaticity. This indicates the extendibility of our 5PC LCD.

**VHF4/
DES4 - 3 14:20** **Image-Dependent Skin-Color Correction Technology
Based on Skin-Based Color Space**

*Y. C. Hsu, H. S. Chen
Nat. Taiwan Univ., Taiwan*

A new automatic skin-color correction method for still image is proposed. Skin-color areas in an image are extracted by skin-color searching algorithm to find out critical color correction range which determines parameters of modification coefficient function. Skin-color is finally corrected by Gaussian distributed coefficients under LSN (Lightness/skin/non-skin) opponent color space.

**VHF4/
DES4 - 4 14:40** **Memory Color Detection and Enhancement for
Improved Television Picture Quality**

*H. Pan, X. Xu, J. Speigle, S. Daly
Sharp Labs. of America, USA*

We propose a unified skin and blue sky color detection and enhancement method that simultaneously satisfies people's opposing color preference of skin and blue sky colors for wide color gamut TVs. Psychophysical experiments and image/video experiments show that the proposed method improves picture quality with more pleasing rendition of skin and blue sky colors.

----- Break -----

15:10 - 16:40

KAIHO

VHF5: Color (2)

Chair: N. Ohta, Rochester Inst. of Tech., USA
 Co-Chair: T. Matsumoto, Sony, Japan

VHF5 - 1: 15:10 *Invited Preferred Reproduction of Natural Image Content on Wide-Gamut Displays*

*I. Heynderickx^{***}, R. de Volder^{***}, D. Sekulovski^{*},
 M. Murdoch^{*}*

^{}Philips Res. Labs., the Netherlands*

*^{**}Delft Tech. Univ., the Netherlands*

*^{***}Tech. Univ. Eindhoven, the Netherlands*

The preferred chroma for rendering natural images containing one or multiple hues is determined in two experiments. The results clearly show the need for wide-gamut displays. Preference in chroma is affected by hue, content and individual. A hue dependent chroma extension factor can cope with the dependency in hue and individual, but not with the content dependency.

VHF5 - 2 15:40 *Performance Evaluation of Gamut Extension Techniques for Multi-Primary Display*

*T. Y. Park, G.-H. Kim, H. H. Son, H. K. Hong, M. Lim,
 H. H. Shin*

LG Display, Korea

To deal with color pleasantness in wide gamut displays, gamut extension is inevitably required. This paper presents therefore gamut extension methods via inverse gamut mapping techniques in order to faithfully reproduce the natural color of an object in multi-primary display (MPD).

VHF5 - 3 16:00 *Reduction of Mobile Display Color Variation by Increasing Color Gamut and Optimizing LED Selection*

*S.-L. Yang, S.-C. F. Jiang, C.-H. Shih, W.-M. Huang
 AU Optronics, Taiwan*

Base on our color variation evaluation model anaylzation, there are several different factors would affect color varition in the mobile display. According to our result, application of increase of color gamut and narrow LED color distribution can reduce more than 20% color variation in mobile display.

VHF5 - 4 Accurate Color Reproduction Method for Displays
16:20

N. Hosoe, Y. Amano, Y. Shimodaira
Shizuoka Univ., Japan

Proposed method makes dozens of conversion matrices by taking into account the color tracking phenomenon and effects of input luminance levels to color difference. As a result, the proposed method achieved the same color conversion accuracy as that of the previous research with a half the number of matrices.

----- Break -----

16:50 - 18:15

KAIHO

VHF6: Video System and Image Quality

Chair: C. Clippingdale, NHK, Japan
 Co-Chair: Y. Shimodaira, Shizuoka Univ., Japan

VHF6 - 1 Flicker Visibility Dependence on Viewing Distance
16:50 and Light-Emission Duty Ratio in a TV Field

M. Ogawa, T. Shiga
Univ. of Electro-Commun., Japan

Visibility of flicker is measured for various viewing distance and light-emission duty ratio in a TV field. It is found that more than 82% duty ratio is necessary to suppress the flicker when viewing distance is 3H, refresh rate is 60Hz, and luminance is 300 cd/m².

VHF6 - 2 Subjective Quality Assessment for Temporal Down-
17:10 Sampling High Frame-Rate Video

Y. Bando, S. Takamura, H. Jozawa
NTT, Japan

In order to display high frame-rate video on current display devices, they must be sub-sampled. When high frame-rate video is sub-sampled, sub-sampling with constant interval is not always needed. This study evaluates the relationship between subjective image quality of sub-sampled sequence and flexibility in selecting the frames to be sub-sampled.

VHF6 - 3L Flicker Perceptions for Wide-Field-of-View and Hold-
17:30 Type Image Presentations

M. Emoto, M. Sugawara
NHK, Japan

To study the flicker perception while viewing displays with a wide field of view (FOV), we measured the critical fusion frequency (CFF) with varying duty ratios and FOVs. We show CFF dependence on duty ratio and FOV. It is important to optimize the trade-off between flicker and motion blur.

**VHF6 - 4L Influence of Viewing Distance and Size of TV on
17:45 Visual Fatigue**

K. Sakamoto^{,**}, S. Aoyama^{*}, S. Asahara^{*}, A. Kimura^{**},
K. Yamashita^{**}, A. Okada^{**}
^{*}Panasonic, Japan
^{**}Osaka City Univ., Japan*

We carried out experiments to investigate the influence of viewing distance and TV screen size on visual fatigue using 17-inch, 42-inch and 65-inch PDP displays. Our results suggest that the optimum viewing distance lies between 165 and 220 cm and might not follow the currently recommended relative distances (3H).

**VHF6 - 5L Designing a Wide-Gamut System Colorimetry for
18:00 UHDTV**

*K. Masaoka, Y. Nishida, M. Sugawara
NHK, Japan*

We discuss the requirements for a wide-gamut system colorimetry for UHDTV. The parameter values are derived based on these requirements. We show that a display with three monochromatic primaries can cover the gamut of Rec. 709, RP 431-2, and Adobe RGB as well as most real object colors.

Author Interviews

18:00 – 19:00

VHF

Supporting Organizations:

Technical Group on Information Display, ITE

Technical Committee on Electronic Information Displays, Electronics Society, IEICE

EVENING GET-TOGETHER WITH WINE

Tuesday, December 8, 2009
18:00–20:00

Room "FOUNTAIN" (2F)
World Convention Center Summit
(Sponsored by Merck Ltd., Japan)

See page 9 for details

Workshop on Projection and Large-Area Displays, and Their Components

Thursday, December 10

9:00 - 10:20

TENYO

LAD1: Digital Cinema and Signage

Chair: E. Buckley, Light Blue Optics, USA

Co-Chair: H. Kanayama, SANYO, Japan

LAD1 - 1 A Large Ultra High Resolution Tiled Display System: 9:00 Architecture, Technologies, Applications, and Tools

S. Deshpande, C. Yuan, S. Daly, I. Sezan

Sharp Labs. of America, USA

We describe architecture, new applications and their enabling technologies of SharpWall - a tiled display system with 10Kx4.5K resolution and 177-inch diagonal size - which we have built as a prototype to research future large-size ultra-high-resolution single panel displays.

LAD1 - 2 High Power Discharge Lamp for Large Screen 9:20 Projection Display

H. Ogawa, R. Obama, T. Ogura

Panasonic, Japan

The market of large screen projection display needs high power discharge lamps with high-intensity and long-life. We have realized them by making bulb-thickness thin. In addition, this burner could be used in a wide power range to make it possible to control bulb-temperature easily.

LAD1 - 3 Ultra-Short Throw Distance Laser Light Source 9:40 Projector with Highest Brightness

T. Abe, M. Okuda, M. Maeda, S. Matsumoto, T. Ando,

K. Tsuji, R. Amano, M. Inoue, T. Ikeda, H. Kanayama

Sanyo Elec., Japan

Newly developed ultra-short throw distance Laser light source projector has achieved the highest brightness and the smallest throw ratio. This projector is composed of fiber rod illumination optics, mirror-lens hybrid projection optics and Laser Color Processing. These technologies allow achievement of high efficiency, ultra-wide angle projection and desirable color reproduction.

LAD1 - 4 10:00 Investigations of a Color Gamut Required for Preferred Color Reproduction by Using a Super-Wide Color Gamut Projector

M. Kanai, T. Kitano^{}, A. Minabe^{*}, K. Fukasawa^{**}, T. Abe^{*}
 Seiko Epson, Japan
^{*}Shinshu Univ., Japan
^{**}Epson R&D, USA*

This paper describes subjective evaluation of a color gamut required for a preferred color reproduction on a laser projection display. As a result, the boundary of the required color gamut is found in low lightness colors. It's expected that the color gamut is correlated with the pseudo-optimal colors.

----- Break -----

| | |
|------------------------------|--------------|
| 10:40 - 12:15 | TENYO |
| LAD2: Pico Projectors | |

Chair: K. Li, Wavien, USA
 Co-Chair: T. Hayashi, 3M, Japan

LAD2 - 1: 10:40 *Invited* The Requirements of Cellular Phone Embedded Small Projector, and the Use Scene

*M. Ota, M. Murata, T. Kaneda, M. Yasuo
 NTT DOCOMO, Japan*

We introduce the use scene of various cellular phones with small projector, and the requirements of cellular phone embedded small projector.

LAD

LAD2 - 2: 11:05 *Invited* Challenges with Embedding a Pico Projector into a Mobile Phone

*J. Dennis
 Texas Instrs., USA*

Mobile phone displays limit the enjoyment and sharing of the content now available on your mobile phone. Projection technology may enrich the user experience and allow for sharing of this content to small groups. This paper will review the challenges associated with embedding a Pico Projector into a mobile handset.

LAD2 - 3: Invited 3M Mobile Projection Technologies
11:30

*E. Shiba, P. Watson, M. Bellanca, A. Ouderkirk,
K. LaRock*, Z. Yun*, S. Saxe*, P. Doug*, T. Hayashi**
3M, Singapore
*3M, USA
**3M APAC, Japan*

We report current and future 3M mobile projection technologies, including the newest MM200 projection engine. In this report, we explain how the design is to achieve 10lumen per 1 Watt, introduce 3M branded projectors, and discuss future developments.

LAD2 - 4 Low Component Count Waveguide-Based Pico-Projector for Cell-Phone Applications
11:55

*K. Li
Wavien, USA*

The next generation of cell phones will have integrated projectors such that large images can be projected and shared. Similar to the cell phone cameras, in order to have a high adoption rate, the cost have to be low, which requires low component count and simple construction. To achieve low cost, the most important factor is to use a small imager chip, which increase the illumination requirements...

----- Lunch -----

13:20 - 14:30

TENYO

LAD3: Laser Projector and Its Components

Chair: S. Deshpande, Sharp Labs. of America, USA
Co-Chair: K. Takeda, Seiko Epson, Japan

LAD3 - 1: Invited Green Laser Technology for Display Application
13:20

S. Kurimura,**
*NIMS, Japan
**Waseda Univ., Japan*

Technologies for compact and high power green lasers directed to laser display will be reviewed, which has made a significant progress for last several years mainly due to the evolution of wavelength-conversion devices and optics.

**LAD3 - 2 Application of the Optical MEMS Scanner
13:45 "ECOSCAN" for Pico Projector**

*E. Kawasaki, H. Yamada, H. Hamanaka
THE NIPPON SIGNAL, Japan*

Our MEMS optical scanner ECOSCAN is a device which contributes to downsizing, lost costs, and high-performance of pico projectors. We mount two scanner chips in a single package for raster scanning. Each chip has a vibration monitor output, which can be used to control the light source etc.

**LAD3 - 3: Invited Rear-View Virtual Image Display Using
14:05 Holographic Laser Projector**

E. Buckley, D. Stindt, L. Lacoste*, R. Isele**,
P. Radojkovic**
Light Blue Optics, USA
*Light Blue Optics, UK
**BMW AG, Germany*

Light Blue Optics' holographic laser projection technology can create a virtual image display consistent with integration into rear-view mirrors. By combining the visual accommodation and reaction time benefits of a head-up display with the ability to present safety-critical information in a rear-view mirror's field of view, safety benefits can result.

----- Break -----

15:00 - 16:20

TENYO

LAD4: Speckle Reduction Technologies

Chair: H. P. Kuo, Hewlett Packard, USA
Co-Chair: H. Kikuchi, NICT, Japan

**LAD4 - 1 Development of Moving Screen System for Laser TV
15:00**

*S. Okagaki, N. Watanabe, D. Echizenya, M. Inoue,
T. Nomura, A. Michimori, T. Sasagawa, H. Sugiura
Mitsubishi Elec., Japan*

The moving screen system is described. We have developed Laser TV that uses three-primary-color lasers for the light source. The moving screen system has been developed for Laser TV to decrease scintillation which is caused by coherency of laser.

**LAD4 - 2 On the Optical Configurations of Speckle Killers for
15:20 Laser Projection Displays**

*T. Kawakami, K. Sekiya, H. Sato, Y. Kuratomi, B. Katagiri,
Y. Suzuki, T. Uchida*

Tohoku Univ., Japan

We show that the speckle killer systems for laser projection displays, in which small diffusers are rotating, can be classified in three. We discuss each characteristics in relation to magnification ratio of the diffuser to the screen. We also show the observed results on a prototyped laser projection display.

**LAD4 - 3 On the Effect of Small Moving Diffusers to the
15:40 Speckle Reduction in Laser Projection Displays**

*H. Satoh, K. Sekiya, T. Kawakami, Y. Kuratomi,
B. Katagiri, Y. Suzuki, T. Uchida*

Tohoku Univ., Japan

We have investigated the effect of a moving diffuser placed at the conjugate point of a micro-display to reduce speckle reduction in laser rear projection displays, and have found and verified that the optical magnification ratio and diffusion angle of the diffuser are closely related to the speckle reduction ratio.

**LAD4 - 4 Consideration on the Principle of Speckle Noise
16:00 Observed on Laser Projection Displays**

*Y. Kuratomi, K. Sekiya, H. Sato, T. Kawakami, B. Katagiri,
Y. Suzuki, T. Uchida*

Tohoku Univ., Japan

A new analysis of speckles, based on the granularity of speckle patterns in laser light source projections, indicates that granularity has an important effect on speckle noise, and generating finer speckles inside the projection system is a key to better speckle reduction.

----- Break -----

EXHIBITION

12:00–18:00 Wednesday, Dec. 9, 2009

10:00–18:00 Thursday, Dec. 10, 2009

10:00–14:00 Friday, Dec. 11, 2009

4F Foyer

World Convention Center Summit

Free admission with your registration name tag.

16:40 - 18:00

TENYO

LAD5: Projection Components

Chair: J. Dennis, Texas Instrs., USA
 Co-Chair: S. Shikama, Setsunan Univ., Japan

**LAD5 - 1 High Contrast Front Projection System for Large
 16:40 Screen Displays Suppressing Reflection of Ambient
 Light**

*R. Sato, M. Ooike, B. Katagiri, Y. Suzuki, M. Kano,
 T. Uchida*

Tohoku Univ., Japan

We proposed a novel front projection screen by diffusing only projected light towards the viewing angle range and reflecting ambient light towards the other angle ranges. With this system, we propose to realize a high quality large screen front projection display with high contrast ratio even in a bright room.

**LAD5 - 2 A High-Contrast See-through Screen
 17:00**

*H. P. Kuo, L. Hubby, H. Ng, A. Jeans, R. Garcia,
 K.-H. Tan, I. Sobel, R. Elder, B. Culbertson, A. Brakovsky*

Hewlett Packard, USA

We present a high-contrast see-through projection screen. The screen allows nearly 100% utilization of illumination from an oblique-angle projector and achieves a ~10x improvement in contrast compared to a Daylite projection screen.

**LAD5 - 3 Direct Measurement of Vcom Voltage in LC Panels
 17:20**

D. Cuypers, A. V. Calster, H. D. Smet**

IMEC vzw, Belgium

**Ghent Univ., Belgium*

Even for high-end LCOS panels, the compensation voltage required for flicker-free operation (V_{com}) slowly shifts with time. Detection of the correct compensation is usually done optically. In this paper, a method to directly measure the needed V_{com} voltage on the cell itself is presented, eliminating the need for the optical detection.

LAD

LAD5 - 4 White LED Lamp with Recycling for Projection Applications*K. Li**Wavien, USA*

This paper described a white LED lamp with recycling such that only one white LED is needed for the projector, which is easier to cool and have less number of components. In addition to in-creasing the output lumens of the system, the recycling increases the output of red color, which is normally insufficient in standard white LEDs. Output of over 230 lumens has been achieved us-ing a 50 W white LED...

Author Interviews

18:00 – 19:00

Friday, December 11

9:00 - 12:00

3F Foyer

Poster LADp: Projection**LADp - 1 Withdrawn****LADp - 2 A Single Panel LCoS Microdisplay for Mobile Projectors**

Y. S. Do^{}, K.-J. Yang^{*}, G.-J. Lee^{*}, J. Kim^{*}, S.-J. Sung^{*},
Y.-H. Lee^{*,**}, H.-J. Chung^{**}, C.-G. Roh^{*,**}, B.-D. Choi^{*}*

^{}Daegu Gyeongbuk Inst. of S&T, Korea*

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

A 0.55" SVGA LCoS microdisplay for the applications to mobile projectors was fabricated. Twisted nematic liquid crystal was used as the light switch layer. The prepared the LCoS panel with field sequential color driving scheme represented γ -corrected 256 gray scales. The preparation and characteristics of single panel TN-LCoS were described.

Supporting Organizations:

Technical Group on Information Display, ITE

Laser Display Technology Research Group, Optical Society of Japan

Workshop on Electronic Paper

Wednesday, December 9

13:20 - 13:25

TENGYOKU

Opening

Opening Remarks

13:20

A. Suzuki, Ricoh, Japan

13:25 - 14:40

TENGYOKU

EP1: Electrophoretic Displays

Chair: A. Suzuki, Ricoh, Japan

Co-Chair: M. Tsuchiya, E Ink, Japan

EP1 - 1: *Invited* History of Electrophoretic Displays and Proposal of a Novel Cell Structure for Lateral Particle Movement Display Devices

13:25

I. Ota

Free, Japan

History of EPD (Electrophoretic Display), especially the early development stage in Matsushita Electric (now Panasonic Corporation) is reviewed. Lateral electric field type EPD should be more studied in order to realize the bright full color reflection type display and the improved cell structure is proposed.

EP1 - 2: *Invited* Bright Color Electronic Paper Technology and Applications

13:50

K.-M. Lenssen, M. van Delden, M. Mueller, L. Stofmeel

Philips Res., the Netherlands

Bright color electronic paper technology based on in-plane electrophoresis is very suitable for application in non-emissive Digital Surfaces, like electronic skins, eco-skins and electronic wallpaper for atmosphere creation. Aimed at these applications simplified electrode geometries and a novel concept for built-in gray levels have been developed.

EP

EP1 - 3: Invited Progress in Subtractive Color Electrophoretic Displays

14:15

*A. Henzen**iRex Techs., the Netherlands*

Full-color capability is generally recognized as the enabling factor for e-paper. In recent work, the preferred route for color electronic paper was proposed to be subtractive color. Now, the first practical results in such a color display based on an in-plane electrophoretic effect will be presented.

----- Break -----

15:00 - 16:20

TENGYOKU

EP2: Particles Moving Displays

Chair: H. Arisawa, Fuji Xerox, Japan

Co-Chair: M. Higuchi, NIMS, Japan

EP2 - 1: Invited Challenge to Color Electronic Paper Based on Particle Control Technologies

15:00

*T. Kitamura**Chiba Univ., Japan*

We have proposed three types of novel Color Electronic Paper technologies based on the movement of white, black and color particles. These are based on an electrophoretic particle movement and movement of particle in the air space.

EP2 - 2 Monolayer Rotating Ball Display

15:25

*H.-S. Lee, H.-Y. Cha, S. Lee, J.-B. Kwak, K. Chae,
H. Lee, Y. W. Lee, C. H. Lee, Y. Oh**Samsung Electro-Mechanics, Korea*

Optically anisotropic rotating balls were disposed in a monolayer, and controllably close packed with respect to one another in the monolayer. The monolayer configuration provided high brightness and improved contrast with better electrical and optical features in comparison with the conventional rotating ball display.

EP2 - 3 Dynamical Behaviors of Charged Particles in Horizontal Switching Electrophoretic Cell

15:45

*J.-H. Yeo, S.-W. Kim, G.-D. Lee**Dong-A Univ., Korea*

We propose a modeling for calculating the dynamical behaviors of a charged particle depending on the patterned electrode in horizontal switching electrophoretic cell and calculate the interaction between electrical field and particle. As a result, we can calculate particle mobility in horizontal switching electrophoretic cell.

EP2 - 4L **Versatile Contents Viewer with Loose-Leaf Active Matrix QR-LPD Sheets**
16:05

*H. Honda, K. Kitamura, H. Maeda, K. Nishimura**
Dai Nippon Printing, Japan
**KDDI R&D Labs., Japan*

Versatile contents viewing system is developed with detachable flexible e-paper sheets and display driver module that can stream contents such as documents, still and moving image via mobile phone. 30 frame/sec of streaming was achieved by highly stabilized AMOTFTs and fast response speed of the QRLPD.

----- Break -----

16:40 - 18:00

TENGYOKU

EP3: LC Type Electronic Paper and Others

Chair: Y. Toko, Stanley Elect., Japan
 Co-Chair: T. Fujisawa, DIC, Japan

EP3 - 1 **300 cm-Length Flexible Cholesteric Liquid Crystal Banner's Metal Electrode Fabricated by Screen Printing Technology**
16:40

S. H. Lee, C. W. Wu, J. H. Liao, Y. Y. Chang
ITRI, Taiwan

This study is to build a workable and stable jointless screen printing technology to form the metal electrode on the 300cm-length flexible cholesteric liquid crystal banners which is a thinner, lighter, good flexibility and saving power display.

EP3 - 2 **Color Laser-Addressing Simple Structure Roll to Roll Electronic Papers**
17:00

H.-Y. Chen, C.-C. Liang, M.-H. Hsieh, C.-L. Chin,
C.-K. Ho, J.-Y. Su
ITRI, Taiwan

This paper proposes a simple structure laser-addressing color R2R electronic paper. The proposed electronic paper is verified by UV laser and its reflected light wavelength can be shifted more than 140nm for displaying color images.



EP3 - 3L: Invited Electrically-Switched LC color for Electronic Papers

17:20

*S.-Y. Lu, L.-C. Chien**Kent State Univ., USA*

We demonstrate a polymer-stabilized cholesteric liquid crystal, where the reflected color can be electrically-switched to reflect a different color. A second electrically switched color based on polymer-stabilized blue phase liquid crystal is also demonstrated. These switchable color devices of are color filters and polarizers free which is suitable for electronic papers.

EP3 - 4L Legibility Investigations of the BiNem e-Reader Display

17:45

J. Osterman, R. Nordström^{}, L. Madsen, M. Irzyk, J. Angel, F. Leblanc**NEMOPTIC, France**^{*}Uppsala Univ., Sweden*

The legibility of the 2-polarizer BiNem e-reader display has been investigated using task-oriented tests and subjective measures. The results show that the BiNem display is comparable to the E-Ink Vizplex EPD display used in the Amazon Kindle 2. An advanced 1-polarizer BiNem mode for increasing the paper-like appearance is proposed.

Author Interviews

18:00 – 19:00

Thursday, December 10

9:00 - 10:05

TENJU

EP4: Electrowetting and Electrochromic Displays

Chair: T. Kitamura, Chiba Univ., Japan

Co-Chair: S. Maeda, Oji Paper, Japan

EP4 - 1: Invited Bistable Electrowetting Displays with High Reflectivity and Large Aperture Ratio

9:00

K. Blankenbach, M. Jentsch, A. Bitman^{}, F. Bartels^{*}, J. Rawert^{**}, D. Jerosch^{**}**Pforzheim Univ., Germany**^{*}Bartels Mikrotechnik, Germany**^{**}Advanced Display Thec., Germany*

Electrowetting displays have some unique features, however only the ADT approach is bistable. This paper deals with a new 3D pixel layout enabling high aperture ratio and a novel method for grey level reproduction based on partial filling of pixel. White reflectance for ambient light is raised beyond state-of-the-art.

EP4 - 2 **Device Application of Organic-Metallic Hybrid
9:25** **Polymers for Electronic Paper**

M. Higuchi^{,**}*

^{}NIMS, Japan*

*^{**}JST, Japan*

Organic-metallic hybrid polymers are formed via complexation of bis(terpyridine)s with metal ions such as Fe(II) or Ru(II). We found that they have excellent electrochromic properties. Electrochromic solid-state devices have been successfully fabricated by using these polymers.

EP4 - 3 **High Speed Passive Matrix Electronic Paper Using
9:45** **Leuco Dye**

T. Higuchi, M. Suzuki, W. Weng, T. Fukuoka,

T. Shimomura, M. Omodani^{}*

Funai Elec. Advanced Appl. Tech. Res. Inst., Japan

^{}Tokai Univ., Japan*

We developed imaging device, "Dynamic ECD" utilizing electrochromism of leuco-dye and attained quick response, high contrast, low cost compared to current reflective display. In this talk, we present basic structure of device and imaging quality, especially image stability.

----- Break -----

13:20 - 16:20

3F Foyer

Poster EPp: Electronic Paper

EPp - 1 **Electrowetting-Based Optical Deflector**

H.-H. Chen^{,**}, C.-C. Lin^{*}, Y.-T. Li^{**}, C.-C. Fu^{**}*

^{}ITRI, Taiwan*

*^{**}Nat. Tsing Hua Univ., Taiwan*

We propose a new idea to fabricate an electrowetting based optical deflector (EBOD), which bases on a SOG (Silicon on Glass) wafer and MEMS technologies. The EBOD combines two kinds of liquid, silicon oil and DI water. The light tuning mechanisms are based on electrowetting phenomena.

EPp - 2 Analysis of the Microfluid Movement Behavior under Different Driving Scheme in Electro-Wetting Display

K.-L. Lo, Y.-S. Huang^{}, C.-Y. Chen^{*}, W.-Y. Cheng,
S.-W. Kuo, H.-H. Lee, Y.-H. Tsai, W.-W. Chiu, R.-L. Sun,
P.-J. Su, C.-W. Wang, J.-W. Shiu, P.-P. Cheng, Y.-C. Liao,
Y.-C. Chen, Y.-H. Chiu*

ITRI, Taiwan

^{}Nat. Chiao Tung Univ., Taiwan*

The microfluid movement behavior in electro-wetting display (EWD) affects the contrast ratio, response time and the optical uniformity of EWD panels. The simulation and experimental results of microfluid movement behavior under different driving scheme and different electrode patterns were presented in this paper to improve the optical performance of EWD.

EPp - 3 New Electrochromic Polymer for Electronic Paper

Y. Kondo, T. Ootake, H. Tanabe

Kuraray, Japan

Electrochromic(EC) type e-paper is attracted with colorfulness and clearness. We have been researching and developing material for EC type e-paper. We developed new EC polymer for e-paper. Our EC polymer is suitable for printable electronics, for instance, ink-jet, screen print, and so on. We introduce our developing technologies.

EPp - 4 Preparation of the Narrow-Dispersed Microcapsules Containing Electronic Ink : Influence of Surfactant and Stirring Rate

Y.-J. Park^{,**}, C. A. Kim^{*}, K.-S. Suh^{*}, S.-Y. Kang^{*},
S.-M. Park^{**}*

^{}Elect. & TeleCommun. Res. Inst., Korea*

*^{**}Pusan Nat. Univ., Korea*

We investigated the parameters to control the electronic ink microcapsules which contain the electrophoretic pigment particles suspension. The effect of surfactant in aqueous polyelectrolyte solutions, the agitation speed, and pH transition profile are typical parameters to control the microcapsule size and size distribution.

EPp - 5 A Novel Electronic Ink Using the Core-Shell Type Particles Prepared in a Non-Polar Media

H. Yoo^{,**}, C. Kim^{*}, K. Suh^{*}, S. Kang^{*}, S. Park^{**}*

^{}Elect. & TeleCommun. Res. Inst., Korea*

*^{**}Pusan Nat. Univ., Korea*

In this study, we prepared two types of core-shell particles for electronic ink. Black particle were prepared by disperse polymerization in non-aqueous media. The above high mobility black particle suspension expects the low operating voltage and high speed in the electrophoretic display.

EPp - 6 Measurement of Short-Term Memory of Human for Studying the Common Difficulty of Working on a Display

*S. Inoue, Y. Koibuchi, M. Omodani
Tokai Univ., Japan*

We suppose rather long holding time for our short-term memory requested by working on a display is a dominant reason of difficulty with complicated tasks on a display. This supposition is agreed by measured performances of identifying tasks between two pages with parallel / non-parallel conditions and measured forgetting curves.

EPp - 7 Withdrawn

EPp - 8L Development of Fast Moving Ball Actuator Mode for Reflective Electronic-Paper Displays

H. Choi, H. Pakr, D. Lee, B. Bae^{}, W. Kim^{**}, B. Kim^{**},
M. Hong*

Korea Univ., Korea

^{}Hoseo Univ., Korea*

*^{**}Dongjin Semichem, Korea*

We described the basic operation mechanism of our novel reflective Electronic-Paper display, Fast Moving Ball Actuator (FMBA) mode[1] in the horizontal switching system in fluid medium. The surface potential of a ball can be controlled by contact open electrode and their locations can be controlled by potential variation.

EPp - 9L A Novel Bistable LCD Switching between Splayed Twist and Reversed Twist States for Texture of Molecular Orientation

R. Takahashi, Y. Toko^{}, S. Saito, T. Takahashi*

Kogakuin Univ., Japan

^{}Stanley Elec., Japan*

A Reversed-Twisted Nematic (R-TN) mode is applied to the bistable LCD with a memory function. In the R-TN cell, the splayed twist state and reversed twist state are able to coexist. The bistable switching is realized due to the optimization of cell configuration and the improvement of electrode structure.

EPp - 10L Solid State Phthalate Derivative-Based Electrochromic Cell toward Full Color Display System

*Y. Watanabe, S. Tanaka, K. Nakamura, N. Kobayashi
Chiba Univ., Japan*

Electrochromism (EC) is applicable to fabricate a new imaging device because of its many superior characteristics. We studied electrochromic properties of phthalate derivatives, which showed three primary colors by electrochemical reaction, from a viewpoint of color electronic paper. Solid state electrochromic cell with gel electrolyte has been demonstrated.

Author Interviews

18:00 – 19:00

Friday, December 11

9:00 - 10:25

TENGYOKU

EP5: Driving Methods for Electronic Paper

Chair: N-S. Roh, Samsung Elect., Korea
Co-Chair: G. Zhou, Philips Res., the Netherlands

EP5 - 1 Withdrawn

EP5 - 2 A Novel Asymmetric Driving Scheme for Rich Gray Levels in Driving a Large-Area High-Resolution Electrowetting Display

9:25

*Y.-C. Chen, Y.-H. Chiu, C.-C. Liang, W.-Y. Lee,
W.-Y. Cheng, H.-Y. Chen
ITRI, Taiwan*

Due to the PWM driving method has the gray-level limitation, this paper proposed an asymmetric driving concept to increase the gray-level number. The performance of the driving concept is successfully validated on a 6 inch active matrix electrowetting display.

EP5 - 3 A Dynamic Gray-level Driving System for Hot-Pluggable Roll to Roll Cholesteric LCD

9:45

*C.-W. Sun, C.-C. Liang, H.-Y. Chen, T.-A. Chen,
P.-C. Yeh, C.-A. Ho, Y.-C. C. Chen, J.-Y. Su
ITRI, Taiwan*

This paper develops a dynamic gray-level driving system for hot-pluggable R2R Cholesteric LCD. Its performance is verified by implementing a real e-Paper application of e-Badge. Satisfactory results of gray-level images and fast-updating rate are obtained.

EP5 - 4
10:05**Speeding up Passive-Matrix Driven Electronic Paper Update by Shrinking Multiline Addressing Data***S. Kaneko, M. Asakawa, R. Hattori, Y. Masuda*,
N. Nihei*, A. Yokoo*, S. Yamada***Kyushu Univ., Japan***Bridgestone, Japan*

We discussed the speeding-up method in the updating time of Quick Response-Liquid Powder Display (QR-LPD). We generated the shrunk multiline addressing "lossless" data using the linearly dependence of an image data matrix. The generated data can reduce the update time by quarter compared with that of a conventional driving method.

Author Interviews

16:20 – 17:20

Supporting Organization:

The Imaging Society of Japan

EXHIBITION

12:00–18:00 Wednesday, Dec. 9, 2009

10:00–18:00 Thursday, Dec. 10, 2009

10:00–14:00 Friday, Dec. 11, 2009

4F Foyer

World Convention Center Summit

Free admission with your registration name tag.

IDW Tutorial in Japanese

Tuesday, December 8, 2009

Room "TENRAN" (4F)

World Convention Center Summit

Detailed information will be announced in October at
<http://www.sidchapters.org/japan/>

Workshop on MEMS for Future Displays and Related Electron Devices

Thursday, December 10

9:00 - 9:05

ZUIYO

Opening

Opening Remarks

9:00

M. Nakamoto, Shizuoka Univ., Japan

9:05 - 10:15

ZUIYO

MEMS1: Emerging Technologies

Chair: Y. Aoyagi, Ritsumeikan Univ., Japan

Co-Chair: D. Bloom, Alces Tech., USA

MEMS1 - 1: *Invited* Quantum Dots in Lighting and Display: From R&D to Product Launch

9:05

*J. Ritter, P. Kazlas, Z. Zhou, M. Stevenson, C. Breen,
Y. Niu, I. Song, J. S. Steckel, S. Coe-Sullivan*

QD Vision, USA

Quantum dot light emitting diodes (QLEDs) offer the promise of exceptional color and efficiency at low cost of manufacture for display and solid-state lighting applications. Recent progress in efficiency (>21 lm/W at 325 nits) and lifetime (>10,000 hrs at 100 nits) demonstrates the commercial potential of this technology.

MEMS1 - 2: *Invited* Challenge to Quatum Dot Display for Mobile Device

9:25

B. L. Choi

Samsung Elect., Korea

Colloidal quantum-dot light-emitting diodes (QD-LED) have recently received considerable attention due to their ease of colour tunability, high brightness and narrow emission bandwidth. In this talk, the progress and possibility of QD application for mobile display will be presented.

MEMS1 - 3 Large-Scale Non-Contact Electric Field Sensor Array, Fabricated by TFT
9:45

*M. Ikeda, K. Nakamura**

Free

**Micronics Japan, Japan*

Very large size device can be fabricated by TFT on glass as LCD. This sensor device is new application of TFT which detect electric field pattern through air gap scanning and consists of 7168 channels with 35 μ m pitch in liner as large size. Present its structure and results.

MEMS1 - 4 High Response Micromirror MEMS Displays Using PZT Gratings
10:00

J. Moon, M. Nakamoto, K. Shiratori

Shizuoka Univ., Japan

Micromirror MEMS displays having 0.1 μ sec response time have been developed by piezoelectric diffractive gratings and dicing saw fabrication method to realize high reliabilities and high response characteristics for low cost and large area MEMS displays.

----- Break -----

10:40 - 11:45

ZUIYO

MEMS2: Displays and Imaging

Chair: J. Jang, Kyung Hee Univ., Korea

Co-Chair: K. Maenaka, Univ. of Hyogo, Japan

MEMS2 - 1: *Invited* Flexible Array Sensors Based on Zinc Oxide Nanowires for Touch Displays
10:40

S. M.-L. Pfaendler, M. E. Swanwick, A. R. Rachamim,

S. H. Dalal, P. Beecher, S. E. Machin, P. Andrew*,*

W. I. Milne, A. J. Flewitt

Univ. of Cambridge, UK

**Nokia Res. Ctr., UK*

Recent efforts towards the fabrication of touch sensing systems are presented, in which zinc oxide nanowire arrays are embedded in a polymer matrix to produce an engineered composite material. In the future, these sensor systems will be fully flexible and multi-touch as intended for Nokia's 'Morph' concept device.

MEMS2 - 2: Invited Power MEMS for New Services and Environment
11:00*H. Kuwano**Tohoku Univ., Japan*

Remotely controlled, or autonomous, monitoring systems such as those in ubiquitous sensor networks need cost-effective and long-lifetime energy supplies. This paper describes the power MEMS as a powerful candidate that are expected to replace or supplement electrochemical batteries in the fields of electrical communication and consumer electronics.

MEMS2 - 3 Uncooled Infrared Radiation Focal Plane Array with Low Noise Pixel Driving Circuit
11:20*R. Ueno, H. Honda, H. Funaki, K. Ishii, M. Ogata,
H. Kwon, H. Yagi, I. Fujiwara, K. Suzuki, K. Sasaki**Toshiba, Japan*

We have analyzed the dominant noise sources in the driving circuit of uncooled infrared radiation focal plane array fabricated on silicon on insulator (SOI) substrate by 0.35 μm CMOS technology and bulk-micromachining, and optimized the design of constant current source MOSFET and its driving condition.

MEMS2 - 4L Color-Sequential Field-Emission Lamp for Advanced Back Lighting in LCD
11:35*Y.-H. Song^{*,**}, D.-I. Kim^{*}, J.-T. Kang^{*}, J.-W. Kim^{*,**},
J.-W. Jeong^{*}**^{*}Elect. & TeleCommun. Res. Inst., Korea**^{**}Univ. of S&T, Korea*

A color-sequential field emission lamp (FEL) was developed by using printed carbon nano tube field emitters with an enhanced turn-off driving method. The new driving greatly shortens the turn-off response time of field emission in the FEL panel, below 4 ms, which is applicable to a color-sequential LCD.

MEMS2 - 5L Withdrawn

----- Lunch -----

13:20 - 14:50

ZUIYO

**MEMS3: Fundamental Components Process
Technologies 1**

Chair: D. Pribat, Ecole PolyTech., France
Co-Chair: S. Koizumi, NIMS, Japan

**MEMS3 - 1: *Invited* Fabrication of Nonlinear Photonic Crystals
and Its Application to All Optical Switching**

13:20

*Y. Aoyagi, S. Inoue**

Ritsumeikan Univ., Japan

**Kyushu Univ., Japan*

Hetero structure non-linear photonic crystal is fabricated for the first time. The performance of this photonic crystal is analyzed and the application of the photonic crystal to high efficient second harmonics and sum frequency generation of optical light and all optical switching circuit are demonstrated.

**MEMS3 - 2: *Invited* Resonant Tunneling Effect in Organic
Superlattice Structure**

13:40

J. Jang, T. J. Park, J. H. Kwon

Kyung Hee Univ., Korea

Superlattice structures were made with organic light emitting materials. The current density-voltage characteristics of the organic superlattice show a peak and a valley between 3 and 8 V, which is due to the resonant tunneling effect. The effect is discussed as a variation of layer thickness.

**MEMS3 - 3: *Invited* MEMS Integrated with Silicon Photonic Wire
Waveguides**

14:00

A. Higo, H. Toshiyoshi, H. Fujita, Y. Nakano

Univ. of Tokyo, Japan

This paper presents design and theoretical analysis of a silicon optical waveguide modulator with an electrostatic micromechanical structure actuated in the evanescent range. We observed a 330-nm MEMS displacement and 7.4 kHz mechanical response on a 5- μ m-wide and 100- μ m-long bridge at a voltage of 60Vpp.

MEMS3 - 4 The Etching Characteristics for Texturing Crystalline Silicon with Soft Mask
14:20

C. Wei, J.-M. Chen^{}, Y.-H. Chien, Y.-Z. Shih, J.-T. Lian^{*}*
Tatung Univ., Taiwan
^{*}*Chunghwa Picture Tubes, Taiwan*

Texturization made from anisotropic etching is able to minimize the reflectivity in solar cell. A soft mask etching characteristics is investigated based on high concentration potassium hydroxide with different etching temperature and time. The stripping of soft mask is the key for highly textured surface.

MEMS3 - 5 On the Texturization of Monocrystalline Silicon for Reflection Reduction
14:35

C. Wei, J.-M. Chen^{}, Y.-H. Chien, Y.-Z. Shih, J.-T. Lian^{*}*
Tatung Univ., Taiwan
^{*}*Chunghwa Picture Tubes, Taiwan*

A surface texturization method with soft etching mask is proposed. The effect of mask size and etching conditions are investigated. A textured surface whose average reflectivity less than 4% is fabricated with etchant concentration 30% KOH, etching temperature 70 °C and 20 minutes etching time.

----- Break -----

15:10 - 16:35

ZUIYO

MEMS4: Fundamental Components Process Technologies 2

Chair: M. Nakamoto, Shizuoka Univ., Japan
 Co-Chair: T. Komoda, Panasonic Elec. Works, Japan

MEMS4 - 1: *Invited* MEMS-Type Switches Based on Carbon Nanotube Arrays
15:10

D. Pribat, D. Dubuc, K. Grenier, S. Pacchini, T. Ricart, C. Cojocaru
Ecole PolyTech., France

Because of their exceptional mechanical characteristics, carbon nanotubes are materials of choice for MEMS applications. We shall present some recent results concerning the fabrication of radio frequency switches based on arrays of carbon nanotubes. Various approaches will be discussed, but emphasis will be put on random arrays, which are easier to fabricate. Our first RF measurements will be presented.

**MEMS4 - 2: Invited Efficient NEA Cathode Operation of Diamond
15:30 PN Junction**

*S. Koizumi, S. Kono**
NIMS, Japan
**Tohoku Univ., Japan*

Highly efficient electron emission was observed from hydrogen terminated p-type diamond surface of pn junction. The emission efficiency exceeded 1% even without specific design of the device for electron emission.

**MEMS4 - 3 Integration of CNT-FEAs with MOSFET on Silicon
15:50 Substrate**

*N. Y. Bae, J. H. Ryu, H. E. Lim, B. T. Son, H. M. Oh,
J. Jang, K. C. Park*
Kyung Hee Univ., Korea

An integration of CNT-FEAs grown with RAP process with MOSFET on silicon substrate has been proposed. The structure is very useful for active control of the emission current of CNT-FEAs. And shadow mask was adapted to simplify process. The feasibility of the integration was studied.

**MEMS4 - 4 Stable Environmental Stability of Robust Carbon
16:05 Nanotubes**

*H. M. Oh, J. H. Ryu, H. E. Lim, B. T. Son, N. Y. Bae,
J. Jang, K. C. Park*
Kyung Hee Univ., Korea

The stability of multi walled CNTs in high temperature and ambient air were studied for environmental harsh condition application. These robust CNTs were annealed in air at 1,000 °C and show very stable structural and electron emission characteristics. The structural robustness and stable electron emission of robust CNT were discussed.

**MEMS4 - 5 Newly Developed Transfer Mold FEA Using Vacuum
16:20 In-Situ Fabrication and Evaluation Method**

K. Eto, M. Nakamoto, J. Moon, K. Shiratori
Shizuoka Univ., Japan

Transfer Mold field emitter arrays have been fabricated and evaluated using the new vacuum in situ system to realize high efficient and reliable field emitter arrays. The new vacuum in situ system is useful for the exact evaluation and fabrication of high reliable field emission displays and lamps.

----- Break -----

16:50 - 18:00

ZUIYO

| |
|--|
| MEMS5: Optical MEMS and Device Technologies |
|--|

Chair: H. Kuwano, Tohoku Univ., Japan
 Co-Chair: S. Coe-Sullivan, QD Vision, USA

**MEMS5 - 1: *Invited* Mechanical Sensors and Actuators in MEMS
 16:50 Technology**

*K. Maenaka
 Univ. of Hyogo, Japan*

In this paper, some MEMS sensors and actuators will be reviewed including packaging technology, acceleration sensors and gyroscopes, built-in actuators for vibratory sensors and optical scanners, in the market and still in the research stage. Finally, fusion of a functional material, PZT, with MEMS technology will be briefly discussed.

**MEMS5 - 2: *Invited* MEMS-Based Polarization Light Modulator
 17:10 Linear Array Microdisplay**

*D. Bloom, M. Bellis, C. DeMarco, J. Koehler, M. Leone,
 R. Yeh
 Alces Tech., USA*

We describe a new MEMS-based microdisplay technology for projection display applications. The microdisplay modulates the polarization state of light upon reflection from a micromechanical device array. The pixel elements have a mechanical risetime and falltime of about 200 nanoseconds. This high speed response enables a scanned linear array display architecture.

**MEMS5 - 3 Extending Rotation Range Confirmed by Macro
 17:30 Model of Gap-Closing Type Electrostatic Micromirror
 Controlling Non-Linearity of Torsion Bar Spring**

*G. I. Shim, R. Mimoto, S. Kumagai, M. Sasaki
 Toyota Technological Inst., Japan*

The nonlinear spring for supporting the micromirror is examined to extend the controllable range in gap-closing type electrostatic micromirror. Nonlinear spring is comprised by distorted torsion bar and parallel shift. As a result, nonlinear spring is confirmed to extend the controllable range through the novel method of macro model.

**MEMS5 - 4 A Mixed-Signal Equivalent Circuit Model for MEMS
17:45 Digital Mirror**

S. Maruyama, M. Mita^{}, K. Takahashi^{**}, T. Takahashi,
H. Fujita, H. Toshiyoshi*

Univ. of Tokyo, Japan

^{}JAXA, Japan*

*^{**}Toyohashi Univ. of Tech., Japan*

We report an equivalent circuit model for an electrostatic digital microelectromechanical mirror by using electrical circuit simulator Qucs. The mechanical equation of motion is converted into an equivalent electrical circuit model. The device model is compatible with the mixed-signal simulation along with electrical circuits as well as other physical models.

Author Interviews

18:00 – 19:00

IDW '10

The 17th International Display Workshops
December 1-3, 2010

Fukuoka International Congress Center
Fukuoka, Japan
<http://www.idw.ne.jp/>

**EVENING GET-TOGETHER
WITH WINE**

Tuesday, December 8, 2009
18:00–20:00

Room “FOUNTAIN” (2F)
World Convention Center Summit
(Sponsored by Merck Ltd., Japan)

See page 9 for details

Workshop on Display Electronic Systems

Wednesday, December 9

13:15 - 13:20

KAIHO

Opening

Opening Remarks

13:15

H. Okumura, Toshiba, Japan

13:20 - 14:40

KAIHO

DES1: Beyond the Standards

Chair: H. Okumura, Toshiba, Japan

Co-Chair: T. Yamamoto, NHK, Japan

DES1 - 1: *Invited* Reconstruction-Based Super-Resolution 13:20 Using Self-Congruency of Images

N. Matsumoto, T. Ida

Toshiba, Japan

A reconstruction-based super-resolution method applicable to a single image is proposed. Using the property of images in which the same intensity patterns appear successively around the edges, the pixels near the edge are copied to other positions in the same image, and the sampling density becomes higher.

DES1 - 2: *Invited* Structure Design for Backside Illuminated 13:40 Ultrahigh-Speed CCDs

T. Arai, T. Hayashida, K. Kitamura, J. Yonai,

H. Maruyama, T. Etoh^{}, H. Kuijk^{**}*

NHK, Japan

^{*}*Kinki Univ., Japan*

^{**}*DALSA, the Netherlands*

A back-side illuminated ultrahigh-speed CCD was designed. A potential profile for n-/p- structures was calculated using a three-dimensional semiconductor device simulator. The thickness and concentration of the n- and p- epitaxial layers were optimized to minimize transit time.

DES1 - 3: Invited 4K/2K Layered Streaming of Super High Definition Video

14:00

*T. Nakachi, T. Fujii**NTT, Japan*

A 4K/2K layered streaming system for super high definition video, which is based on the JPEG2000 coding technique, is introduced. This system implements JPEG2000 multi-layer scalable coding technology. Furthermore, we introduce the latest research on error correction and encryption schemes for layered video streaming.

DES1 - 4: Invited Improvement of Motion Image Quality by Using High Frame Rate from Shooting to Displaying

14:20

*Y. Kuroki**Sony, Japan*

To improve motion-image quality, we developed prototypes of a 240fps HD resolution camera, a 240fps 4Kx2K projector and a 240fps LCD display. These high frame rate equipments bring extremely high quality of motion image.

----- Break -----

DES

15:00 - 16:15

KAIHO

DES2: Backlight Control

Chair: H. Sasaki, Toshiba, Japan

Co-Chair: H.-S. Koo, Ming-Hsing Univ. of S&T, Taiwan

DES2 - 1 A Novel and Efficient Algorithm for Uniform of LED Backlight

15:00

*C.-M. Ko, C.-F. Hsu**AU Optronics, Taiwan*

This paper introduces a novel and efficient algorithm used in luminance uniformity calibration system (LUCS) which can improve the uniformity of LED backlight display. The system captures the luminance image and produces compensation data based on the concept of light spread function (LSF).

DES2 - 2 Withdrawn

DES2 - 6L Adaptive Dimming for Edge-Lit LCD Using Sorted Sector Covering Method
15:15

T. Jung, M. Albrecht, C. Xu
Saarland Univ., Germany

The originally for direct-lit developed Sorted Sector Covering (SSC) local dimming algorithm is adopted for edge-lit LCD. SSC uses the physical viewing approach from LED to LCD, and is therefore also well-suited for edge-lit structures. Combined with an image preprocessor we achieve high power saving at low hardware cost.

DES2 - 3 Sorted Sector Covering Algorithm with Condensed Image Data and Soft Clipping Extension for Low-Cost Local Dimming Processor and High Power Saving
15:30

M. Albrecht, C. Xu
Saarland Univ., Germany

A preprocessing step condensing the image has been inserted to the local dimming processor, so the Sorted Sector Covering (SSC) algorithm is capable to deliver clipping-free as well as soft-clipping affected results. This leads to high power saving of 47% and a significant reduction of the HW-complexity.

DES2 - 4 Multi Output Flyback Converter with Direct Energy Transfer for LED Backlight
15:45

D. Cho, S. W. Choi, J. H. Kim, G. W. Moon, W. S. Oh,
B. C. Yang*, T. S. Jang**
KAIST, Korea
**Samsung LCD, Korea*

Multi output flyback converters integrating direct energy transfer technique are proposed. In the proposed system, overall power efficiency can be improved. Moreover, the power rating of semiconductor components can be reduced. The comparison of power efficiency between conventional and proposed system are presented along with experimental-results for 46" LED TVs.

DES2 - 5 Ultra Low Power Display Module Using Solar Cell and Adaptive Backlight Dimming Technique
16:00

C.-F. Hsu, C.-C. Lai, T.-Y. Chang, S.-H. Liao
Wintek, Taiwan

The solar cell not only detects the ambient illumination but also provides the power to save about 10% power consumption of display module. The adaptive backlight dimming technique achieves about 30% power saving and maintains image performance depending on image content and the ambient illumination.

----- Break -----

16:40 - 17:50

KAIHO

DES3: Advanced Display Systems

Chair: Y. Kudo, Hitachi, Japan
 Co-Chair: A. Nagase, Mitsubishi Elec., Japan

**DES3 - 1: Invited Temporal and Spatial Electronic Image
 16:40 Formation for LCD's**

H.-P. Shieh

Nat. Chiao Tung Univ., Taiwan

Issues on temporal and spatial electronic image formation from power consumption, image quality, and others will be presented.

**DES3 - 2: Invited Backlight Adjustment, Image Compensation,
 17:00 and Color Model Mapping for High Dynamic
 Range(HDR) Spatial Modulated Display System**

*Y.-P. Huang, H.-P. Shieh, K.-G. Wang, L.-Y. Liao,
 F.-C. Lin, Y.-K. Cheng*

Nat. Chiao Tung Univ., Taiwan

For achieving high quality HDR Display System, three steps : Backlight adjustment, Real-time image compensation, and Color model mapping, have to be considered. Three novel methods were proposed, and had been demonstrated on a 37" HDR-LCD with high contrast, wide color gamut, less image distortion, and low power consumption.

**DES3 - 3 Development of a 15M-Pixel Super High Resolution
 17:20 Medical LCD**

*M. Hasegawa, Y. Tanaka, K. Ichikawa**

TOTOKU Elec., Japan

**Kanazawa Univ., Japan*

Title: Development of a 15M-Pixel Super High Resolution Medical LCD
 We developed a new medical display by utilizing our independent sub-pixel drive (ISD) technology which realizes resolution of 15M sub-pixels to accept higher resolution for digital mammography devices. This technology was considered effective for the accurate depiction of the fine anatomical structures such as micro-calcifications of the mammography.

DES

**DES3 - 4 An Advanced Voltage Differential Signaling Interface
17:35 for Chip-On-Glass Applications of TFT-LCD**

*J.-P. Hong, J.-H. Choi, K.-I. Oh, K.-M. Kim, J.-H. Kim,
S.-H. Paik, K.-S. Kim, S.-W. Kim, H.-M. Song, J.-R. Shim,
J.-H. Na, D.-S. Kim, D.-K. Han, I.-Y. Jung*, G.-W. Do*,
H.-H. Lee*, J.-S. Kim*, K.-T. Moon**

Silicon Works, Korea

**LG Display, Korea*

An intra-panel interface for Chip-On-Glass application is developed using an Advanced Voltage Differential Signaling (AVDS). The AVDS interface consists of the timing controller with transition compensator and the column driver ICs. The operating frequency of system using the AVDS interface is measured as 200MHz and it has low EMI characteristics.

Author Interviews

18:00 – 19:00

Thursday, December 10

9:00 - 12:00

3F Foyer

Poster DESp: Display Electronic Systems

**DESp - 1 PWM Limit Control Method and Block Contrast Ratio
for Local-Dimming Backlights**

*K. Fujiwara, H. Ichioka, T. Murai, K. Hashimoto,
H. Murakami, K. Otoi, T. Yamamoto, M. Teragawa*

Sharp, Japan

This paper presents our innovative PWM Limit Control Method (PLCM), and a key parameter Block Contrast Ratio (BCR) for local-dimming backlight system. PLCM is capable of achieving peak luminance and reducing motion blur, and BCR affects its image quality. There is a close correlation between PLCM effect and BCR.

DESp - 2 A Fast Transient LED Driver with Dithering Dimming

D. Cho, S. W. Choi, J. H. Kim, G. W. Moon, W. S. Oh,
B. C. Yang*, T. S. Jang**

KAIST, Korea

**Samsung LCD, Korea*

A conventional high dimming ratio LED driver requires a fast transient power converter and an additional control circuit for PWM-dimming. In this paper, the dithering controlled power converter without dimming circuit is proposed. Experiment results verify that the proposed system can achieve the dimming ratio 256:1 at 600Hz dimming frequency.

DESp - 3 LED Control Signal Extraction by Using Multiple Representative Values*W. Zhang, M. Chen, W. Niu, D. Huang**Hong Kong Appl. S&T Res. Inst., Hong Kong*

Locally dimming backlight dramatically increases the contrast of LCD display. However, such structure introduces new artifacts, especially halo effect, which does not exist in traditional constant backlight display. More sophisticated LED control algorithm is necessary to alleviate such problem.

DESp - 4 Investigation and Reduction of Viewing Angle Dependent Image Degradation Found in Adaptive Dimming Technique*S. Ogaki, K. Sakakibara, T. Shiga**Univ. of Electro-Commun., Japan*

A steep change in backlight luminance distribution due to the application of the adaptive dimming technique causes image degradation around the boundary of the blocks when the LCD is viewed from an angle. The degradation can be reduced by broadening the luminance distribution of a block.

DESp - 5 Spatial and Temporal Filtering for Local Dimming Backlight Modulation*K. C. Tai, E. G. Chen, S.-T. Cho, C.-J. Chen, C.-L. Yang, J.-P. Pang**InnoLux Display, Taiwan*

We propose a method by using JND (just noticed difference) of luminance as a parameter to design the temporal and spatial filter which can be easily implemented in the hardware. The proposed technique in our experiment can effectively let the observers hardly to see these artifacts in our experiment.

DESp - 6 A Novel Side Light LED Backlight Control for Large Area Displays*C.-W. Su, C.-I Chiang, T.-Y. Li, C.-C. Chang, C.-L. Tsou**Chunghwa Picture Tubes, Taiwan*

We have developed two new control technologies for side light LED backlight. The Novel control technology called scanning control and local gray control. We also implement of highly integrated high power-LED module driving system which can develop a power management system which can achieve power saving.

DESp - 7 A Novel Concept of the Feedback Compensation for RGB LED Backlight

*C.-W. Su, C.-I Chiang, C.-L. Tsou
Chunghwa Picture Tubes, Taiwan*

We have proposed a novel feedback system for RGB LED backlight. We use linear CCD to replace color sensor to measure luminance and color accuracy, and then feedback compensation for RGB LED backlight. Besides, the linear CCD is cheaper than the color sensor that can achieve cost down.

DESp - 8 Withdrawn**DESp - 9 Feedback Based Power Management for LCD Backlight Modulation for Guaranteed Average Levels of Power Consumption**

*L. Kerofsky
Sharp Labs. of America, USA*

Backlight modulation is effective at reducing average LCD power consumption; average power depends upon the displayed content. We proposed a power control algorithm to guarantee average backlight power. Scene-Cut dependant temporal filtering minimizes artifacts. Power control applications include response to a smart electricity grid or guaranteed battery life.

DESp - 10 The Method for Compensation Color-Shift on Color Sequential LCD

*W.-C. Tai, C.-C. Tsai, K.-T. Hu, H.-M. Chen, C.-L. Liu,
C.-N. Mo
Chunghwa Picture Tubes, Taiwan*

Color sequential method demands fast response time by using liquid crystal display. If the response time of the liquid crystal is not fast enough, the method causes color-shift artifact in its nature. This paper discusses the color-shift effect by simulation data and proposes some experiment data with TN mode display.

DESp - 11 Improvement of Dynamic Image Quality by a Novel Overdrive Algorithm

*Y. W. Fang, J. H. Lu, J. F. Chen, K. S. Wang, C. Y. Lee
AU Optronics, Taiwan*

We developed a novel algorithm for obtaining the optimum overdrive (OD) gray level. The SV-CSF index is derived in the subjective experiments. The novel algorithm is then established from the SV-CSF index. By applying the novel OD level LUT (look-up table), the image quality compared with conventional LUT is examined.

DESp - 12L HSI Color Space Based LED Backlight Dynamic Control in 47-in. 120 Hz LCD TV

*X. Chen, W. Liu, Y. Chen, M. Qiao
R&D Ctr. of Hisense Elec., China*

We demonstrate a 47-inch 120Hz LED backlight LCD TV based on HSI color space 2D local dimming technology. Both energy saving and contrast improving have been achieved. The negative image quality issues induced by local dimming such as partition halo, and video brightness reduction have also been successfully addressed.

DESp - 13L Charge Redistribution SC Digital-to-Analog Converter for Large-Sized Flat Panel Displays

*Y. Lee, K.-S. Lee
Sun Moon Univ., Korea*

This work describes an 8-bit charge redistribution switched-capacitor DAC suitable for large-sized flat panel displays. The proposed DAC uses only 4 binary weighted capacitors that both convert the MSB bits and the LSB bits. Therefore, the area and power can be considerably reduced with respect to conventional DAC circuits.

DESp - 14L A Fast Pen Tracking Scheme for Bistable Passive Matrix Color Cholesteric LCD

*C.-C. Hsu, C.-J. Chen, C.-C. Liang, Y.-S. Chang,
C.-C. Wu, C.-Y. Chen
ITRI, Taiwan*

To apply a real-time handwriting function on the passive matrix color cholesteric LCD, a fast pen tracking scheme is proposed to pixel-wised update the touched pixels but not frame-by-frame. The cumulative driving scheme is applied to speed up the apparent response time. The experimental results verify its feasibility and efficiency.

DESp - 15L Adapted Block Matching Motion Estimation Algorithm

*S.-W. Choi, M.-R. Choi
Hanyang Univ., Korea*

In this paper, we propose Adapted Block Matching Motion Estimation (ABMME) Algorithm by classifying blocks into two types (average motion blocks and local motion blocks) and performing motion estimation differently. Experimental results show that proposed method prevents degradation of picture quality with low computation compared with conventional algorithms.

13:20 - 15:00

KAIHO

VHF4/DES4: Color (1)

Chair: K. Sekiya, Tohoku Univ., Japan

Co-Chair: T. Matsumoto, Sony, Japan

**VHF4/
DES4 - 1: Invited Measuring Light and Color: An Introductory
Talk to Photometry**

13:20

*N. Ohta**Rochester Inst. of Tech., USA*

Photometry is used for measuring light quantities based upon our spectral luminous efficiency function established in 1924. In my talk, I will describe the basis of photometry. I will also mention the limitation of, and the improvement of modern photometry.

**VHF4/
DES4 - 2: Invited Extending Applications of Multi-Primary Color
LCDs**

13:50

*K. Tomizawa, K. Nakamura, S. Ueki, Y. Yoshida, T. Mori,
M. Hasegawa, A. Yoshida, Y. Narutaki, Y. Itoh,
Y. Yoshida, M. Teragawa**Sharp, Japan*

We developed a five-primary color (5PC) LCD which can reproduce real-surface colors; however, multi-primary color LCDs have relatively lower luminance for 'bright green' than TV broadcasting standards. This paper introduces new algorithms reproducing bright green and simultaneously keep its fidelity in chromaticity. This indicates the extendibility of our 5PC LCD.

**VHF4/
DES4 - 3: Image-Dependent Skin-Color Correction Technology
Based on Skin-Based Color Space**

14:20

*Y. C. Hsu, H. S. Chen**Nat. Taiwan Univ., Taiwan*

A new automatic skin-color correction method for still image is proposed. Skin-color areas in an image are extracted by skin-color searching algorithm to find out critical color correction range which determines parameters of modification coefficient function. Skin-color is finally corrected by Gaussian distributed coefficients under LSN (Lightness/skin/non-skin) opponent color space.

VHF4/
DES4 - 4
14:40

**Memory Color Detection and Enhancement for
Improved Television Picture Quality**

*H. Pan, X. Xu, J. Speigle, S. Daly
Sharp Labs. of America, USA*

We propose a unified skin and blue sky color detection and enhancement method that simultaneously satisfies people's opposing color preference of skin and blue sky colors for wide color gamut TVs. Psychophysical experiments and image/video experiments show that the proposed method improves picture quality with more pleasing rendition of skin and blue sky colors.

Author Interviews

18:00 – 19:00

DES

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

Call for Papers
**Special Section
on Electronic Displays**

IEICE Transactions on Electronics
Submission Deadline: Feb. 26, 2010
<http://ny7084.rie.shizuoka.ac.jp/eid/top-e.htm>

BANQUET

Wednesday, December 9, 2009
19:30–21:30
Room "TENZUI" (4F)
World Convention Center Summit
See page 9 for details

Topical Session on Flexible Displays

Thursday, December 10

9:00 - 9:10

TENZUI

Opening

Opening Remarks

9:00

H. Fujikake, NHK, Japan

9:10 - 10:35

TENZUI

FLX1: Flexible LC Technology

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

Co-Chair: T. Takahashi, Kogakuin Univ., Japan

FLX1 - 1: *Invited* The Importance of Surface Alignment of Bistable Nematic LCD

9:10

*M. Kimura, J. B. Lias, K. Goda, Y. Azumai, T. Akahane
Nagaoka Univ. of Tech., Japan*

The importance of surface alignment in bistable nematic liquid crystal devices is reviewed. Firstly, some example of bistable LCD with tailored alignment surface is discussed. Secondly, the image sticking problem in cholesteric bistable LCD caused by the surface memory effect is investigated by ellipsometry.

FLX1 - 2 High Performance Full Color Cholesteric LCD with Dual Stack Structure

9:35

*K.-T. Chen, Y.-C. Liao, J.-C. Yang, J.-W. Shiu, Y.-S. Tsai,
K.-W. Wu, C.-J. Chen, C.-C. Hsu, C.-C. Wu, W.-C. Chen,
C.-L. Chin
ITRI, Taiwan*

A 10.4-inch 100 ppi full color cholesteric liquid crystal display with high reflectivity and high resolution by dual stacking is demonstrated. Each individual ChLC panel is fabricated by the development of the pixelized vacuum filling technique. The reflectivity of our panel is about 27% with 100 ppi resolution and 3-bit color.

**FLX1 - 3 Flexible Display for LC on Bare Plastic Substrate with
9:55 New Photosensitive Azodye Solution**

*L. Yao, A. Murauski, T. Du, Q. Yu, V. Chigrinov,
H. S. Kwok*

Hong Kong Univ. of S&T, Hong Kong

Flexible optically rewritable twist nematic liquid crystal display based on photoalignment technology with new solution of azodye material has been demonstrated. The solution does not exhibit any breakage when it is deposited on plastic substrate. It shows fine property of rewritable and reproducibility of alignment quality for flexible display.

**FLX1 - 4 Tilt-Angle and Spacer Distribution Density
10:15 Dependent LC Filling by Continuous Air-Extracting
Technique**

*C.-M. Hsu, C.-J. Chan, W.-T. Wu, K.-S. Tsen**

Southern Taiwan Univ., Taiwan

**MIRDC, Taiwan*

Cell filling of a flexible LCD using a continuous air-extracting technique is demonstrated faster than with the traditional method. The cell filling rate was found dependent on substrate tilt-angle and distribution density of spacer with the optimized θ at 45° and $D_{sp} = 360 \text{ pcs/mm}^2$.

----- Break -----

FLX

10:40 - 11:50

TENZUI

FLX2: Flexible Electronic Paper

Chair: S. Maeda, Oji Paper, Japan
Co-Chair: Y. Masuda, Bridgestone, Japan

**FLX2 - 1: *Invited* Innovative Applications of Flexible LCD
10:40 Technology**

*C.-C. Liao**, Y.-R. Lin*, C.-W. Kuo*, C.-Y. Chang**

**ITRI, Taiwan*

***Device 2.0, Taiwan*

Many materials and manufacturing methods of flexible LCDs have been studied for last two decades. The market of flexible LCDs is narrow now. In this paper, different techniques will be combined with flexible LCDs to create several new concept products to add values of flexible LCD and broaden its market.

FLX2 - 2: Invited A 200 ppi All-Printed Organic TFT Backplane for Flexible Electrophoretic Displays

11:05

*K. Suzuki, K. Yutani, M. Nakashima, A. Onodera,
S. Mizukami, M. Kato, T. Tano, H. Tomono,
M. Yanagisawa, K. Kameyama
Ricoh, Japan*

A 200 ppi all-printed OTFT backplane was fabricated with a channel length of 5 μm and mobility of over 0.1 cm^2/Vs by a surface energy controlled Ink-Jet printing and several printing methods on plastic substrate. A flexible electrophoretic display driven by the all-printed OTFT backplane was successfully demonstrated.

FLX2 - 3 Development of Electrode Materials for Flexible Electronic Paper: Application of Conductive Organic Polymers by Higher Resolution Patterning

11:30

M. Nishii, R. Sakurai, K. Sugie, Y. Masuda, R. Hattori
Bridgestone, Japan
Kyushu Univ., Japan

A flexible electronic paper panel containing transparent conductive polymer of PEDOT/PSS has been prepared. For the substrates coated by PEDOT/PSS, laser ablation was performed to generate line-shaped patterned electrodes in the resolution of 88 dpi. The electronic paper exhibited comparable display properties to that composed of conventional ITO electrodes.

----- Lunch -----

13:20 - 14:55

TENZUI

FLX3: Materials & Components for Flexible Displays

Chair: S. K. Ramadas, Tera-Barrier Films, Singapore
Co-Chair: T. Nonaka, AZ Materials, Japan

FLX3 - 1: Invited Nanoparticulate High Barrier Films for Flexible Displays and Lighting Applications

13:20

*S. K. Ramadas, Z. M. Shwe, M. Auch
Tera-Barrier Films, Singapore*

A new nanoparticulate barrier stack concept has resolved barrier film's pore effect issues by sealing the defects of the barrier oxide films using nanoparticles. This concept has demonstrated a breakthrough moisture barrier performance of better than 10^{-6} $\text{g}/\text{m}^2/\text{day}$ at 60 $^{\circ}\text{C}$ & 90 % relative humidity.

**FLX3 - 2: Invited Status of Thin Film Encapsulation of OLED:
13:45 From Pilot to Manufacturing**

X. Chu, M. Rosenblum, S. Lin, C. Suen
Vitex Sys., USA

Multilayer organic/inorganic thin film encapsulation, commercialized by Vitex as Barix, has shown effective water vapor transmission rate of 10^{-7} g/m²/day with fewer and thinner barrier layers with improved process. The Barix process can meet less than 4 min cycle time requirement for G4 size substrate and offers low material cost.

**FLX3 - 3 Curved Display Technology Based on Glass
14:10 Substrates**

W. C. Yang, J. Y. Wu, C. Y. Su, Y. C. Liu, W. Y. Chien,
H. P. Kuo, M. S. Chen, W. M. Huang
AU Optronics, Taiwan

The curved display technology based on glass substrates is demonstrated in this paper. This technology is achieved by the ultra thin cell and curved module design. The curved panel possesses good display properties and similar producing process comparable to traditional flat panel display, and thus would be highly mass-producible.

FLX

**FLX3 - 4: Invited Plastic Substrate and Backplane for Flexible
14:30 AMOLED by Sheet to Sheet Process**

H.-C. Cheng, Y. S. Huang, C.-J. Liu, C.-W. Lin, K.-Y. Ho,
C.-H. Cheng, S. Y. Peng, Y.-P. Chen, H.-C. Lin,
B.-C. Kung, Y.-Z. Chen, P.-F. Lee, J.-J. Huang, C.-C. Lee
ITRI, Taiwan

We demonstrate an innovative approach of 4.1-inch QVGA AMOLED on colorless PI substrate by sheet to sheet process. The top-gate a-Si:H TFTs backplane, can be fabricated through 6 masks processes and easily de-bonded from glass carrier. The de-bonded display shows brightness more than 150 nits and bendable within 2.5 cm-radius.

----- Break -----

SID 2010

International Symposium, Seminar and Exhibition
May 23–28, 2010

Seattle, Washington, USA

15:00 - 16:20

TENZUI

FLX4: Flexible Active-Matrix Devices

Chair: N. Kawashima, Sony, Japan

Co-Chair: Y. Fujisaki, NHK, Japan

FLX4 - 1: Invited Printable High Performance Semiconductors for Curvilinear and Flexible Large-Area Electronics

15:00

C. A. Bower, E. Menard, J. W. Hamer^{}, R. S. Cok^{*},
R. G. Nuzzo^{**}, J. A. Rogers^{**}*

Semprius, USA

^{}Eastman Kodak, USA*

*^{**}Univ. of Illinois, USA*

We describe the fabrication and printing of inorganic semiconductor materials for high-performance Curvilinear and Flexible Large-Area Electronics of diverse form. We describe methods to obtain high performance in printed electronics, including exemplary active-matrix OLED displays with printed backplanes of silicon integrated circuits (ICs) in place of conventional thin-film transistors (TFTs).

FLX4 - 2 The Stability of a-IGZO Thin Film Transistors on Plastic Substrate with Mechanical and Illumination Stress

15:25

*J.-Y. Yan, C.-Y. Hung, H.-C. Yao, Y.-Y. Wu, H.-C. Lin,
C.-L. Liao, J.-J. Huang, Y.-S. Huang, H.-C. Cheng
ITRI, Taiwan*

In this article, the amorphous InGaZnO₄ thin film transistors were fabricated on the polyimide substrate and the maximum process temperature below 250°C. The mobility, threshold voltage and subthreshold swing of a-IGZO TFT are 11.6cm²/Vs, 1.8V and 0.26V/dec, respectively. Also, the mechanical and illumination effect of a-IGZO TFTs were investigation.

FLX4 - 3 Fabrication of Flexible 4.7-in. QVGA AMOLED Panel Driven by In-Ga-Zn-Oxide TFTs with Flexible Color Filter

15:45

*K. Arihara, M. Kano, K. Motai, Y. Naitou, M. Kadowaki,
H. Nakajima, T. Tsuboi, C. Kato, Y. Kishimoto, H. Maeda
Dai Nippon Printing, Japan*

We have developed a novel flexible AM-OLED display driven by amorphous In-Ga-Zn-Oxide TFTs fabricated onto stainless steel substrates. A 320 × 240 × RGB active matrix 4.7-inch panel was achieved by using white-OLEDs and a flexible color filter. Also, preferable full color moving images were demonstrated at the frame frequency of 60 Hz.

FLX4 - 4L 16:05 High-Speed Laser-Sintering of Nano-Metal Inks (Cu and Ag) for Inkjet Printing on Quartz Fiber Substrates

A. Mimura^{}, N. Shibayama^{*}, M. Takeda^{*}, T. Itoh^{**}*

^{}BEANS Lab., Japan*

*^{**}AIST, Japan*

Inkjet direct printing technology is proposed for producing thin film devices on fiber substrates. For a metallization, direct CO₂ laser irradiation in air was tested to achieve high-speed sintering of Cu and Ag nano-metal inks on quartz wafer. The metal eduction was successfully confirmed.

----- Break -----

16:40 - 17:40

TENZUI

FLX5: Flexible OLED

Chair: H. Kuma, Idemitsu Kosan, Japan
Co-Chair: O. Yokoyama, Seiko Epson, Japan

FLX5 - 1 16:40 Towards All R2R Printed SMOLED for Lighting, Signage and Display

*K. R. van den Hoonaard, S. Harkema, I. de Vries,
G. Kirchner, J. J. Michels, D. Deganello^{*}, J. A. Cherry^{*},
E. W. A. Young*

TNO, the Netherlands

^{}Swansea Univ., UK*

This study highlights the feasibility of SMOLED printing from solution for display and lighting applications. This work has a special emphasis on foil based processing, R2R in particular. Slot die printing and gravure printing was studied for multilayer printed SMOLED device structures. Hoy parameters were used to select appropriate solvents.

FLX5 - 2 17:00 Efficient and Chromatic-Controllable White Organic Light-Emitting Diodes on Plastic Substrates Using Color Conversion Method

B. Li, S. Sun, L. Lu, Y. Liao, C. Li, J. ZHANG, H. Xu^{},
B. Wei*

Shanghai Univ., China

^{}SVA Electron, China*

The chromatic-stability white organic light emitting diodes have been investigated basing on color conversion method, and result found little CIE coordinate migration under driving voltage from 5V to 12V.

FLX

**FLX5 - 3 Multilayer Transparent Electrodes for Flexible and
17:20 Inverted Organic Light-Emitting Diodes**

*C. Yun, H. Cho, S. Park, S. Yoo
KAIST, Korea*

We present highly flexible and inverted top-emission organic light-emitting diodes (ITOLEDs) based on multilayer transparent electrodes (MTEs) as transparent anodes. MTEs with an efficient hole-injection property as well as high ductility introduced almost same or even better luminance efficiency than bottom-emitting OLEDs with conventional ITO films.

Author Interviews

18:00 – 19:00

IDW '10

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Topical Session on Input Technologies

Friday, December 11

9:00 - 9:05

TENRAN

Opening

Opening Remarks

9:00

H. Okumura, Toshiba, Japan

9:05 - 10:25

TENRAN

INP1: Imaging Devices & Systems

Chair: S. Kawahito, Shizuoka Univ., Japan

Co-Chair: Y. Ukai, UDDI, Japan

INP1 - 1: *Invited* Recent Progress of CMOS Imaging Devices

9:05

S. Kawahito

Shizuoka Univ., Japan

This paper presents recent progress of CMOS imaging devices. Backside illumination greatly improves the sensitivity. A hole-based detector greatly improves the dark current. The readout noise has reached to single electron level by using column amplification techniques. Column ADCs and time resolved pixels are becoming important for new functions of imagers.

INP

INP1 - 2: *Invited* CMOS Based Retinal Prosthesis Technology

9:25

T. Tokuda, J. Ohta

Nara Inst. of S&T, Japan

CMOS-based retinal prosthesis technology is presented. After issues around CMOS-based stimulator for patterned stimulation on retina are discussed, we propose multi-chip architecture which is the key approach to realize a flexible and multi-site patterned stimulator. Design, packaging and demonstrations of our CMOS-based multi-chip flexible retinal stimulator is presented in detail.

INP1 - 3: 9:45 *Invited* **Stacked Image Sensor Using Organic Photoconductive Films with ZnO-TFT Readout Circuits**

S. Aihara, H. Seo, M. Kubota, N. Egami, T. Hiramatsu, M. Furuta*, T. Hirao**

NHK, Japan

**Kochi Univ. of Tech., Japan*

Image pickup from a stacked image sensor with green- and red-sensitive organic photoconductive films, each having a readout circuit of zinc oxide-thin film transistor, was demonstrated. A color image with a resolution corresponding to the pixel number was obtained, clearly indicating that color separation occurred in the vertically stacked structure.

INP1 - 4 10:05 **CMOS Image Sensor with a Thin Overlaid Panchromatic Organic Photoconductive Layer for Sensors with Reduced Pixel Size**

M. Ihama, T. Mitsui, K. Nomura, Y. Maehara, H. Inomata, T. Gotou, Y. Takeuchi

FUJIFILM, Japan

We proposed a new CMOS image sensor with a thin overlaid panchromatic organic photoconductive layer as the best candidate for sensors with reduced pixel size. We experimentally made the trial products of the proposed sensor, verified the potential capability of our proposal, and proved the validity of the organic CMOS sensor.

----- Break -----

10:40 - 12:20

TENRAN

INP2: Touch Panel (1)

Chair: M.-J. Jou, AU Optronics, Taiwan

Co-Chair: K. Takatori, NEC LCD Techs., Japan

INP2 - 1: 10:40 *Invited* **In-Cell Multi-Touch Panel: Trend and Applications**

M.-J. Jou, C.-H. Li, Y.-J. Hsieh

AU Optronics, Taiwan

Touch panel can provide most intuitive way to interact with variety of application. But the challenge is also coming with system complexity, software interface and supporting in operating system. This article will describe the theory of multi-touch panel and the proposal for system integration.

INP2 - 2: Invited Low Temperature Poly-Si TFT LCDs with Integrated Contact-Type Touch Sensors**11:00**

*S. Hayashi, Y. Yamauchi, H. Mizuhashi, T. Koito,
M. Tamaki, M. Kondo, R. Tsuzaki, M. Minegishi
Sony Mobile Display, Japan*

We have developed 2.5 inch QVGA poly-Si TFT LCDs with integrated contact-type touch sensors and drivers which realize not only smoother touch response but also the detection of stylus pressure. They reduce external modules and provide better transmittance than conventional LCDs with touch panels.

INP2 - 3: Invited AM Displays with Imbedded Photo-Sensors**11:20**

*J. Jang, S. H. Kim, M. H. Kang, J. H. Hur
Kyung Hee Univ., Korea*

We reviewed in this paper the active matrix displays with imbedded photo-sensors. AMLCD imbedded with backlight control and ambient light sensors, and AMLCD with image sensor were developed based on a-Si:H TFT. Sensors based on a-Si TFT on metal foil was also developed for flexible sensor. The compensation pixel circuits for AMOLED display using TFT optical feedback circuits and AMOLED with lateral LTPS PIN sensor were developed.

INP2 - 4: Invited A System LCD with Integrated Infra-Red Sensing Optical Touch Panel**11:40**

C. Brown, H. Kato, K. Tanaka*, Y. Sugita*
Sharp Labs. of Europe, UK
Sharp, Japan

We describe a System LCD with integrated infra-red sensitive optical touch panel. The touch panel function is achieved by an image sensor containing a novel pixel circuit with in-pixel amplification and temperature compensation. The high sensitivity and robustness of this circuit enable adoption of the touch panel in mobile devices.

INP2 - 5 Touch Panel Embedded LCD Using Conductive Overlay**12:00**

*H. Haga, J. Yanase, Y. Kamon, Y. Kitagishi, K. Takatori,
H. Asada, S. Kaneko
NEC LCD Techs., Japan*

A touch panel embedded LCD using a conductive overlay formed on the color filter substrate as a transducer has been demonstrated. To achieve high sensitivity, a parasitic current reduction technique which removes 99% of it has been developed.

----- Lunch -----

13:20 - 14:40

TENRAN

INP3: Touch Panel (2)

Chair: G. Largillier, Stantum, France
 Co-Chair: H. Okumura, Toshiba, Japan

INP3 - 1: *Invited* Democratizing Multi-Touch Technology
13:20

G. Largillier
Stantum, France

Whereas Vision Human Factor studies provide an abundant literature to characterize display modules, building a specification for touch sensitive systems - and more noticeably for multi-touch capable ones - remains substantially empirical. Existing metrology gives useful data with regards to the mechanical and optical performances of touch panels. However, it fails to measure what import the most to the user: tactile performances....

INP3 - 2: *Invited* Touch Technology on LCD

13:40

K. Uh, J. Lee, J. Park, S. Park
Samsung Mobile Display, Korea

Touch technologies have been adapted to mobile devices as a key user interface of inputting and obtaining information. In terms of Display itself, the integration of TSP on display actively proceeds in order to take the TSP value on displays, along with adding values of thinner design and better outdoor view ability. In this paper, features of conventional and integrated touch screen technologies are reviewed.

INP3 - 3 **Dual Area Design in Large Size Internal Capacitive Touch Panel**

14:00

S.-Z. Peng, S.-H. Huang, H.-C. Huang, Y.-N. Chu,
W.-T. Tseng, H.-T. Yu, M.-L. Lee
Chunghwa Picture Tubes, Taiwan

Chunghwa Picture Tube, LTD has proposed a novel internal touch panel structure in this paper. We have invented a dual pattern area design for large size touch panel in novel internal touch panel structure. Compared with single pattern area design, the dual pattern area can decrease the resistance and parasitic capacitance in long axis sensor traces.

INP3 - 4: Invited Fast Updating of Bistable Displays for Pen Tracking and Page Flipping

14:20

*B. Rhodes**Ricoh Innovations, USA*

We present a driver for bistable displays with fast, low-latency image updates suitable for interactive interfaces such as pen tracking, pop-up menus and quickly flipping through pages in a document. Images are updated quickly, and the resulting ghosting artifacts are removed over time using an unobtrusive “sparkle” update.

Author Interviews

16:20 – 17:20



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| Program Committee: | Y. Asakura | Nittoh Kogaku |
| | Y. Fushimi | Panasonic |
| | Y. Hayashi | Sony |
| | H. Kanayama | Sanyo Elec. |
| | S. Koike | Seiko Epson |
| | H. Nakano | Barco |
| | T. Ogura | Panasonic |
| | K. Ohara | Texas Inst. Japan |
| | S. Ouchi | Hitachi |
| | Y. Sakai | Ushio |
| | Z. Tajima | Mobara Atecs |
| | T. Yoshida | Toppan Printing |

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 | Oji Paper |
| | Y. Masuda | Bridgestone |
| | N.-S. Roh | Samsung Elec. |
| | Y. Toko | Stanley Elec. |
| | T. Tsuchiya | E-ink |
| | G. F. Zhou | Philips Res. |

Workshop on MEMS for Future Displays and Related Electron 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 | NICT |
| | J. M. Kim | Samsung |
| | K. Matsumoto | Olympus |
| | W. I. Milne | Cambridge Univ. |
| | T. Ooasa | Tokyo Electron |
| | S. Sugiyama | Ritsumeikan Univ. |
| | H. L. Tuller | MIT |
| | S. Uchikoga | Toshiba |
| | J.-B. Yoon | KAIST |
| | Y. Yoshida | Mitsubishi Elec. |

Workshop on Display Electronic Systems

| | | |
|---------------------|---------------------|--------------------------|
| Workshop Chair: | H. Okumura | Toshiba |
| Program Chair: | K. Sekiya | Tohoku Univ. |
| Vice Program Chair: | K. Kälántär | Nippon Leiz |
| General Secretary: | Y. Kudo | Hitachi |
| Program Committee: | T. Fujine | Sharp |
| | S. Ito | Shizuoka Univ. |
| | 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. |
| | S. Ono | Panasonic |
| | H. Sasaki | Toshiba |
| | N. Suzuki | Nokia Japan |
| | K. Takeuchi | Univ. of Electro-Commun. |
| | T. Yamamoto | NHK |

Topical Session on Flexible Displays

| | | |
|--------------------|-------------|-----------------|
| Session Chair: | H. Fujikake | NHK |
| General Secretary: | S. Maeda | Oji Paper |
| Session Co-Chair: | Y. Masuda | Bridgestone |
| | K. Nomoto | Sony |
| | S. Tokito | NHK |
| | T. Tomono | Toppan Printing |

Topical Session on Input Technologies

| | | |
|--------------------|-------------|----------------|
| Session Chair: | H. Okumura | Toshiba |
| Program Committee: | A. Suzuki | Ricoh |
| | N. Suzuki | Nokia Japan |
| | K. Takatori | NEC LCD Techs. |
| | Y. Ukai | UDDI |

IDW '10

The 17th International Display Workshops
December 1-3, 2010

Fukuoka International Congress Center
Fukuoka, Japan
<http://www.idw.ne.jp/>

EVENING GET-TOGETHER WITH WINE

Tuesday, December 8, 2009
18:00–20:00

Room “FOUNTAIN” (2F)
World Convention Center Summit
(Sponsored by Merck Ltd., Japan)

See page 9 for details

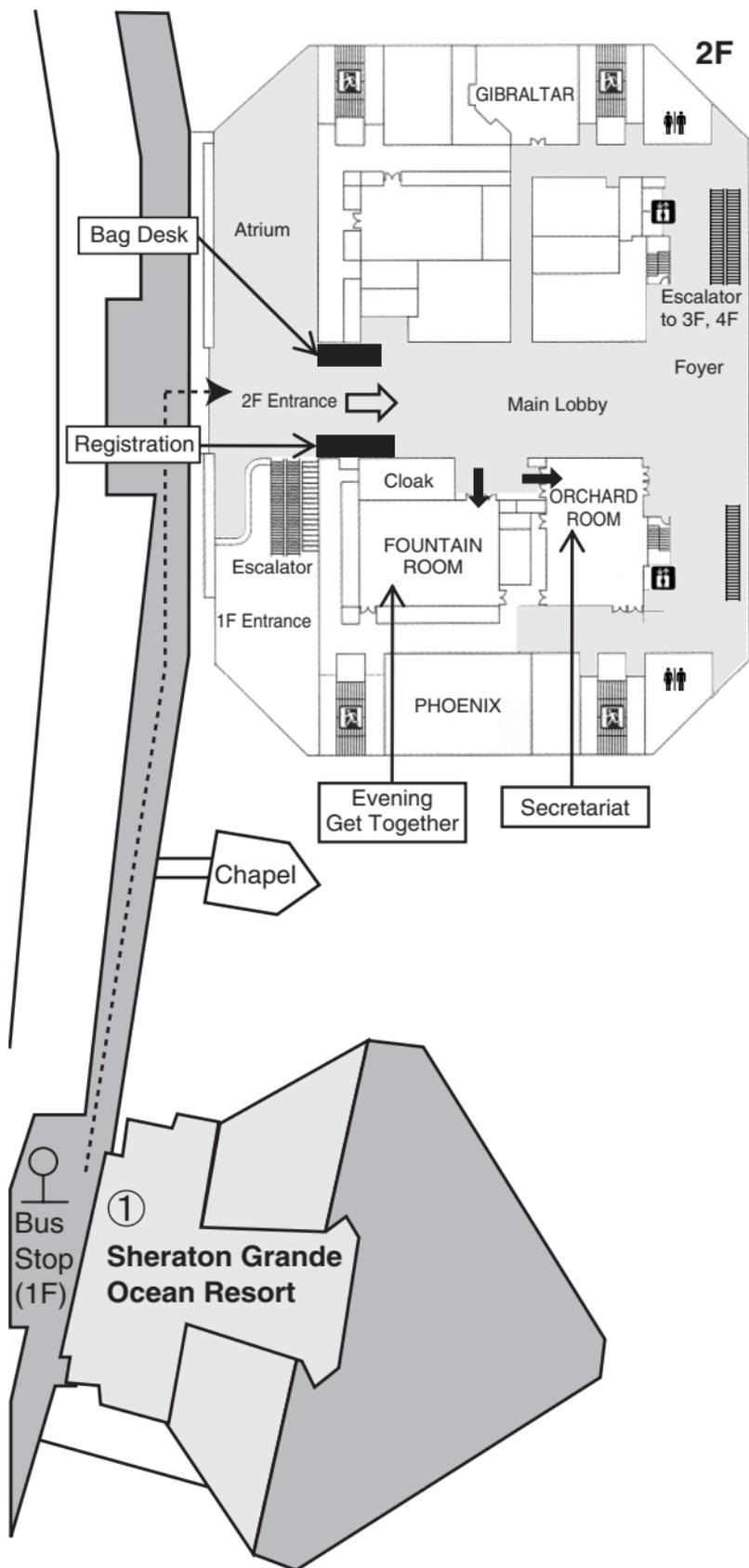
IDW Tutorial in Japanese

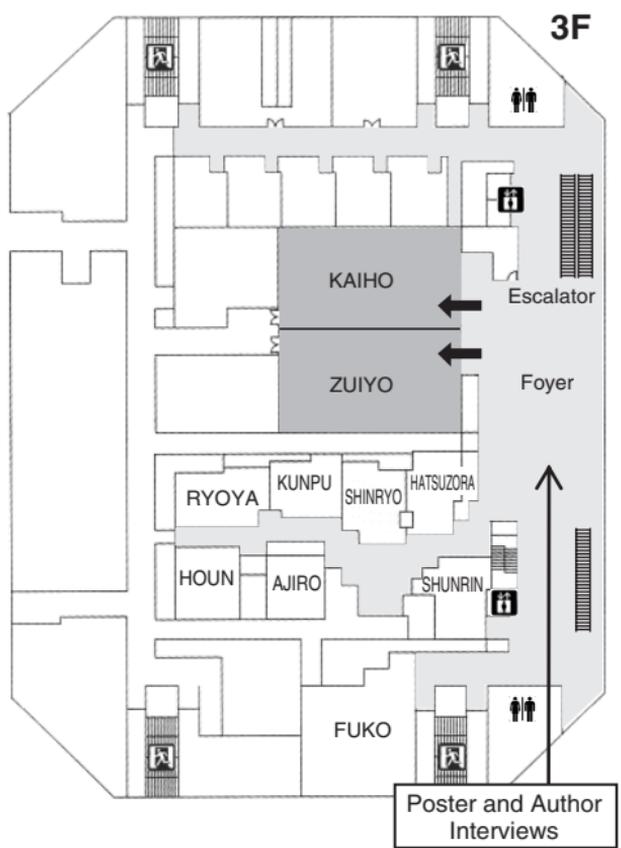
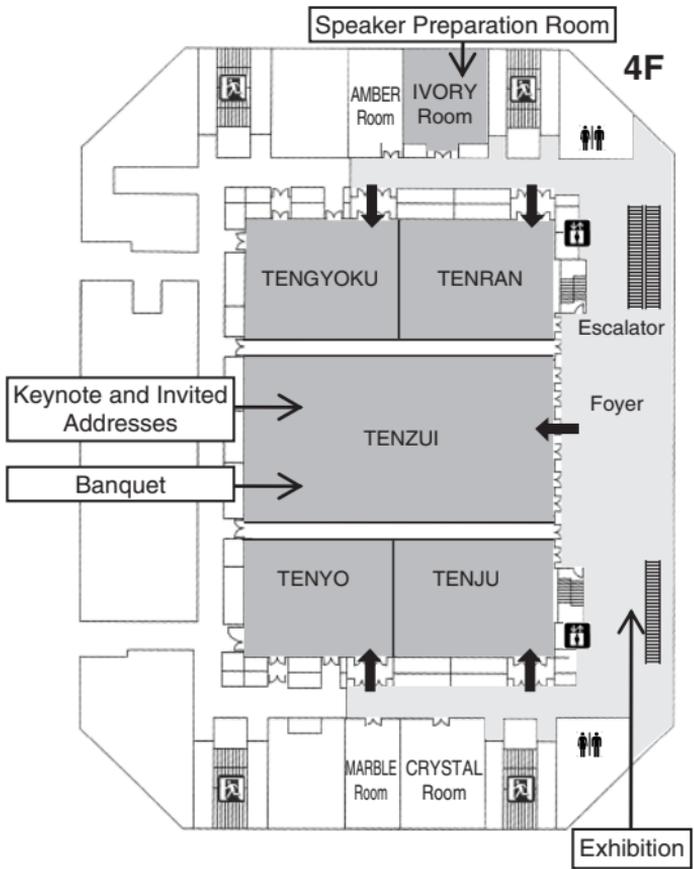
Tuesday, December 8, 2009
Room “TENRAN” (4F)

World Convention Center Summit

Detailed information will be announced in October at
<http://www.sidchapters.org/japan/>

FLOOR PLAN





MEMO

Call for Papers

Feature on IDW '09

**The Journals of The Institute of Image
Information and Television Engineers**

Submission Deadline: Feb. 26, 2010

http://www.ite.or.jp/ronbun/ronbun_index.htm

(in Japanese)

Call for Papers

Special Section on Electronic Displays

IEICE Transactions on Electronics

Submission Deadline: Feb. 26, 2010

<http://ny7084.rie.shizuoka.ac.jp/eid/top-e.htm>

IDW '09 Session Navigator

| | Location | Wednesday, Dec. 9 | | | | | Thursday, Dec. 10 | | | | | Friday, Dec. 11 | | | | |
|------------------------------|----------|--------------------------------------|---------------------------------------|-------------------------------------|---------------------------|--|-----------------------------------|---|---|------------------------------------|-------------|-----------------|---------------------------------------|--------------------------------------|---|----------------------------|
| | | 9:30-12:10 | PM | | | 18:00-19:00 | AM | | PM | | 18:00-19:00 | AM | | PM | | 16:20-17:20 |
| Keynote & Invited | TENZUI | Opening, Keynote & Invited Addresses | | | | | | | | | | | | | | |
| LCT | TENZUI | | | | | | | | | | | | Measurement Method & Characterization | New Alignment Technology | Advanced Non-contact Alignment Technology | |
| | TENRRAN | | | | High Performance LCDs (1) | | Advanced Blue Phase LC Technology | Emerging LC Materials | New Functional LC Devices | High Performance LCDs (2) | | | | | | |
| | 3F Foyer | Posters | | | | A.I. | | | | | A.I. | | | | | A.I. |
| AMD | TENZUI | System on Panel | Si Device Technologies | | | | | | | | | | | | | |
| | TENGYOKU | | | | | *AM-OLED (2) | Sensing Devices | Organic TFT | | | | | | Oxide TFT (1) | Oxide TFT (2) | |
| | TENYO | | | | *AM-OLED (1) | | | | | | | | | | | |
| FMC | TENZUI | | | | | | | | | | | | | | | |
| | TENGYOKU | | | | | | | | Materials I | Materials II | | | | | | |
| | TENJU | Manufacturing Technologies I | Manufacturing Technologies II | Environmental Friendly Technologies | | | | | | | | | Backlight I | Backlight II | Optical Films I | Optical Films II |
| PDP | TENJU | | | | | | | | | | | | | | | |
| | TENYO | | | | | | | | | | | | | | | |
| | 3F Foyer | | | | | | | | | | | | Posters | | | A.I. |
| PH | TENJU | | | | | | | | | | | | | | | |
| | KAIHO | | | | | Phoshors in General | Phosphors for LEDs 1 | Phosphors for LEDs 2 | Phosphors in EL & PDP | | | | | | | |
| | 3F Foyer | Posters | | | | | | | | | | | | | | A.I. |
| FED | KAIHO | | | | | | | | | | | | CNTs & FEDs | *Phosphors for FEDs | Field Emitters (1) | Field Emitters (2) |
| | 3F Foyer | | | | | | | | | | | | | | | A.I. |
| | TENGYOKU | | | | | *AM-OLED (2) | | | | | | | | | | |
| OLED | TENJU | | | | | | | | | OLED Lighting | | | | | | |
| | TENYO | OLED Material & Device | OLED Technologies | *AM-OLED (1) | | | | | | | | | | | | |
| | 3F Foyer | | | | A.I. | | | | | | | | Posters | | | |
| 3D | ZUIYO | | | | | | | | | | | | 3D Display Image | 3D Display & Acquisition | 3D Display Performance (1) | 3D Display Performance (2) |
| | 3F Foyer | | | | | | | | | | | | | | | A.I. |
| | TENGYOKU | | | | | | | | | | | | | | | |
| VHF | KAIHO | | | | | | | *Color (1) | Color (2) | Video System & Image Quality | | | | | | |
| | ZUIYO | Moving Image Quality | Dynamic Range & Gray Scale Expression | Display Human Factors | | | | | | | | | | | | |
| | 3F Foyer | | | | A.I. | | | | | | | | Posters | | | |
| LAD | TENYO | | | | | Digital Cinema & Signage | Pico Projectors | Laser Projector & Its Components | Speckle Reduction Technologies | Projection Components | | | | | | |
| | 3F Foyer | | | | | | | | | | | | | | | |
| | TENGYOKU | Electrophoretic Displays | Particles Moving Displays | LC Type Electronic Paper & Others | | | | | | | | | | Driving Methods for Electronic Paper | | |
| EP | TENJU | | | | | Electrowetting & Electrochromic Displays | | | | | | | | | | |
| | 3F Foyer | | | | A.I. | | | | | | | | | | | A.I. |
| | TENGYOKU | | | | | | | | | | | | | | | |
| MEMS | ZUIYO | | | | | Emerging Technologies | Displays & Imaging | Fundamental Components Process Technologies 1 | Fundamental Components Process Technologies 2 | Optical MEMS & Device Technologies | | | | | | |
| | 3F Foyer | | | | | | | | | | | | | | | A.I. |
| | KAIHO | Beyond the Standards | Backlight Control | Advanced Display Systems | | | | *Color (1) | | | | | | | | |
| DES | 3F Foyer | | | | A.I. | | | | | | | | | | | |
| | TENZUI | | | | | Flexible LC Technology | Flexible Electronic Paper | Materials & Components for Flexible Displays | Flexible Active-Matrix Devices | Flexible OLED | | | | | | |
| | 3F Foyer | | | | | | | | | | | | | | | A.I. |
| INP | TENRRAN | | | | | | | | | | | | Imaging Devices & Systems | Touch Panel (1) | Touch Panel (2) | |
| | 3F Foyer | | | | | | | | | | | | | | | 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
 LAD: Workshop on Projection & Large-Area Displays & Their Components
 EP: Workshop on Electronic Paper
 MEMS: Workshop on MEMS for Future Displays & Related Electron Divices
 DES: Workshop on Display Electronic Systems
 FLX: Topical Session on Flexible Displays
 INP: Topical Session on Input Technologies

A.I.: Author Interviews
 *: Joint Session

IDW '09 Timetable

| Date | 2F Lobby | 4F SUMMIT HALL | | | | 3F MID ROOM | | 3F Foyer | 4F Foyer | | |
|--|-----------------------------|---|---------------------|--------------------------|----------------------|---------------------------|-------------------------------------|----------------------|-------------------------------------|---------------------------|---|
| | | TENZUI | TENRAN | TENGYOKU | TENJU | TENYO | KAIHO | | | ZUIYO | |
| Tue. Dec. 8 | Registration 17:00-20:00 | Evening Get-Together at FOUNTAIN Room (2F) 18:00-20:00 | | | | | | | | | |
| Wednesday, December 9 | Registration 8:00-18:00 | Opening, Keynote Address 9:30-11:00 | | | | | | | | | |
| | | Break | | | | | | | | | |
| | | Invited Address 11:10-12:10 | | | | | | | | | |
| | | Lunch | | | | | | | | LCTp, PHp 13:20-16:20 | Exhibition 12:00-18:00 |
| | | AMD1 13:20-14:45 | | EP1 13:20-14:40 | FMC1 13:20-14:55 | OLED1 13:20-14:40 | DES1 13:15-14:40 | VHF1 13:20-14:40 | | | |
| | | Break | | | | | | | | | |
| | | AMD2 15:00-16:15 | | EP2 15:00-16:20 | FMC2 15:00-16:20 | OLED2 15:00-16:20 | DES2 15:00-16:15 | VHF2 15:00-16:30 | | | |
| | | Break | | | | | | | | | |
| | | | LCT1 16:40-18:00 | EP3 16:40-18:00 | FMC3 16:40-18:00 | OLED3/AMD3 16:40-17:40 | DES3 16:40-17:50 | VHF3 16:40-18:00 | | | |
| | | | | | | | | | Author Interviews 18:00-19:00 | | |
| Break | | | | | | | | | | | |
| Banquet at TENZUI Room (4F) 19:30-21:30 | | | | | | | | | | | |
| Thursday, December 10 | Registration 8:00-18:00 | FLX1 9:00-10:35 | | AMD4/OLED4 9:00-10:10 | EP4 9:00-10:05 | LAD1 9:00-10:20 | PH1 9:00-10:25 | MEMS1 9:00-10:15 | FMCp, VHFp, DESp 9:00-12:00 | Exhibition 10:00-18:00 | |
| | | Break | | | | | | | | | |
| | | FLX2 10:40-11:50 | LCT2 10:40-12:15 | AMD5 10:40-12:10 | OLED5 10:40-11:35 | LAD2 10:40-12:15 | PH2 10:40-12:10 | MEMS2 10:40-11:45 | | | |
| | | Lunch | | | | | | | | | PDPp, OLEDp, 3Dp, EPp 13:20-16:20 |
| | | FLX3 13:20-14:55 | LCT3 13:20-14:50 | AMD6 13:20-14:45 | PH3 13:20-14:40 | LAD3 13:20-14:30 | VHF4/DES4 13:20-15:00 | MEMS3 13:20-14:50 | | | |
| | | Break | | | | | | | | | |
| | | FLX4 15:00-16:20 | LCT4 15:00-16:30 | FMC4 15:00-16:20 | PH4 15:00-16:10 | LAD4 15:00-16:20 | VHF5 15:10-16:40 | MEMS4 15:10-16:35 | | | |
| | | Break | | | | | | | | | |
| | | FLX5 16:40-17:40 | LCT5 16:40-18:05 | FMC5 16:40-18:00 | PDP1 16:40-18:00 | LAD5 16:40-18:00 | VHF6 16:50-18:15 | MEMS5 16:50-18:00 | | | |
| | | | | | | | | | Author Interviews 18:00-19:00 | | |
| Friday, December 11 | Registration 8:00-13:00 | LCT6 9:00-10:20 | INP1 9:00-10:25 | EP5 9:00-10:25 | FMC6 9:00-10:20 | PDP2 9:00-10:20 | FED1 9:00-10:20 | 3D1 9:00-10:25 | AMDp, LADp 9:00-12:00 | Exhibition 10:00-14:00 | |
| | | Break | | | | | | | | | |
| | | LCT7 10:40-12:05 | INP2 10:40-12:20 | | FMC7 10:40-12:20 | PDP3 10:40-12:00 | FED2/PH5 10:40-11:50 | 3D2 10:40-12:00 | | | |
| | | Lunch | | | | | | | | | |
| | | LCT8 13:20-14:00 | INP3 13:20-14:40 | AMD7 13:15-14:40 | FMC8 13:20-14:55 | PDP4 13:20-14:40 | FED3 13:20-14:40 | 3D3 13:20-14:40 | | | |
| | | Break | | | | | | | | | |
| | | AMD8 14:50-16:20 | FMC9 15:00-16:20 | PDP5 15:00-16:20 | FED4 15:00-16:00 | 3D4 15:00-16:20 | | | | | |
| | | | | | | | Author Interviews 16:20-17:20 | | | | |

**IDW '09 Secretariat:
c/o Bilingual Group Ltd.
3-3-6 Kudan Minami, Chiyoda-ku
Tokyo 102-0074, Japan**

**IDW '09
FINAL PROGRAM**