

DAILY PROGRAM

Thursday
September 21

2017

IDMC'17

International Display Manufacturing Conference

Taipei World Trade Center Nangang Exhibition Hall, Taiwan, September 20-22, 2017

國際顯示製程前瞻技術研討會

DAILY PROGRAM

Thursday, September 21

09:00-10:30

Room 504a

Session 1: 3D Display and AR/VR Technology (I)

Chairs: Hoang-Yan Lin, National Taiwan University, Taiwan
 Tongsheng Mou, Zhejiang University, China

Thu-S01-01 (Invited)**Display Metrology: Challenge from Real Image to Virtual Image**

Tongsheng Mou, Zhejiang University (*China*)

The VR display provides an immersive 3D visual experience. The image is only visible in a given space "eye-box," so the evaluation requires an optical measurement device that simulates the human eye. We introduce the international standardization background and proposes a measurement method for evaluation of VR display's imaging performance.

Thu-S01-02**Cyber Sickness Assessment Using EEG for Virtual Reality**

Yi Tien Lin, National Chiao Tung University (*Taiwan*)

Cyber sickness is one of the most important problems of virtual reality (VR). This study investigated the electroencephalography (EEG) signals change when users suffered from the cyber sickness. According to the results, we found that a higher degree of cyber sickness feeling accompanied with increasing amplitude of high-frequency EEG signals.

Thu-S01-03**Enhancing Resolution of Light Field Image by 2D/3D Switchable Hybrid Display**

Chun-Ping Wang, Hsin-Hsueh Lee, Jui-Yi Wu, Po-Yuan Hsieh, Yi-Pai Huang, National Chiao Tung University (*Taiwan*)

Hybrid display was proposed to avoid accommodation - convergence conflict and compensate the resolution of light field image. With the function of TN cell and LC MLA, hybrid display could switch the LF image and full resolution 2D image in flicker-free rate.

Thu-S01-04**A 3D Interaction Technique Based on Gesture Recognition**

Chao Ping Chen, Keyu Wang, Hao Fu, Yang Li and Bing Yu, Shanghai Jiao Tong University (*China*)

In this paper, we propose a three-dimensional (3D) interaction technique based on the hand gesture recognition. Our experimental results show that the support vector machine (SVM) outperforms the k-nearest neighbors (k-NN) in terms of accuracy. The accuracies of SVM are 90.9% and 72.6% in the simple and complex backgrounds, respectively.

09:00-10:30

Room 504b

Session 2: Transparent Display

Chairs: Jia-Chong Ho, Industrial Technology Research Institute, Taiwan
 Zong Qin, National Chiao Tung University, Taiwan

Thu-S02-01 (Invited)**WiseChip's PMOLED Provide You Better Design and Life by Transparent OLED**

Chien-Le Li, WiseChip Semiconductor Inc. (*Taiwan*)

OLED was believed to be the next generation of display and OLED specific application is T-OLED which is called see-through OLED. In the past 2 years, WSI studied the transparent OLED and started to push our new product on to the markets. We would like to introduce you our HUD head-up-display which has clearly 180° fully viewing angles and no more color distortion, clearly visible under sunlight or at night. Transparent PMOLED HUD not only makes it easier and closer to you but also simplifies the overall designs of devices. More important, it is capable of providing better information. WISECHIP expects to expand its product on flexible and transparent and OLED lighting to be its driving force in the future.

Thu-S02-02**Light Coupling Transparent Polymer Network LCD**

Syuan Ling Yang, Jui-Ping Yu, Yi Wen Chang and Min Hsuan Chiu, AU Optronics Corporation (*Taiwan*)

We developed the first full color transparent display with polymer network liquid crystal display. The novel light coupling design is achieved the true local image switch of transparent LCD. The first active matrix 15.6" light coupling PNLC transparent display prototype's transparency is 12% with conventional pixel design and without polarizer.

Thu-S02-03**The New Transparent Display Technology Using by Dye-Doped Liquid Crystal**

Shao-Huai Wu, Chien-Hua Chen and Jan-Tian Lian, Chunghwa Picture Tubes, LTD. (*Taiwan*)

In this paper, we have succeeded to develop a 6.9-in transparent display by using dye-doped LC technology which can display monochromatic image. At the same time, transparent display can have advantages high transmittance without polarizer. Finally, the transparent display by using dye-doped LC technology has good visibility and transparency.

Thu-S02-04**High Image Quality of Transparent Display with the Proprietary Scattering Liquid Crystal**

Shin-Yi Cheng, Chien-Hua Chen and Jan-Tian Lian, Chunghwa Picture Tubes, LTD. (*Taiwan*)

In this paper, we demonstrate a novel concept of transparent display with the proprietary scattering LC technology. RGBW transparent display employed Matlab algorithms to enhance the image quality of the panel. The result of 6.1 inch RGBW transparent display shows outstanding performance with high transmittance of 16% and colorful images.

Thu-S02-05**Far Field Scattering Simulation of Random Two and Four Domain Polarization Grating Using FDTD**Zhibo Sun, The Hong Kong University of Science and Technology (*Hong Kong*)

With the help of FDTD, we simulate two and four domain random grating used for transparent display and get the optimal domain size, respectively. Also, we use sweep function in FDTD to find the best optical path difference (OPD) is half-wavelength which means retardation is π .

09:00-10:30**Room 504c****Session 3: Display Components and Materials**

Chairs: Chiyi-Ming Leu, Industrial Technology Research Institute, Taiwan
Geoffrey Wu, BenQ Materials Corporation, Taiwan

Thu-S03-01 (Invited)**Liquid Crystal Coating Type Wide Band Quarter Wave Film (WBQWF) of the Ultra-Thin Circular Polarizer for Flexible OLED Panel**Da-Ren Chiou, Imat Corporation (*Taiwan*)

Liquid crystal coating type Wide Band Quarter Wave Film (WBQWF) of the ultra-thin circular polarizer for flexible OLED panel was successfully developed. We reduced the total thickness of the circular polarizer to the scale of 60 μm . This ultra-thin circular polarizer passed the bending and folding test of IEC 62715-6-1.

Thu-S03-02**Photo-Induced Microscale Semiconductor Nanorods Patterns**Wanlong Zhang¹, Julian Schneider¹, Abhishek Srivastava¹, Andrey Rogach², Vladimir Chigrinov¹ and Hoi-Sing Kwok¹

- 1) The Hong Kong University of Science and Technology (*Hong Kong*)
- 2) City University of Hong Kong (*Hong Kong*)

In this paper, we present microscale semiconductor nanorods' patterns, which highlights the precise control of photo-induced alignment technology. Fluorescence microscope images show the dependence of polarized emission and emission under exposure to linearly polarized blue light, giving potential for future display photonic applications.

Thu-S03-03**Photoluminescence and Lifetime of CdTe Colloidal Quantum Dot Embedded in Sodium Chloride**Chung Ping Yu, Yu-Ming Huang, Li-Ann Ke, Shun-Chieh Hsu, Yin-Han Chen, Teng-Ming Chen, Hao-Chung Kuo and Chien-Chung Lin, National Chiao Tung University (*Taiwan*)

Colloidal quantum dots (CQD) are embedded in ionic crystal (sodium chloride) by recrystallization method. Inorganic salts NaCl is the protective layer of QD to avoid the effects of ambient temperature and humidity in order to maintain high luminous efficiency and the characteristics.

Thu-S03-04**Silver Nanowire Composite Film via Transferring and Alkanethiolate Decorating for Stability Improvement**

Yuwang Xu, Guishi Liu and Ming Weng, Sun Yat-sen University (*China*)

In this work, silver nanowire composite film for stability improvement was proposed via a transferring process and alkanethiolate decoration. The conductivity remained almost unchanged under high temperature and high humidity durability test for months. A flexible projected capacitive touch panel was successfully demonstrated using this method.

Thu-S03-05**Advanced Photo Spacer Material for High Resolution Display Applications**

Jia-Hong Ye, Ching-Liang Huang, Kuo-Yu Huang and Chia-Tien Peng, AU Optronics Corporation (*Taiwan*)

We developed a new process of photo spacer material especially for utilizing high resolution display applications. The developed spacer shows steep slope (base angle $\sim 80^\circ$) and top Critical-Dimension 4.5 μ m. In this work, we also use this new technique to show a high resolution prototype display.

11:00-12:30	Room 504a
Session 4:	3D Display and AR/VR Technology (II)
Chairs:	Yu-Cheng Fan, National Taipei University of Technology, Taiwan Yi-Pai Huang, National Chiao Tung University, Taiwan

Thu-S04-01 (Invited)**Research of Hologram Printing Technology Aiming at Practical Applications**

Yasuyuki Ichihashi, National Institute of Information and Communications Technology / Applied Electromagnetic Research Institute (*Japan*)

Wavefront printing technology realizes not only a three-dimensional picture with deep perspective but also a particular kind of optical element that it is called holographic optical element. I present wavefront printing technology in NICT and introduce studies on some applications with the use of this technology.

Thu-S04-02**A Calibrating Method for Projected-Type Auto-Stereoscopic 3D Display System with DDHOE**

Ping-Yen Chou¹, Ryutaro Oi², Koki Wakunami², Kenji Yamamoto², Yasuyuki Ichihashi², Makoto Okui², Jackin Boaz Jessie³ and Yi-Pai Huang¹

- 1) National Chiao Tung University (*Taiwan*)
- 2) National Institute of Information and Communications Technology (*Japan*)
- 3) National Institute of Information and Communications Technology (*India*)

A new calibrating method for binocular auto-stereoscopic display system, which using holographic optical element (HOE) to diffract projected light to observer, was proposed. In this method, the auto-scanning, auto-capturing, and image process were used to figure out the left eye, right eye, and non-workable regions in HOE.

Thu-S04-03**A 3D Floating Display System Design with Flat-Form Optical Films**

Zih-Sin Yu, Yi-Pai Huang and Han-Ping Shieh, National Chiao Tung University (*Taiwan*)

A 3D floating display system, with steady platform structure, which provides horizontal parallax images to multiple viewers is designed. In the system, 360 degree viewing angle floating images are available. The images will differ in longitudinal direction as observer moving.

Thu-S04-04**Light Field Technology Apply on Near to Eye Display**

Kuei-En Peng, Yu-Ching Cheng, Jui-Yi Wu and Yi-Pai Huang, National Chiao Tung University (*Taiwan*)

Light field near-eye display developed to achieve thin, lightweight head-mounted display and to solve the problem of accommodation-convergence conflict was demonstrated for more comfortable immersive experience.

11:00-12:30**Room 504b****Session 5: Printed Display and Electronics (I)**

Chairs: Zheng Cui, Suzhou Institute of Nanotech, China
Paul Yang, Sun Yat-Sen University, Taiwan

Thu-S05-01 (Invited)**Printing-Based Stretchable Hybrid Electronic System**

Yongtaek Hong, Seoul National University (*South Korea*)

Enabling technology for printing-based stretchable hybrid electronic system is presented, which includes strain-engineered stretchable substrate, inkjet-printed wrinkled silver interconnects with printed cross-over dielectric, stable direct chip bonding, and modulus-gradient conductive core-shell structured via. Stretchable hybrid electronic system showed highly stable operation under 15~20% tensile strain.

Thu-S05-02 (Invited)**Upgrade the Manufacturing Technology for Photonic and Biomedical Industry by Microfluidic Technology**

An-Bang Wang, National Taiwan University (*Taiwan*)

There is constant need to improve the competition ability in industry. To significantly reduce material cost and operation time, a brief review on the upgrading manufacturing technology in future photonic (e.g., printed electronics) and biomedical applications by modern microfluidic technology will be given and discussed.

Thu-S05-03 (Invited)**Current Status of Quantum-Dot Display: Photoluminescence and Electroluminescence**

Xiaogang Peng, Zhejiang University (*China*)

Quantum dots as fluorophores have been accepted in back-lighting units of liquid-crystal-displays recently, and quantum-dot light-emitting-diodes are advanced rapidly to potentially alter the roadmap for display industry. This talk shall concentrate on recent advancements of the field along these two directions.

Thu-S05-04

Solution-Processed and Flexible UV Detector Array Fabricated by a UV-assisted Pattern Process with Zinc Oxide and Silver Nanowires

Yu-Cheng Wang, National Sun Yat-sen University (*China*)

In this paper, a flexible all-nanowires ultraviolet detector array was developed by all-solution process. A UV-assisted process was proposed to realize the pattern of both silver nanowires electrode and zinc oxide nanowires channel. The obtained UV detector array showed good performance and flexibility.

11:00-12:30	Room 504c
Session 6:	Measurement, Standard, and Human Factor
Chairs:	Hsueh-Ling Yu, CIE, Taiwan Pei-Li Sun, National Taiwan University of Science and Technology, Taiwan

Thu-S06-01 (Invited)

The Measurement of Optical Properties for Curved Displays

Hsueh-Ling Yu¹, Richard Young², Chin-Chai Hsiao³ and Wen-Chun Liu³

- 1) CIE (*Taiwan*)
- 2) Instrument Systems GmbH (*Germany*)
- 3) Industrial Technology Research Institute (*Taiwan*)

Luminance and ambient contrast ratio (ACR) are two of the most important optical properties of displays. This paper presents the modification of traditional photometry measurement methods to increase the accuracies of image luminance and reflectance measurements for curved displays as ACR is usually calculated from the reflectance of screen.

Thu-S06-02 (Invited)

Motion Picture Response Time Relates to Motion Blur Behavior in the Global Backlight LCD

Chang-Hung Li¹, Su-Hui Lu¹, Tsung-Ying Hsieh², Ko-Shun Wang², Wei-Hung Kuo¹ and Ming-Hsien Lee¹

- 1) AU Optronics Corporation (*Taiwan*)
- 2) iboson Technology Corporation (*Taiwan*)

In this paper, we discussed the MPRT relates to motion blur behavior in the global backlight LCD. The specific equal-intensity band was measured and was explained by the temporal integration model. After optimizing the flash timing of backlight, less than 4 ms of MPRT was measured in our ultra high resolution LCD.

Thu-S06-03**Development of Laser Confocal Microscopy for Internal Defect Measurement**

Chia Liang Yeh, Fu-Shiang Yang, Wei-Hsiung Tsai and Keng-Li Lin, Industrial Technology Research Institute (*Taiwan*)

Organic light-emitting display has flexibly deformable characteristics. However, when the foldable display is repeatedly folded and unfolded, which may cause the film between the metal electrodes and the active layers to delaminate. Accordingly, we have developed a non-destructive measurement that can identify potential defects before ensuring manufacturing steps are applied.

14:00-15:30

Room 504a

Session 7: Intelligent and Green Manufacturing

Chairs: Li-Wei Lin, AU Optronics Corporation, Taiwan
Jean Yang, Innolux Corporation, Taiwan

Thu-S07-01 (Invited)**Green Manufacturing of TFT Cell Photo Alignment Tech.**

Wei Ming Huang, AU Optronics Corporation (*Taiwan*)

Green manufacturing is the target of Science industry. TFT-LCD industry has used rubbing process to align liquid crystal. But the technology has some drawbacks such as rubbing cloth wasted and IPA solvent used. Photo-alignment is the key technology to overcome the drawback of rubbing process to reach Green manufacturing.

Advance Fringe Field Switch is the critical technology of TFT-LCD development. It has wide viewing angle, better color-washout performance and also improves the low light efficiency of IPS mode. But the technology needs better anchoring force between alignment film and liquid crystal. So we need higher rubbing strength to avoid image sticking. There is some side effect will happen such as ESD, particle and rubbing mura. Due to solve these side effect, we need to control the life-time of rubbing cloth. It will increase the manufacturing costs and against the concept of green manufacturing. We develop the photo-alignment technology instead of rubbing process. Photo-alignment technology use LPUV to irradiate alignment film and the alignment file will have some photo reaction like photo-isomerization, photo-decomposition and photo-dimerization. Although we introduce the photo-alignment technology successfully, we still need to fine-tune the alignment film, LPUV dosage and process recipe to reach better panel performance in the future.

Thu-S07-02 (Invited)**The Practical Green Manufacturing Operations Sharing of AUO**

Hsien Sheng(Steven) Chiu, AU Optronics Corporation (*Taiwan*)

This article is sharing about the important milestones and transformations of AUO green manufacturing management in the past few years. AUO GP has been operated for more than

nine years since 2008, and has achieved excellent results in goal management with the high-level executive concerns and through the effective operation of the GP team. Among them, the systematic management and e-system are necessary infrastructures for large organizations, and those are foundations that drive keeping improvement and accumulation KM to the next steps of AUO GP operation.

Thu-S07-03 (Invited)

Energy - Saving Evaporation Technology for Zero Discharge of Wastewater in TFT-LCD Industry
TaiJui Chiang, AU Optronics Corporation (*Taiwan*)

Due to climate change, long-term water supply tends to be stressed in Taiwan, with likely water shortages between floods and droughts. In 2015, AUO completed Taiwan's first processed water fully recycled plant at its Longtan site. The site's daily water usage is approximately 20,000 tons. The condensed effluents resulting from repeated recycling after wastewater discharge are high in concentration and difficult to manage. Given the goal of 100% zero discharge, wastewater management is an unavoidable issue that the Company must handle. Using reliable and stable technology to process wastewater is an essential core subject. Where current technologies are concerned, the evaporation cycle acquired from nature has proven to be the most effective processing method. The evaporating equipment created based on evaporation theory has been utilized in the petrochemical industry for a long time, as the low-end waste hot air produced in general production processes in the petrochemical industry can be used as the heat source for evaporation. However, in the wastewater system and in the panel industry, the waste heat produced is very little and generating the additional heat required would involve fueling up boilers, thus creating an extra challenge in energy saving. The issue is being examined through preliminary research, technological evaluation, equipment selection, and subsequent construction and installment. All technological applications cover processing efficiency and operational convenience; another significant research topic is the pursuit of energy conservation, carbon reduction, and environmental sustainability, which are the goals of continuously refining zero-discharge process with an advanced evaporating technology.

Thu-S07-04 (Invited)

A Case Study of Material Flow Cost Accounting Application in Panel Factory
Chih Lin Chen, National Cheng Kung University (*Taiwan*)

Take AUO's Fab in the Lungke Science Park for example, Material Flow Cost Accounting (MFCA) was utilized to analyze the raw material usage in the panel manufacturing process and related costs and expenditures to identify the direction for cost saving and green design.

Thu-S07-05 (Invited)

A Practice on Seismic Risk Management for the Process Equipment in High-Tech Industry
Chin-Lian Tsai, Innolux Corporation (*Taiwan*)

Since 2005, the Seismic-resistance Engineering team of INNOLUX CORPORATION has been continuing cooperation with 2 centers and 4 universities to improve Seismic-resistance engineering for producing process equipment. Further, after both Earthquakes occurred on Mar. 04. 2010 and Feb. 06. 2016, the team

conducted the anti-seismic risk management; they prepared guards against next potential earthquakes causing damage.

To decrease loss is to increase competition, the seismic experts and the Seismic-resistance Engineering team will continue working together to study and to solve seismic problems. The technology can also be introduced to factories with the same high-technical process equipment.

14:00-15:30

Room 504b

Session 8: LC Technology (I)

Chairs: Ivan Wu, AU Optronics Corporation, Taiwan
Yu Shih Tsou, Innolux Corporation, Taiwan

Thu-S08-01 (Invited)

Liquid Crystal Displays toward Green and Flexibility

Seung Hee Lee, Chonbuk National University (*South Korea*)

Evolution of liquid crystal displays (LCDs) continues toward low cost, low power consumption, high performance, and flexible displays. This paper discusses on future LCDs with PI-less alignment process, wider color gamut with quantum rod, low frequency driving of FFS mode, and flexible LCDs with optically isotropic LC mixtures.

Thu-S08-02 (Invited)

Innovative LC Material Development at Merck

Ray Chou, Merck Performance Material (*Taiwan*)

LCD has become the mainstream display technology for the last decade while the development of alternative display technologies like OLED and micro-LED never stops. Merck is not only investing the potential future technologies but most importantly also shows full commitment to keep improving LCD performance via innovative LC materials.

Thu-S08-03 (Invited)

High Contrast Ratio of a Homogeneously Aligned LCD by Improving of Light Leakage Ratio

Seok-Lyul Lee, AU Optronics Corporation (*Taiwan*)

We have successfully measured depolarized light leakage intensity in homogeneously aligned LCD panel by using LLR (light leakage ratio) analysis method. The LLR analysis shows dark state is related to pixel design, process and materials. In order to reduce LLR, the photo-alignment process, optimized photo spacer (PS) design and low depolarized materials will be considered.

Thu-S08-04

AgNW Based Flexible PDLC towards Roll-To-Roll Fabrication

Peng Chen, Yuwang Xu and Yadi Zhang, Sun Yat-sen University (*China*)

Flexible PDLC is an important technology for future smart windows. We explored utilizing R2R

process to fabricate PDLC. Also, the composition and process parameters were optimized to achieve high transmittance (92.5%) at 80V, where the flexible AgNW transparent film has low sheet resistance (10.8 Ω /sq.) and high transmittance (86%).

Thu-S08-05

Wall Spacer Induced by Capillary Force and Its Application of Flexible Liquid Crystal Display

Jingshen Qiu, Weixing Zhang and Guishi Liu, Sun Yat-sen University (*China*)

Cell gap maintenance is essential for flexible LCD. New methods like post spacer and polymer wall involve complex process. Here, spacer is simply constructed by capillary-force-driving UV mixture into an elastomer mold and following UV irradiation. Flexible LC cells based on this method have comparative performance to the rigid cells.

14:00-15:30

Room 504C

Session 9: Color EPD & Flexible TFT/LCD

Chairs: Poyuan Lo, E ink Holding, Taiwan
Chu-Yu Liu, AU Optronics Corporation, Taiwan

Thu-S09-01 (Invited)

The Present and Future of Color Electrophoretic Displays

Michael McCreary, E-Ink Holdings (*USA*)

Full color, paper-like electrophoretic displays have been demonstrated utilizing only color particles, no CFA, and a single TFT backplane. For many applications, these low power, daylight readable displays have large advantages over emissive OLED and backlit LED color displays. Black and White Electrophoretic Displays (EPD) have become the display of choice for electronic readers and other applications requiring daylight readability, ultra-long battery life, and a paper-like look. Now, multiple color EPD platforms have been commercialized that are finding increased acceptance in a variety of applications from architecture to art. After years of research, advanced Color ePaper displays (ACeP) have now also been demonstrated that are capable of a broad, full color gamut utilizing only color particles and a single TFT backplane. Such displays show promise for signage and many more full color applications.

Thu-S09-02 (Invited)

Materials Design and Process Engineering for Flexible TFT Backplane Technologies

Antonio Facchetti, Flexterra Inc. (*USA*)

Here, we will report the design and realization of unconventional TFT materials for solution-processed/flexible backplane technologies. Our materials span organic and hybrid organic-inorganic semiconductors, polymeric dielectric and passive, and charge injection layers. The best semiconductor-dielectric material combination enables TFT carrier mobilities surpassing that of amorphous silicon in a FAB line.

Thu-S09-03 (Invited)

A Flexible Plastic AM-LCD with Extensible Light Guide Plate

Yi-hsiang Lai, AU Optronics Corporation (*Taiwan*)

A silicone-based light guide plate (LGP) was successfully fabricated to overcome the bending moment during bending situation. The bending radius of flexible plastic liquid crystal display (LCD) with extensible LGP could be between flat to 20mm.

Thu-S09-04**Fabrication of Multi-Color E-Paper by Transfer Method**

Li Wang, Shao-Zhi Deng and Bo-Ru Yang, Sun Yat-sen University (*China*)

A colorful electrophoretic display (EPD) is still absent in consumer market despite several attempts by applying color filters and multi-particle system. Here, we propose a transfer printing method to realize the multi-color EPD by deploying color microcapsules into subpixels which is simpler and still have high contrast and saturation.

Thu-S09-05**A Reliable 300oC EMMO IGZO TFT Technology on Flexible Substrate**

Sarah Bebiche, Sisi Wang, Hoi-Sing Kwok and Man Wong, The Hong Kong University of Science and Technology (*Hong Kong*)

EMMO IGZO TFTs have been fabricated on 20- μm thick polyimide flexible substrates. The TFTs exhibited good stability against both electrical and mechanical stress, the latter in the form of repeated bending to a radius of 0.75 mm.