



ADVANCE PROGRAM

2020 VIRTUAL DISPLAY WEEK INTERNATIONAL SYMPOSIUM

August 3-7, 2020 (Monday – Friday)

Session 1: Annual SID Business Meeting

Session 2: Opening Remarks / Keynote Addresses

- 2.1: **Keynote Address 1:** Robert Wisnieff, IBM T.J. Watson Research Center
- 2.2: **Keynote Address 2:** David Luebke, NVIDIA Corp.
- 2.3: **Keynote Address 3:** Michael Heckmeier, Merck KGaA
- 2.4: **Keynote Address 4:** Frank Ko, AU Optronics Corp.

Session 3: 8K, High Resolution LCDs (*Liquid Crystal Technology*)

Chair: Miyoshi Ayama, Utsunomiya University

Co-Chair: Philip Chen, National Chiao Tung University

- 3.1: **Invited Paper:** Super Bright 8K LCD with 10,000 nit has been Realized with Excellent Light-Resistance Characteristics of IGZO TFT Backplane
Jun Nishimura, Sharp Corp. Display Device Company, Kameyama, Japan
- 3.2: **Invited Paper:** A Wide Color Gamut LCD with a Polarized Laser Backlight
Shinichi Komura, Japan Display Inc., Mobarra, Japan
- 3.3: **Novel Microstructure Film to Improve Viewing Angle of Multi-Domain Polymer Sustained Alignment LCD**
Kun-Cheng Tien, AU Optronics, Hsinchu, Taiwan Roc
- 3.4: **Novel LCD Pixel Design with Extra Large Aperture Ratio for PsVA Mode Display**
Surigalatu Borjigin, Shenzhen China Star Optoelectronics Semiconductor Display Technology Co.Ltd., Shenzhen, China
- 3.5: **Late-News Paper:** Two-Dimensionally Aligned Array with 1µm Pixel Pitch Using Ferroelectric Liquid Crystal Pixels for Holography Application
Shintaro Aso, Japan Broadcasting Corporation, Tokyo, Japan

Session 4: Automotive Display Components (*Automotive/Vehicular Displays and HMI Technologies*)

Chair: David Hermann, Volvo Car Corporation AB

Co-Chair: Karlheinz Blankenbach, Pforzheim University

- 4.1: **Invited Paper:** Technical Cover Glass Designed for Automotive Infotainment Display
Casey Kang, Corning Incorporated, Corning, NY US
- 4.2: **Anti-Glare Cover Glass Optical Properties Dependence on the Display Module Configuration**
Masanobu Isshiki, AGC Inc., Yokohama, Japan
- 4.3: **Late-News Paper:** OLED Device Technologies for Automotive Application
Shigeru Mori, Tianma Japan, Ltd., Kawasaki, Japan
- 4.4: **Increase of Contrast in 3D HUD Using an Active Parallax Barrier**
Akinori Sato, KYOCERA Corporation, Shiga, Japan

Session 5: AR/VR Invited Session (*Augmented, Virtual and Mixed Reality / Display Systems*)

Chair: Achin Bhowmik, Starkey Hearing Technologies

Co-Chair: Seung Woo Lee, Kyung Hee University

- 5.1: **Invited Paper:** Human Factors in Virtual and Augmented Reality
Martin Banks, University of California Berkeley, Berkeley, CA US
- 5.2: **Invited Paper:** Computational Eyeglasses and Near-eye Displays with Focus Cues
Gordon Wetzstein, Stanford University, Stanford, CA US
- 5.3: **Invited Paper:** Towards Cost-Effective AR/MR Displays Mass Production: The Emergence of an Industrial Hardware Ecosystem for Waveguide Combiners and Micro iLED Displays
Bernard Kress, Microsoft, Redwood City, CA US
- 5.4: **Invited Paper:** Current Challenges in Augmented-Reality Waveguide Display Technology
Jonathan Waldern, DigiLens Inc., Sunnyvale, CA US

Session 6: OLED Materials I (*OLEDs*)

Chair: Denis Kondakov, DuPont

Co-Chair: Sven Zimmermann, Novaled GmbH

- 6.1: **Invited Paper:** Lifetime Improvement of TADF-OLEDs
Jun-Yun Kim, LG Display, Seoul, South Korea
- 6.2: **Invited Paper:** Innovative Technological Progress of Lifetime in Hyperfluorescence

- Junji Adachi, Kyulux Inc., Fukuoka, Japan*
- 6.3: **Efficient and Long Lifetime Blue TADF and Deep Blue Hyper Fluorescent Materials and Devices**
Jang-Hyuk Kwon, Kyung Hee University, Seoul, South Korea
- 6.4: **Late-News Paper: Realizing Deep Blue Emission in Blue Phosphorescent Organic Light-Emitting Diodes**
Jinwon Sun, Samsung Display, Co., Ltd., Yongin, South Korea

Session 7: Reliability (Active Matrix Devices)

Chair: *Hsing-Hung Hsieh, HP International Pte. Ltd.*

Co-Chair: *Xiaojun Guo, Shanghai Jiao Tong University*

- 7.1: **Distinguished Paper: Alleviation of Abnormal NBTI Phenomenon in LTPS TFTs on Polyimide Substrate for Flexible AMOLED**
Jaeseob Lee, Samsung Display Co., Ltd., Yongin, South Korea
- 7.2: **Invited Paper: Hot Carrier Degradation in High Mobility Metal Oxide Thin Film Transistors**
Yukiharu Uraoka, Nara Institute of Science and Technology, Ikoma, Japan
- 7.3: **High ESD Robustness and Low Visible Light Reflectance Design for LTPS-TFTs on Glass Substrates in Modular Micro-LED Displays**
Seongho Son, Samsung Electronics Co., Ltd., Suwon, South Korea
- 7.4: **Late-News Paper: Development of High-Mobility Top-Gate IGZTO-TFT and Suppression of Threshold Voltage Shift in Short Channel Utilizing Laser Irradiation Process**
Mitsuru Nakata, NHK Science & Technology Research Laboratories, Tokyo, Japan

Session 8: Advances in Lighting: OLEDs, Materials, and Manufacturing (Lighting)

Chair: *Eric Margulies, Universal Display Corporation*

Co-Chair: *J. Norman Bardsley, Bardsley Consulting*

- 8.1: **Invited Paper: Development of High-Temperature Stable Red OLEDs for Automotive Lighting**
Marina Kondakova, OLEDWorks LLC, Rochester, NY US
- 8.2: **Invited Paper: High Refractive Index Material for Display and Lighting Applications**
Selina Monickam, Pixelligent Technologies, LLC, Baltimore, MD US
- 8.3: **Invited Paper: OLED Lighting Design and Roll-to-Roll Manufacturing**
Christian May, Fraunhofer-Institute for Organic Electronics, Dresden, Germany
- 8.4: **Invited Paper: Flexible Glass Substrate for OLED Lighting Application and Efficient Internal Light Extraction for OLED Lighting Devices**
Dipak Chowdhury, Corning Technology Center Korea, Seoul, South Korea

Session 9: MicroLED Manufacturing (Display Manufacturing)

Chair: *Ion Bitu, Google LLC*

Co-Chair: *Bradley Bowden, Corning Research and Development Corporation*

- 9.1: **Invited Paper: Colloidal Lead Halide Perovskite Nanocrystals as Classical and Quantum Light Sources**
Maksym Kovalenko, ETH Zurich and Empa, Zurich, Switzerland
- 9.2: **Manufacturing Process for Mass-Production of Micro LED Displays**
Koichi Kajiyama, V-Technology Co., Ltd, Yokohama, Japan
- 9.3: **Advanced Process and Structure of Backplane for Micro LED Display**
Hua-Fei Xie, Peking University, Shenzhen, China
- 9.4: **Applying FPD Panel and Manufacturing Technologies to Alternative Applications and New Business Models**
Charles Annis, IHS Markit, Tokyo, Japan
- 9.5: **Late-News Paper: A 3.9-inch LTPS TFT Full Color MicroLED Display with Novel Driving and Reflector Cavity Process**
Masaya Tamaki, Kyocera Corporation, Shiga, Japan

Session 10: HDR LCDs I (Liquid Crystal Technology / Display Systems / High-Dynamic-Range LCDs)

Chair: *Brian Berkeley, Highlight Display LLC*

Co-Chair: *Shin-Tson Wu, University of Central Florida*

- 10.1: **Invited Paper: High Dynamic Range Mini-LED and Dual-Cell LCDs**
Shin-Tson Wu, University of Central Florida, Orlando, FL US
- 10.2: **Invited Paper: Development of Dual-Cell LCD with Mega Contrast**
Lei Guo, Hefei Xinsheng Optoelectronics Technology Co., Ltd., Hefei, China
- 10.3: **Invited Paper: Active Matrix Mini-LED Backlight on Glass for 75-inch LCDs**
Jiayang Fei, TCL China Star Optoelectronics Technology Co., Ltd., Shenzhen, China
- 10.4: **Invited Paper: A High Dynamic Range Monitor: Apple Pro Display XDR**
Mingxia (Vincent) Gu, Apple Inc., Cupertino, CA US

Session 11: Automotive Display Technologies and Systems (Automotive/Vehicular Displays and HMI Technologies)

Chair: *Casey Kang, Corning Incorporated*

Co-Chair: *Rashmi Rao, Harman International*

- 11.1: **High Reliability Flexible AMOLED Display with Algorithm Compensation for Automotive Application**
Youxiong Feng, BOE Technology Group Co., Ltd., Chengdu, China

- 11.2: **Late-News Paper:** Display/Projection Features: The Next Growth Driver for Automotive Lighting
Pars Mukish, Yole Développement, Villeurbanne, France
- 11.3: **Distinguished Paper:** Advanced Methods for Safe Visualization on Automotive Displays
Benjamin Axmann, Daimler AG Group Research, Boeblingen, Germany
- 11.4: **Invited Paper:** Virtual prototyping and testing of automotive capacitive touch sensors
George Bouzianas, Fieldscale PC, Thessaloniki, Greece

Session 12: OLED AR/VR (Augmented, Virtual and Mixed Reality / OLEDs)

Chair: Qi Wang, eMagin Corporation

Co-Chair: Franky So, North Carolina State University

- 12.1: **Invited Paper:** Directional SPP Emission in OLEDs Using Diffractive Optical Elements
Xiangyu Fu, North Carolina State University, Raleigh, NC US
- 12.2: **High Performance OLED Microdisplays Made with Multi-Stack OLED Formulations**
John Hamer, OLEDWorks LLC, Rochester, NY US
- 12.3: **Organic Light-Emitting Diode Microdisplay with a 32:9 Aspect Ratio for Wide Field of View**
Hyunkoo Lee, Electronics and Telecommunications Research Institute, Daejeon, South Korea
- 12.4: **1000PPI LTPS OLED Display for VR Application**
Ziyang Yu, Chengdu BOE Optoelectronics Technology Co., Ltd., Chengdu, China

Session 13: OLED Materials II (OLEDs)

Chair: Hitoshi Kuma, Idemitsu Kosan Co., Ltd.

Co-Chair: Nicholas Thompson, Universal Display Corporation

- 13.1: **Invited Paper:** The Impact of Spontaneous Orientation Polarization on the Maximum Efficiency and Stability of Organic Light-Emitting Devices
Russell Holmes, University of Minnesota, Minneapolis, MN US
- 13.2: **Late-News Paper:** How to Reduce Harmful Blue Light on OLED Device
Jinsook Bang, Samsung Display Corporation, Youngin, South Korea
- 13.3: **Improvement of Blue Pixels in OLED Panels with More Efficient Fluorescent and TADF Emitters**
Thomas Baumann, cynora GmbH, Bruchsal, Germany
- 13.4: **Late-News Paper:** Effect of Molecular Structure of Host Materials on Thermal Stability and Device Characteristics of Solution Processed OLEDs
Min Chul Suh, Kyung Hee University, Seoul, South Korea

Session 14: Image Sensors (Active Matrix Devices)

Chair: Sang Hee Park, KAIST

Co-Chair: Tse Nga Tina Ng, University of California San Diego

- 14.1: **Flexible Large-Area Multi-Fingerprint Sensors Based on Thermal Mass Detection**
Florian De Roose, imec, Leuven, Belgium
- 14.2: **Invited Paper:** OLED Display Incorporating an Organic Image Sensor
Yasuhiro Niikura, Semiconductor Energy Laboratory Co., Ltd., Kanagawa, Japan
- 14.3: **Flexible Image Sensor Array Using IGZO TFT Backplane Technology for X-Ray Detector**
Rikiya Takita, Sharp Corporation, Taki, Japan
- 14.4: **Late-News Paper:** Large-Area Optical Fingerprint Sensors for Next Generation Smartphones
Noémie Ballot, Isorg, Limoges, France

Session 15: Advanced TFT Manufacturing (Display Manufacturing)

Chair: Dr. Chiwoo Kim, APS Holdings

Co-Chair: Greg Gibson, nTact

- 15.1: **Invited Paper:** Manufacturing Technology of LTPO TFT
Ui-Jin Chung, LG Display Co., Ltd., Paju, South Korea
- 15.2: **Gen 10 Excimer Laser Annealing System**
Takahiro Fuji, The Japan Steel Works, Ltd., Yokohama, Japan
- 15.3: **Resistance Reduction of Molybdenum Metallization by Tungsten Seed Layer**
Harald Köstenbauer, Plansee SE, Reutte, Austria
- 15.4: **New Gen. 6 Exposure Tools for 1.2 μ m Resolution**
Nobuhiko Yabu, Canon Inc., Utsunomiya, Japan

Session 16: MicroLED Color Conversion (Emissive, Micro-LED, and Quantum-Dot Displays)

Chair: Seth Coe-Sullivan, Luminit, LLC

Co-Chair: Ioannis Kymissis, Columbia University

- 16.1: **Invited Paper:** Hybrid Full-Color MicroLED Display with Quantum-Dot Color Conversion Using Inkjet-Printing and Photolithography Methods
Yang Gu, X-Vision Lab, Visionox Technology Inc., Kunshan, China
- 16.2: **A 4-inch Full Color Active-matrix Mini-LED Display Based on 0408 Chip and 500um Pixel**
Hong Meng, Peking University, Shenzhen, China

- 16.3: **High-End Displays Applications by Micro-LEDs**
Chien-Chung Lin, Industrial Technology Research Institute, Hsinchu, Taiwan Roc
- 16.4: **Late-News Paper: High Color Gamut Mini-LED Backlight Demon Based on Dual-Emissive Perovskite Quantum Dots Films**
Haizheng Zhong, Beijing Institute of Technology, Beijing, China
- 16.5: **Late-News Paper: High Flux Stable Perovskite Quantum Dots-Polymer Composite for Down-Converting Applications**
Lutfan Sinatra, Quantum Solutions LLC, Thuwal, Saudi Arabia

Session 17: HDR LCDs II (Liquid Crystal Technology / Display Systems / High-Dynamic-Range LCDs)

Chair: Jenn Jia Su, AU Optronics Corporation

Co-Chair: Matthew Sousa, 3M

- 17.1: **Invited Paper: An Overview of Solutions for Achieving HDR LCDs**
Jenn Jia Su, AU Optronics Corporation, Hsinchu, Taiwan Roc
- 17.2: **A Method for Improving Image Contrast Based on Dual Cell Display**
Yizhuo Zhao, TCL China Star Optoelectronics Technology Co., Shenzhen, China
- 17.3: **Novel Mini-LED Backlit for 75-inch HDR LCD**
Enhui Guan, BOE Technology Group Co., Ltd., Beijing, China
- 17.4: **Enhancing the Picture Quality of Local Dimming Mini-LED LCD**
Chun-Chi Chen, TCL China Star Optoelectronics Technology Co., Ltd., Shenzhen, China
- 17.5: **Distinguished Paper: Birefringent Light-Shaping Films for Mini-LED Backlights**
Ziqian He, University of Central Florida, Orlando, FL US
- 17.6: **Invited Paper: 4K HDR "Stacked-Panel" TV Based on Dual-Cell LCD**
Weidong Liu, Hisense Visual Technology Co., Ltd, Qingdao, Shandong, China

Session 18: Head-Up Displays (HUD) (Automotive/Vehicular Displays and HMI Technologies)

Chair: Philippe Coni, THALES Avionics

Co-Chair: Haruhiko Okumura, Toshiba Corporation

- 18.1: **Invited Paper: Holographic Optical Elements for Automotive Windshield Displays**
Ian Redmond, Ceres Holographics Ltd, St Andrews, FL United Kingdom
- 18.2: **Improvement of Light Leakage in HUD System**
Kenta Kamoshida, KYOCERA Corporation, Shiga, Japan
- 18.3: **Impact Study of Windshield Geometry on the Subjective Customer Perception for Augmented Reality Head-Up Displays (AR-HUD)**
Daniel Wagner, Mercedes-Benz AG, Sindelfingen, Germany
- 18.4: **Invited Paper: Switchable Lightfield Displays for Automotive Applications**
David Fattal, Leia Inc, Menlo Park, CA US

Session 19: Human Factors with AR/VR (Augmented, Virtual and Mixed Reality / Applied Vision)

Chair: Takashi Shibata, Tokyo University of Social Welfare

Co-Chair: Paolo Sacchetto, Apple, Inc.

- 19.1: **Distinguished Paper: Differences Between Oculomotor and Perceptual Artifacts for Temporally Limited Head-Mounted Displays**
Alexander Goettker, Facebook, Redmond, WA US
- 19.2: **Vergence-Accommodation Conflicts in Augmented Reality: Impacts on Perceived Image Quality**
Ian Erkelens, Facebook, Redmond, WA US
- 19.3: **Foveated Brightness Control Technology for VR Applications**
Seung-Woo Lee, Kyung Hee University, Seoul, South Korea
- 19.4: **Research on Reducing Motion Sickness of Playing First Person Shooting VR Game with Texture Blur**
Ting-Lan Tsai, National Taiwan University of Science and Technology, Taipei City, Taiwan Roc

Session 20: OLED Materials III (OLEDs)

Chair: Jang Hyuk Kwon, Kyung Hee University

Co-Chair: Changwoong Chu, Samsung Display Corporation

- 20.1: **Invited Paper: High-Efficiency Near-Infrared OLEDs with Pure Organic Materials**
Ken-Tsung Wong, National Taiwan University, Taipei, Taiwan Roc
- 20.2: **High Efficiency and Long Device Lifetime Green Organic Light Emitting Diodes Using a Pt Complex**
Sunghun Lee, Samsung Electronics, Suwon, South Korea
- 20.3: **Universal Method to Inject Electrons Into Organic Semiconductors Utilizing Hydrogen Bonds**
Hirohiko Fukagawa, NHK Science & Technology Research Laboratories, Tokyo, Japan
- 20.4: **Study on the Effect of OLED Device Lifetime Improvement According to Hole Injection Barrier and p-Dopants**
Jaechul Hong, Samsung Display Co.,Ltd., Yongin, South Korea

Session 21: Super Resolution and Gen 11 (Active Matrix Devices)

Chair: Dr. Kalluri Sarma, Honeywell, Inc

Co-Chair: Hyun Jae Kim, Yonsei University

- 21.1: **Invited Paper: 5291-ppi Microdisplay Using CAAC-IGZO FET with Channel Length of 60 nm**
Hideaki Shishido, Semiconductor Energy Laboratory Co., Ltd., Atsugi, Japan

- 21.2: **Invited Paper:** 1?m Pixel Pitch Spatial Light Modulator Panel for Digital Holography
Chi-Sun Hwang, ETRI, Daejeon, South Korea
- 21.3: **Invited Paper:** High Quality 8K4K Displays Driven by Oxide Semiconductor Thin Film Transistor in the Generation 11 Equipment
Hyun-Sik Seo, TCL Shenzhen China Star Optoelectronics Technology Co., Ltd., Shenzhen, China

Session 22: Flexible Technologies I: Manufacturing (*Display Manufacturing / Flexible Displays and E-Paper*)

Chair: Yukio Endo, AGC Inc.

Co-Chair: Kyung-Tae Kang, Korea Institute of Industrial Technology

- 22.1: **Formation of Silicon-Based Thin Film Encapsulation for Fabrication of Highly Flexible OLED Devices**
Eun Jung, Samsung Display, Yongin, South Korea
- 22.2: **An Ultra-Thin Flexible Thin Film Encapsulation Structure with High Transmittance and Reliability**
Youwei Wang, BOE Technology Group Co., Ltd., Beijing, China
- 22.3: **5um Thickness of Low-Retardation Plastic Foil with Gas Barrier and Transparent Conductive Layer for Bendable Devices**
Hiroki Kinoshita, LINTEC Corporation, Saitama, Japan
- 22.4: **Development of Rolled Long Ultra-thin Glass and Its Mass Production Technology**
Hiroki Mori, Nippon Electric Glass Co., Ltd., Otsu, Japan
- 22.5: **Late-News Paper: Silicone-Based Low-k Material for Display**
Brandon Swatowski, Dow Chemical, Midland, MI US

Session 23: MicroLED Display Systems (*Emissive, Micro-LED, and Quantum-Dot Displays*)

Chair: Yong-Seog Kim, Hongik University

Co-Chair: Larry Weber, Consultant

- 23.1: **Invited Paper: Invited: Essentials of MicroLED Display Production**
Reza Chaji, VueReal, Waterloo, ON Canada
- 23.2: **Distinguished Paper: Wrap-Around Electrodes for MicroLED Tiled Displays**
David Pastel, Corning Inc., Corning, NY US
- 23.3: **Highly Transparent, Ultra-Thin Flexible, Full Color Mini-LED Display with IGZO TFT Substrate**
Yang Sun, TCL China Star Optoelectronics Technology Co. Ltd., Shenzhen, China
- 23.4: **Full Color, Active-Matrix Micro-LED Display with Dual Gate a-IGZO TFT Backplane**
Jin Jang, Kyung Hee University, Seoul, South Korea
- 23.5: **Late-News Paper: High-Resolution Monolithic Micro-LED Full-Color Micro-Display**
Xu Zhang, Hong Kong University of Science and Technology, Kowloon, Hong Kong

Session 24: LTPO (*Active Matrix Devices*)

Chair: James Chang, Apple, Inc.

Co-Chair: Man Wong, Hong Kong University of Science & Technology

- 24.1: **Invited Paper: Development of High Quality IGZO-TFT with Same On-Current as LTPS**
Kazuatsu Ito, Sharp Corporation, Tenri, Japan
- 24.2: **Distinguished Paper: Fluorination for Enhancing the Resistance of Indium-Gallium-Zinc Oxide Thin-Film Transistor against Hydrogen-Induced Degradation**
Sisi Wang, The Hong Kong University of Science and Technology, Hong Kong, China
- 24.3: **Complementary LTPO Technology, Pixel Circuits and Integrated Gate Drivers for AMOLED Displays Supporting Variable Refresh Rates**
Jiahao Kang, Royole Corporation, Fremont, CA US
- 24.4: **Distinguished Paper: High Refresh Rate and Low Power Consumption AMOLED Panel Using Top-gate n-Oxide and p-LTPS TFTs**
Ryo Yonebayashi, Sharp Corporation, Tenri, Japan

Session 25: Innovative Display Driving Circuits (*Display Electronics*)

Chair: Ya Hsiang Tai, National Chiao Tung University

Co-Chair: Soo-Yeon Lee, Seoul National University

- 25.1: **Multi-Bit MIP(Memory-in-Pixel)-Based Pixel Circuit of CMOS Backplane for Micro-LED Display**
Jewoo Seong, Ulsan National Institute of Science and Technology (UNIST), Ulsan, UNK South Korea
- 25.2: **LTPO TFT Technology for Level Shifter Integrated Gate Driver in UHD 4K Displays**
Jin Jang, Kyung Hee University, Seoul, South Korea
- 25.3: **Fault-Tolerant Integrated Gate Driver for Flexible Displays**
Seung-Woo Lee, Kyung Hee University, Seoul, South Korea

Session 26: Novel Waveguides for AR Glasses (*Augmented, Virtual and Mixed Reality / Display Systems*)

Chair: Nikhil Balram, Google Inc.

Co-Chair: Brian Schowengerdt, Magic Leap

- 26.1: **Distinguished Paper: Chirped Polarization Volume Grating for Wide FOV and High Efficiency Waveguide-Based AR Displays**
Kun Yin, University of Central Florida, Orlando, FL US
- 26.2: **Invited Paper: A Holographic Waveguide Display with Polarization Volume Gratings**

- Yuning Zhang, Southeast University, Nanjing, China*
- 26.3: **Tolerancing Capabilities of Crossed Gratings Versus Linear Gratings**
Alexandra Crai, WaveOptics Ltd., Abingdon, United Kingdom
- 26.4: **Late-News Paper: Super-Light Smart Glasses Using a Thin Plastic Light Guide Plate**
Shigenobu Hirano, Ricoh Company, Ltd., Ebina, Japan

Session 27: Printed OLEDs I (OLEDs)

Chair: *Changwoong Chu, Samsung Display Corporation*

Co-Chair: *Yasunori Kijima, Huawei Technologies Japan K.K.*

- 27.1: **Invited Paper: Latest Development of Soluble OLED Material for Printed Display.**
Daisuke Fukushima, Sumitomo Chemical Co., Ltd., Tsukuba, Japan
- 27.2: **Invited Paper: Soluble Small Molecules in Top Emission OLED Devices from Ink Jet Printing: Requirements and Performance Status**
Sebastian Meyer, Merck KGaA, Darmstadt, Germany
- 27.3: **Improved Device Performance for Inkjet Printed OLEDs via Interfacial Mixing Control**
Heung Gyu Kim, Samsung Display Co., Ltd., Yongin, South Korea
- 27.4: **Late-News Paper: Key Materials for High Performance Solution-Process OLEDs**
Koichiro Iida, Mitsubishi Chemical Corporation, Yokohama, Japan

Session 28: Seeing Through the Display (Interactive Displays and Systems)

Chair: *Steven Bathiche, Microsoft*

Co-Chair: *Jeff Han, Consultant*

- 28.1: **Image Capture Through TFT Arrays**
Neil Emerton, Microsoft Applied Sciences, Redmond, WA US
- 28.2: **Study of the Image Blur Through FFS LCD Panel Caused by Diffraction for Camera Under Panel**
Quan Tang, Wuhan China Star Optoelectronics Technology Co., Ltd., Wuhan, China
- 28.3: **Pixel Design for Transparent MicroLED Display with Low Blurring**
Zhengyu Feng, Peking University, Shenzhen, China
- 28.4: **Investigation of Moiré Interference in Pinhole Matrix Fingerprint on Display Technology**
Yang Zeng, Shanghai Tianma Microelectronics, Shanghai, China

Session 29: Flexible/Foldable Device Manufacturing (Display Manufacturing)

Chair: *Tian Xiao, NEXT Biometrics Inc.*

Co-Chair: *Wei Lung Liao, AU Optronics Corp.*

- 29.1: **Invited Paper: Analysis of Dynamic Strain on Foldable Devices**
Naotsugu Ando, Yuasa System, Okayama, Japan
- 29.2: **Invited Paper: Mechanics of Bendable Glass Substrates**
Timothy Gross, Corning Incorporated, Corning, NY US
- 29.3: **WITHDRAWN**
- 29.4: **Edge Strength Measurement of Free-Form Displays**
Bosun Jang, Corning Incorporated, Corning, NY US

Session 30: MicroLED Displays (Emissive, Micro-LED, and Quantum-Dot Displays)

Chair: *Francois Templier, CEA-LETI*

Co-Chair: *Jean-Jacques Drolet, Osram Opto Semiconductors*

- 30.1: **Invited Paper: Development of MicroLED Display by PixeLED Display Technology**
Ying-Tsang Liu, PlayNitride Inc., Zhubei, Taiwan Roc
- 30.2: **WITHDRAWN**
- 30.3: **Distinguished Paper: Sub-Micron Full-Color LED Pixels for Micro-Displays and Micro-LED Main Displays**
Seth Coe-Sullivan, NS Nanotech, Ann Arbor, MI US
- 30.4: **MicroLED Display Technology Trends and Intellectual Property Landscape**
Eric Virey, Yole Developpement, Portland, OR US
- 30.5: **Late-News Paper: Glass Based High Brightness AMLED Using Dual Gate Coplanar a-IGZO TFT**
Jin-Woo Choi, Samsung Display, Yongin, South Korea

Session 31: Structure Engineering (Active Matrix Devices)

Chair: *Norbert Fruehauf, University of Stuttgart*

Co-Chair: *Kwon-Shik Park, LG Display*

- 31.1: **Invited Paper: The Multimodal Thin-Film Transistor (MMT): A Versatile Low-Power and High-Gain Device with Inherent Linear Response**
Radu Sporea, University of Surrey, Guildford, United Kingdom
- 31.2: **Invited Paper: Nanostructures Oxide Thin-Film Transistors Fabricated by Near-Field Nanolithography with Enhanced Device Performance**
Chuan Liu, Sun Yat-sen University, Guangzhou, China

Session 32: Algorithms for Image Quality Improvement (Display Electronics)

Chair: Mainak Biswas, Google

Co-Chair: Moon-Sang Hwang, Samsung Display Co., Ltd.

- 32.1: **Weak Sub-Color Sub-Sampling for High Resolution Image Bandwidth Reduction**
JoonHee Lee, LG Display, Seoul, South Korea
- 32.2: **Improvement in Directional Cubic Convolution Image Interpolation**
Liu-Xiao Lei, Beijing BOE Optoelectronics Technology Corporation, Beijing, China
- 32.3: **AMOLED IR Drop Compensation for Channel Length Modulation**
Feng-Ting Pai, Novatek Microelectronics Corp., Hsinchu, Taiwan Roc
- 32.4: **Late-News Paper: OLED Display Gamma LUT Optimization Based on Principal Component Analysis**
Hyunchul Kim, Google, Inc, Mountain view, CA US

Session 33: 3D and Holographic (Augmented, Virtual and Mixed Reality / Display Systems)

Chair: W. Hendrick, Collins Aerospace

Co-Chair: Zong Qin, National Chiao Tung University

- 33.1: **Invited Paper: Tabletop True 3D Display Systems Based on Projection Light Field and Integral Imaging**
Qiong-Hua Wang, Beihang University, Beijing, China
- 33.2: **Improving Image Quality of 360-Degree Tabletop 3D Screen System**
Motohiro Makiguchi, NTT Service Evolution Laboratories, Kanagawa, Japan
- 33.3: **Viewing Angle Enhanced DMD Holographic Display with Reduced Speckle Noise**
Byounghyo Lee, School of Electrical and Computer Engineering, Seoul National University, Seoul, South Korea

Session 34: Printed OLEDs II (OLEDs)

Chair: CC Lee, BOE Technology Group Co., Ltd.

Co-Chair: JJ Lih, CPT Technology Group

- 34.1: **Invited Paper: Towards Efficient and Stable Printed Single-Layer OLEDs**
Paul Blom, Max Planck Institute for Polymer Research, Mainz, Germany
- 34.2: **Distinguished Paper: Development of 55-inch 8K AMOLED TV by Inkjet Printing Process**
Zhongyuan Wu, BOE Technology Group Co., Ltd., Hefei, China
- 34.3: **OLED Display with High Resolution Fabricated by Electrohydrodynamic Printing**
Lan Mu, South China University of Technology, Guangzhou, China

Session 35: Touch Sensing on Flexible Displays (Interactive Displays and Systems / Flexible Displays and E-Paper)

Chair: Martin Grunthaler, Apple

Co-Chair: Shiming Shi, BOE Technology Group Co., Ltd.

- 35.1: **The Mechanism and Solution of Horizontal Line Defects by Mutual Interference of Flexible OLED and Touch Sensor**
Hyun Wook Cho, Samsung Display, Yongin, South Korea
- 35.2: **Influence of Low Ground Mass and Moisture Touch in On-Cell Touch with Foldable AMOLED**
Shih-Hsuan Huang, AU Optronics Corporation, Hsinchu, Taiwan Roc
- 35.3: **The Application of Metal Mesh Manhattan Patterns in Flexible Touch Panel**
Shuang Wang, Shanghai Tianma Micro-Electronics Co. Ltd., Shanghai, China
- 35.4: **High Sensitive Pen Writing Solution Based on Mechanical Sensing**
Hee Seomoon, Samsung Display, Yongin, South Korea

Session 36: Novel Process for Printed Displays (Display Manufacturing / Printed Displays)

Chair: Toshiaki Arai, JOLED Inc

Co-Chair: Yong Taek Hong, Seoul National University

- 36.1: **Invited Paper: High-Resolution Induced-Electrohydrodynamic (iEHD) Jet Printing for Display**
Doyoung Byun, Sungkyunkwan University, Suwon, South Korea
- 36.2: **Invited Paper: The Latest Breakthrough of Printing Technology for Next Generation Premium TV**
Jueng Gil (James) Lee, Guangdong Juhua Printed Display Technology Co. Ltd., Guangzhou, China
- 36.3: **Novel and Simple Patterning process of Quantum dots via Transfer Printing for Active Matrix QD-LED**
Soo Deok Han, University of Cambridge, Cambridge, United Kingdom
- 36.4: **Solution-Processed Transparent Top Electrode for QD-LED**
Hywel Hopkin, Sharp Laboratories of Europe Ltd., Oxford, United Kingdom

Session 37: MicroLEDs: Manufacturing and Characterization (Emissive, Micro-LED, and Quantum-Dot Displays)

Chair: Ioannis Kymissis, Columbia University

Co-Chair: Zhaojun Liu, Southern University of Science and Technology

- 37.1: **Yield Statistics for Fault Tolerant Micro LED Displays**

- Khaled Ahmed, Intel Corporation, Santa Clara, CA US*
37.2: **Efficient MicroLED Display Manufacturing Necessitates New Functional Production Test Technologies to Replace Traditional LED Parametric Test**
Francois Henley, Tesoro Scientific, Inc., Saratoga, CA US
37.3: **Power Consumption of OLED and μ LED Displays**
En-Lin Hsiang, University of Central Florida, Orlando, FL US
37.4: **Micro LED Defect Analysis via Photoluminescent and Cathodoluminescent Imaging**
Keith Behrman, Columbia University, New York, NY US

Session 38: Circuit and New Application of TFTs (Active Matrix Devices)

Chair: *Takashi Nakamura, Japan Display Inc.*

Co-Chair: *Chen Xi, BOE Technology Group Co., Ltd.*

- 38.1: **Invited Paper: High-Performance Metal-Oxide Semiconductor Based Optoelectronics**
Sung Kyu Park, Chung-Ang University, Seoul, South Korea
38.2: **Magnifying Viewer Using Poly-Si Thin-Film Phototransistor and Liquid-Crystal Microlens Array**
Mutsumi Kimura, Ryukoku University, Otsu, Japan
38.3: **A Novel Gate Driver Circuit Employing IGZO TFTs for External Compensation**
Xuehuan Feng, BOE Technology Group Co., Ltd., Hefei, China
38.4: **AMOLED Display Global Dimming Using PWM on Backgate**
Lynn Verschueren, imec, Leuven, Belgium

Session 39: Advanced Pixel and Driving Circuits (Display Electronics)

Chair: *Richard McCartney, Pixel Scientific, Inc.*

Co-Chair: *Carlin Vieri, Google*

- 39.1: **8K Broadcast Monitor Display System**
Ran Duan, BOE Technology Group Co., Ltd., Beijing, China
39.2: **Distinguished Paper: A 14-Gb/s Dual Mode Receiver with MIPI D-PHY and C-PHY Interfaces for Mobile Display Drivers**
Tae-Jin Kim, Samsung Electronics, Hwaseong, South Korea
39.3: **Distinguished Paper: In-Pixel Temperature Sensor for High-Luminance Active-Matrix Micro-LED Display Using LTPO TFTs**
Jin Jang, Kyung Hee University, Seoul, South Korea
39.4: **A Method of Panel-Current Limitation for Automotive OLED Displays**
Hyun-Chang Kim, Samsung Display Co., Yongin, South Korea

Session 40: Novel Optics for HMDs (Augmented, Virtual and Mixed Reality / Emerging Technologies and Applications)

Chair: *Susan Jones, Nulumina Corp.*

Co-Chair: *Gary Jones, Nanoquantum Corporation*

- 40.1: **Invited Paper: Fast-Switching Liquid Crystal Devices for Near-Eye and Head-Up Displays**
Shin-Tson Wu, University of Central Florida, Orlando, FL US
40.2: **Demonstration of a Novel Single-Layer Double-Pass Optical Architecture for a Pupil-Matched Occlusion-Capable Optical See-Through Head-Mounted Display**
40.3: **Invited Paper: A Large RGB-Achromatic Metalens for Virtual/Augmented Reality Applications**
Federico Capasso, Harvard University, Cambridge, MA US
40.4: **Cost-Efficient Polymer Flat Lens for Chromatic Aberration Correction in Virtual Reality Displays**
Tao Zhan, University of Central Florida, Orlando, FL US
Hong Hua, University of Arizona, Tucson, AZ US
40.5: **Distinguished Paper: A Scanning Waveguide Display with 100° FOV**
Jianghao Xiong, University of Central Florida, Orlando, FL US

Session 41: Printed OLEDs III (OLEDs)

Chair: *DZ Peng, Tianma*

Co-Chair: *Yifan Zhang, Apple, Inc.*

- 41.1: **Invited Paper: Recent Technology of Printed OLED Display and Its World's First Commercialization**
Kazuhiro Noda, JOLED Inc., Kyoto, Japan
41.2: **Invited Paper: Recent Developments in Inkjet-Printed OLEDs for High Resolution, Large Area Applications**
Jin-Goo Kang, Samsung Display Co., Ltd., Yongin, South Korea
41.3: **17.3 Inch UHD Resolution AMOLED Panel Fabricated by Ink Jet Printing Process**
Peng-Yu Chen, AU Optronics Corporation, Hsinchu, Taiwan Roc
41.4: **Preparation of High Performance Top-Emission OLED for Large Size Display**
Chunjing Hu, BOE Technology Group Co., Ltd., Beijing, China

Session 42: Fingerprint Sensing Displays (Interactive Displays and Systems)

Chair: *Patrick Worfolk, Synaptics*

Co-Chair: *Hong-Jye Hong, AU Optronics*

- 42.1: **A Controller IC for On-Display Touch and Multi-Fingerprint Sensor**

- Min Gyu Kim, Samsung Electronics, Hwaseong, South Korea*
42.2: **Establishment and Simulation Optimization of Optical Fingerprint Recognition Structure in LCD Screen**
Jianmou Huang, Xiamen Tianma Microelectronics Co., Ltd., Xiamen, China
42.3 **Late-News Paper: Full-Screen Capacitive Fingerprint Sensor and Touch Sensor**
Toshinori Uehara, Japan Display Inc., Ebina, Japan
42.4: **LTPS TFT-LCD with In-Cell Optical Fingerprint Scanner**
Bozhi Liu, Xiamen Tianma Microelectronics, Xiamen, China
42.5: **Spoof Detection Scheme for Optical Fingerprint Sensors Under Display**
Jin-Woo Kim, Samsung Display Corporation, Yongin, South Korea

Session 43: OLED Analysis and Mechanisms (OLEDs)

Chair: *Nicholas Thompson, Universal Display Corporation*

Co-Chair: *Hitoshi Kuma, Idemitsu Kosan Co., Ltd.*

- 43.1: **Invited Paper: A Quantitative Microscopic Kinetic Model for Efficiency Roll-Off in OLEDs**
Troy Van Voorhis, MIT, Cambridge, MA US
43.2: **Application of Liquid Extraction Surface Analysis (LESA)-NanoESI-Orbitrap-MS to a Degradation Analysis of Organic EL Elements**
Hikaru Takano, Toray Research Center, Inc., Otsu, Japan
43.3: **Ab-Initio Simulation of Doped Injection Layers**
Tobias Neumann, Nanomatch GmbH, Karlsruhe, Germany
43.4: **Combining Steady-State, Frequency, and Time Domain Data for a Comprehensive Analysis of Multilayer TADF OLEDs**
Sandra Jenatsch, Fluxim AG, Winterthur, Switzerland

Session 44: Highly Integrated Semiconductor Information Displays (Emissive, Micro-LED, and Quantum-Dot Displays)

Chair: *Qun Yan, Fuzhou University*

Co-Chair: *Kevin Gahagan, Corning Incorporated*

- 44.1: **Invited Paper: Micro-LEDs for Technological Convergence between Displays, Optical Communications, and Sensing and Imaging Systems**
Martin Dawson, University of Strathclyde, Glasgow, United Kingdom
44.2: **Invited Paper: More Than MicroLED: Mass Transfer of Pixel Engines for Emissive Displays**
John Rogers, Northwestern University, Evanston, IL, US
44.3: **Invited Paper: Integration of Additional Functionalities into the Frontplane of AMOLED Displays**
Pawel Malinowski, imec, Leuven, Belgium
44.4: **A Brief Survey of MicroLED Technologies**
Ioannis Kymissis, Columbia University, New York, NY, US

Session 45: Conformable LCDs (Liquid Crystal Technology)

Chair: *Takahiro Ishinabe, Tohoku University*

Co-Chair: *Linghui Rao, Microsoft*

- 45.1: **Invited Paper: Multi-Spliced LCDs for Foldable Mobile Device - Seamless Technology and Applications**
Yung Hsun Wu, Innolux Corporation, Maili County, Taiwan Roc
45.2: **Distinguished Paper: Ultra-Narrow Border Display with a Cover Glass Using LCDs with a Polyimide Substrate**
Shinichiro Oka, Japan Display Inc., Mobara, Japan
45.3: **Late-News Paper: Homogeneous Alignment LCDs Could be Prime Candidate for Multiple Scene Interactive Interface and Devices**
Ruizhi Yang, BOE Technology Group Co., Ltd., Beijing, China
45.4: **Late-News Paper: Zero Light Leakage ADS Display Technology**
Feifei Wang, BOE Technology Group Co., Ltd., Beijing, China

Session 46: Variable Refresh Rate (Display Electronics)

Chair: *Taesung Kim, Google LLC*

Co-Chair: *Bong-Hyun You, Samsung Display Co.*

- 46.1: **Invited Paper: Variable Refresh Rate Displays**
Gerrit Slavenburg, NVIDIA, Santa Clara, CA US
46.2: **A Novel Hybrid Frame Rate Driving Method for Low Frequency OLED Displays**
Nana Xiong, Tianma Micro-Electronics Co., Ltd., Shanghai, China
46.3: **Invited Paper: Image Adaptive Refresh Rate Technology for Ultra Low Power Consumption**
Bonghyun You, Samsung Display, Yongin, South Korea
46.4: **Novel OLED Low Frame Frequency Driving Method with Minimized Flicker**
Jieliang Li, Xiamen Tianma Microelectronics, Xiamen, China

Session 47: Micro-Projection Technology (Augmented, Virtual and Mixed Reality / Display Systems)

Chair: *Satoshi Ouchi, Hitachi, Ltd*

Co-Chair: *Fujio Okumura, NEC Corporation*

- 47.1: **The World Smallest OLED Microdisplay Projection Device Design Methodology**
Kazuichiro Itonaga, Sony Corporation, Atsugi, Japan
- 47.2: **Solid State Projection Display Based on Angular Color Projection and MicroLED**
Yongjing Wang, Photonic Crystal Co. LTD, San Jose, CA China
- 47.3: **Invited Paper: High Brightness and RGB Integration of Eu-doped GaN-based Red LEDs for Ultrahigh-resolution Micro-LED Display**
Yasufumi Fujiwara, Osaka University, Osaka, Japan
- 47.4: **Fiber Scanning Technology with Rectangle Display Area for Projection Unit**
Shinsuke Onoe, Hitachi, Ltd., Tokyo, Japan

Session 48: OLED Devices I (OLEDs)

Chair: *Yasunori Kijima, Huawei Technologies Japan K.K.*

Co-Chair: *Denis Kondakov, DuPont*

- 48.1: **Invited Paper: Next Generation Highly Efficient and Stable Phosphorescent Emitting Materials For OLEDs**
Byoung ki Choi, Samsung Electronics, Suwon, South Korea
- 48.2: **Design Strategies of Fluorescent Dopants toward Pure Blue for Highly Efficient Top Emission OLEDs**
Ryota Takahashi, Idemitsu Kosan Co., Ltd., Sodegaura, Japan
- 48.3: **Efficiency Color-Shift Tradeoffs in Strong-Cavity, Top-Emitting OLEDs**
S. Matthew Menke, 3M, Saint Paul, MN US
- 48.4: **Toward the Achieving Excellent Longevity of Blue OLED Device: A Computation Study on Importance of the Co-Optimization of Material and Device**
Sangho Jeon, Samsung Display, Yongin, South Korea

Session 49: E-Paper (Flexible Displays and E-paper)

Chair: *Makoto Omodani, Tokai University*

Co-Chair: *Keisuke Hashimoto, E Ink Holdings*

- 49.1: **Fast-Switching Electrophoretic E-Paper with Mixture of Liquid Crystal and E-ink for Charging and Rheological Optimizations**
Bo-Ru Yang, Sun Yat-sen University, Guangzhou, China
- 49.2: **Color Reproduction in Reflective Displays: Stacked CMY**
Alex Henzen, South China Normal University, Guangzhou, China
- 49.3: **Late-News Paper: Hybrid Capacitor Type Organic Electrochromic Device for Multicolor Representation**
Norihisa Kobayashi, Chiba University, Chiba, Japan
- 49.4: **Late-News Paper: Prototyping of Practical e-Tile and Estimation of its Image Impression from Distant Observers**
Makoto Omodani, Tokai University, Hiratsuka, Japan

Session 50: Display Measurement Standards I (Display Measurement)

Chair: *Stephen Atwood, Consultant*

Co-Chair: *Thomas Fiske, Microsoft*

- 50.1: **Invited Paper: Color/White Light Output, Luminance Contours, and Colour Volume**
David LeHoty, Independent, Mountain View, CA US
- 50.2: **Distinguished Paper: Measuring the Color Capability of Modern Display Systems**
Euan Smith, Kaptivo Ltd, Cambridge, United Kingdom
- 50.3: **Electro-Optical Transfer Characteristic, the Undervalued Display Feature**
Michael Becker, Instrument Systems GmbH, München, Germany
- 50.4: **Standardizing Fundamental Criteria for Near Eye Display Optical Measurements: Determining the Eye-Box**
Rupal Varshneya, Night Vision Electronic Sensors Directorate Department of the Army, Fort Belvoir, VA US

Session 51: Quantum Dot Electroluminescence I (Emissive, Micro-LED, and Quantum-Dot Displays)

Chair: *Michele Ricks, EMD Performance Materials*

Co-Chair: *Jean-Jacques Drolet, Osram Opto Semiconductors*

- 51.1: **Invited Paper: Charge Injection Control of Cadmium-Free Quantum Dot Light-Emitting Diodes**
Baek Kim, NanoPhotonica Inc., Gainesville, FL US
- 51.2: **High Efficiency and Long Lifetime InP-Based Red Quantum Dot Light-Emitting Diodes**
Jang-Hyuk Kwon, Kyung Hee University, Seoul, South Korea
- 51.3: **Efficient InP/ZnS Quantum Dot Light-Emitting Diodes with Improved Electron Confinement**
Zhenghui Wu, Southern University of Science and Technology, Shenzhen, China
- 51.4: **QLED-on-Silicon Microdisplays with Peripheral-Circuit-Compensation Design**
Sikai Su, Peking University, Shenzhen, China

Session 52: Fast Switching LCDs (Liquid Crystal Technology)

Chair: *Dr Akihiro Mochizuki, I-CORE Technology, LLC*

Co-Chair: *Prof. Jian Gang Lu, Shanghai Jiao Tong University*

- 52.1: **Invited Paper: Liquid Crystal Materials and Devices for Displays and Photonics**
Vladimir Chigrinov, Foshan University, Foshan, China
- 52.2: **Fast-Response Liquid Crystals for AR and Head-Up Displays**

- Yannanqi Li, University of Central Florida, Orlando, US*
- 52.3: Fast-Response Cloud-Point Ferroelectric Liquid Crystal Dammann Grating for LiDAR Applications**
Zhengen Yuan, The Hong Kong University of Science and Technology, Hong Kong, China
- 52.4: Late-News Paper: 27" 240Hz Wide View ADS Gaming LCM Development Meeting 1.x ms RT and VESA HDR Standard**
Dongchuan Chen, Beijing BOE Display Technology Co., Ltd., Beijing, China

Session 53: Emerging Processes and Materials (Emerging Technologies and Applications)

Chair: *Abhishek Srivastava, Hong Kong University of Science & Technology*

Co-Chair: *Ian Underwood, University of Edinburgh*

- 53.1: 2D and 3D Printed Copper Conductors from Chemically Designed Nanomaterials**
Sunho Jeong, Kyung Hee University, Yongin-si, South Korea
- 53.2: Composite Films with Ultra-Thin Glass and Polymer for Novel Optically-Functional Films**
Takeshi Murashige, Nitto Denko Corporation, Osaka, Japan
- 53.3: CdSe/CdS Nanorod Enhancement Film for Blue-Laser Based Visible Light Communication Systems**
Jerry Cheng, The Hong Kong University of Science and Technology, Hong Kong, Hong Kong
- 53.4: Dielectric Metasurfaces: Design for Manufacturability**
Khaled Ahmed, Intel Corporation, Santa Clara, CA US
- 53.5: Late-News Paper: a-IGZO TFT Based Active Matrix Pressure Sensor by Integrating ZnO Nanowires as Sensing Unit**
Xuwen Shi, Institute of Microelectronics of Chinese Academy of Sciences, Beijing, China

Session 54: AR/VR Technologies (Augmented, Virtual and Mixed Reality / Display Systems)

Chair: *Sergei Yakovenko, Apple*

Co-Chair: *Grace Lee, Google*

- 54.1: Improved Polarizing Film for PBS Applications in HMDs**
David Aastuen, 3M Display Materials & Systems Division, St. Paul, MN US
- 54.2: Distinguished Paper: Doubling the Pixel Density for VR Displays with a Polymer Grating**
Junyu Zou, University of Central Florida, Orlando, FL US
- 54.3: Digitally Switchable Micro-Lens Array for Integral Imaging**
Hong Hua, University of Arizona, Tucson, AZ US
- 54.4: Prediction of Saccadic Eye Movement for Foveated Rendering**
Anna Kruchinina, Lomonosov Moscow State University, Moscow, Russian Fed.
- 54.5: Measuring Direct Retinal Projection Displays**
John Penczek, University of Colorado, Boulder, Boulder, CO US

Session 55: OLED Devices II (OLEDs)

Chair: *Sven Zimmermann, Novald GmbH*

Co-Chair: *Qi Wang, eMagin Corporation*

- 55.1: Invited Paper: Self-Assembled Cathode Patterning in AMOLED for Under-Display Camera**
Zhibin Wang, OTI Lumionics Inc., Toronto, ON Canada
- 55.2: Methods for Overcoming the Trade-Off Between Efficiency and Lifetime of Organic Light-Emitting Diodes: OLED Lifetime Simulation**
Junyoung Lee, Samsung Display Corporation, Yongin, South Korea
- 55.3: Efficient, Low Haze Light Extraction for OLED Displays Using Micro-Optic Patterns Imprinted on Glass**
Dmitri Kuksenkov, Corning Research & Development Corporation, Corning, NY US
- 55.4: Novel Methodology for Reproducibility of OLED Lifetimes and Identification of Killer Impurities**
Hiroshi Fujimoto, Fukuoka i3-Center for Organic Photonics and Electronics Research (i3-opera), Fukuoka, Japan

Session 56: Foldable Displays I (Flexible Displays and E-paper)

Chair: *Kyung Cheol Choi, KAIST*

Co-Chair: *Cheng-Chung Lee, ITRI*

- 56.1: Invited Paper: Research on a Commercial Foldable AMOLED and Relevant Technologies**
Shiming Shi, BOE Technology Group Co., Ltd., Beijing, China
- 56.2: A Foldable AMOLED Module with Excellent Bending Capability and Pencil Hardness after Low Temperature Testing**
Takehiro Mura, Sharp Corporation, Kameyama, Japan
- 56.3: Quantitative Evaluation of Neutral-plane Splitting for Foldable Displays**
Masumi Nishimura, Japan Display, Inc., Mobara, Japan
- 56.4: Suppression of Angular Color Shift for Foldable OLEDs by Integrating an Advanced Circular Polarizer**
Wei-Feng Xu, BenQ Materials Corporation, Taoyuan, Taiwan Roc

Session 57: Display Measurement Standards II (Display Measurement)

Chair: *Udo Krueger, TechnoTeam*

Co-Chair: *Frank Rochow, Adviser*

- 57.1: Spatiotemporal Noise Targets Inspired by Natural Imagery Statistics**
Timo Kunkel, Dolby Labs, Inc., San Francisco, US
- 57.2: A New Approach to Motion Frequency Metrics Quantifies Motion-Induced Blur**

- Dale Stolzka, Samsung Electronics, Co., Ltd., San Jose, CA US
- 57.3: **Characterizing Image Retention for HDR OLED Displays**
Kevin Kam, Columbia University, New York, NY US
- 57.4: **Simulation of Line-Based MTF Measurements for Pixelated Displays**
Kenichiro Masaoka, NHK Science & Technology Research Laboratories, Tokyo, Japan

Session 58: Quantum Dot Electroluminescence II (Emissive, Micro-LED, and Quantum-Dot Displays)

Chair: Chang Hee Lee, Samsung Display Corporation

Co-Chair: Xiao Wei Sun, Southern University of Science and Technology

- 58.1: **Invited Paper: Progress in High Efficiency Heavy Metal Free QD-LED Development**
Christian Ippen, Nanosys, Inc., Milpitas, CA US
- 58.2: **Distinguished Paper: Active Matrix QD-LED with Top Emission Structure by UV Lithography for RGB Patterning**
Yohei Nakanishi, SHARP Corporation, Tenri, Japan
- 58.3: **Distinguished Paper: High Efficient Quantum Dot Light Emitting Diodes with Blue Cadmium-Free Quantum Dots**
Tatsuya Ryowa, Sharp Corporation, Tenri, Japan
- 58.4: **Efficient Cadmium-Free Quantum Dot Light-Emitting Diodes**
Mo Hinwai, Fukuoka i3-Center for Organic Photonics and Electronics Research (i3-opera), Fukuoka, Japan

Session 59: Privacy and Sunviewable Displays (Liquid Crystal Technology)

Chair: Xiao-Yang Huang, Ebulent Technologies Corp

Co-Chair: Gang Xu, Huawei

- 59.1: **FFS-Based Privacy LCD With High Contrast and Transmittance**
Koji Murata, SHARP, Nara, Japan
- 59.2: **Brightness Improvement of Reflective LCD**
Xinli Ma, Beijing BOE Display Technology Co., Ltd., Beijing, China
- 59.3: **A Transflective 31.5" IGZO-TFT LCD with Twisted VA Mode**
Takahiro Sasaki, SHARP, Tenri, Japan
- 59.4: **Late-News Paper: High Transmittance and High Charging Rate 8K 120Hz ADS LCD TV**
He He Hu, BOE Technology Group Co., Ltd., Beijing, AL China

Session 60: Machine Learning for Display Algorithms and Electronics (Machine Learning for Displays / Display Electronics)

Chair: Chaohao Wang, Apple Inc.

Co-Chair: Hyongsik Nam, Kyung Hee University

- 60.1: **Novel Image Sticking Prevention Method Using Deep Learning**
Youngwook Yoo, Samsung Display, Youngin, South Korea
- 60.2: **Self-Supervised Perceptual Motion Deblurring Using a Conditional Generative Neural Network Guided by Optical Flow**
Jaihyun Koh, Samsung Display Corporation, Yongin, South Korea
- 60.3: **Invited Paper: Machine Learning Approaches to Active Stylus for Capacitive Touch-Screen Panel Applications**
Hyongsik Nam, Kyung Hee University, Seoul, South Korea
- 60.4: **Implementation and Optimization of FSRCNN-s Algorithm Based on SDSoC Platform**
Yanan Ji, TCL China Star Optoelectronics Technology Co. Ltd., Guangdong, China

Session 61: High-Resolution OLED Display Manufacturing (Augmented, Virtual and Mixed Reality / Display Manufacturing)

Chair: Dr Robert Visser, Applied Materials

Co-Chair: Joerg Winkler, Plansee SE

- 61.1: **A New Fine Metal Mask Pixel Patterning Technology for High Resolution OLED Displays**
Chiwoo Kim, APS Holdings, Hwaseong, South Korea
- 61.2: **2-inch, 2000 ppi Silicon Nitride Mask for Patterning Ultrahigh-Resolution OLED Displays**
Yibin Jiang, Hong Kong University of Science and Technology, Kowloon, Hong Kong
- 61.3: **Distinguished Paper: Vertically Integrated, Double-Stack Oxide-TFT Layers for High Resolution AMOLED Backplane**
Jin Jang, Kyung Hee University, Seoul, South Korea
- 61.4: **Invited Paper: Development of the OLED Mass Production System (2:30 PM - 2:50 PM)**
Eiichi Matsumoto, Canon Tokki Corporation, Mitsuke Japan

Session 62: OLED Devices III (OLEDs)

Chair: Chang-Wook Han, LG Display Co., Ltd

Co-Chair: Jang Hyuk Kwon, Kyung Hee University

- 62.1: **Invited Paper: Understanding Degradation Processes of Organic Light-Emitting Devices**
Youngmin You, Ewha Womans University, Seoul, South Korea
- 62.2: **Deep-Red and Near-Infrared OLEDs with High Efficiency and Long Lifetime for Display and Light-Source Applications**
Satoshi Seo, Semiconductor Energy Laboratory Co., Ltd., Atsugi, Japan
- 62.3: **Design of High-Performance Tandem Blue Devices for Quantum Dot OLED Display**

- Linlin Wang, Hefei BOE Joint Technology Co., Ltd., Beijing, China
62.4: **Ultrathin Cu-Ag Anode for High Light Outcoupling Efficiency by Eliminating Waveguide Mode in OLED**
Yong-Bum Park, University of Michigan, Ann Arbor, MI US

Session 63: Foldable Displays II (Flexible Displays and E-paper)

Chair: Kyung Cheol Choi, KAIST

Co-Chair: Meng-Ting Lee, Huawei Technology

- 63.1: **Numerical Study on Module Stacking Design of Flexible Panel with Water-Drop Folding Shape**
Liming Dong, BOE Technology Group Co., Ltd., Beijing, China
63.2: **Continuous Observation of Neutral-Plane Splitting throughout the Folding Process of Foldable Displays Using Optical Microscopy and Digital Image Correlation Method**
Masatomo Hishinuma, Japan Display, Inc., Mobarra, Japan
63.3: **Translating 2 Point Bend with Step Stress Methodology**
Kurt Gerber, Corning Incorporated, Corning, NY US

Session 64: Flexible Technologies II: Measurement (Display Measurement)

Chair: Makoto Omodani, Tokai University

Co-Chair: Stephen Atwood, Consultant

- 64.1: **Separating Specular Reflection from Diffuse Haze for ePaper Using the Extended Variable Aperture Source Method**
Dirk Hertel, E Ink Corporation, Billerica, MA US
64.2: **Metrology of Non-Planar Light Sources Using Near-Field Goniometric Measurement Method**
K Kalantar, Global Optical Solutions, Tokyo, Japan
64.3: **Simulation of Beam Shaping by Micro-Textures for Curved Displays**
Urs Aeberhard, Fluxim AG, Winterthur, Switzerland

Session 65: Quantum Dot Electroluminescence III (Emissive, Micro-LED, and Quantum-Dot Displays)

Chair: Dr. Jonathan Steckel, ST Microelectronics

Co-Chair: Yajie Dong, University of Central Florida

- 65.1: **Invited Paper: Enhanced Efficiency of InP-Based Red and Green Quantum Dot Light-Emitting Diodes**
Yanzhao Li, BOE Technology Group Co., Ltd., Beijing, China
65.2: **High Luminescent Red Quantum Dot Light-Emitting Diodes by Inkjet Printing**
Xiao Wei Sun, Southern University of Science and Technology, Shenzhen, China
65.3: **Green Top-Emission Quantum Dot Light-Emitting Diodes (TE-QLED) with Normal and Inverted Structure**
Jiun-Haw Lee, National Taiwan University, Taipei, Taiwan Roc
65.4: **Control of Carrier Injection and Transport Behavior in QLEDs via Modulating the Schottky Barrier**
Yong-Seog Kim, Hongik University, Seoul, South Korea

Session 66: Self-Aligned LCDs (Liquid Crystal Technology)

Chair: Michael Wittek, Merck KGaA

Co-Chair: Shui Chih Lien, CSOT

- 66.1: **Invited Paper: Liquid Crystal Mixture with a Composition Including Highly Reliable Fluorinated Diluter and RM-Monomer for PSVA and PI-less IPS LCDs**
Toshihiro Shibata, Chiracol Co.LTD, Saitama, Japan
66.2: **Invited Paper: Reactive Mesogen Multi-Twist Retarders for Advanced AR/VR Displays**
Michael Escuti, ImagineOptix Corporation, Durham, NC US
66.3: **The Way To Improve Black Circle Mura in Curved Display by Polyimide-Less Technology**
Wei Cui, Peking University, Shenzhen, China
66.4: **Reactive Monomers Optimized for Fast Response Liquid Crystals with High Reliability**
Mei Chen, TCL China Star Optoelectronics Technology Co., Ltd., Shenzhen, China
66.5: **Late-News Paper: Fast Response Texture Free Polymer Stabilized Vertically Aligned Liquid Crystal Displays**
Yong-Woon Lim, Samsung Display, Asan, South Korea

Session 67: Emerging Applications with Machine Learning (Machine Learning for Displays / Emerging Technologies and Applications)

Chair: K Käläntär, Global Optical Solutions

Co-Chair: Fang-Cheng Lin, Apple Inc

- 67.1: **Distinguished Paper: Efficient Multi-Quality Super-Resolution Using a Deep Convolutional Neural Network for an FPGA Implementation**
Min Beom Kim, LG Display Co., Ltd., Seoul, South Korea
67.2: **Lightweight Tone-Mapped HDRNET with Exposure Stack Generation**
Sukju Kang, Sogang University, Seoul, South Korea
67.3: **ColorNet: A Neural Network-Based System for Consistent Display of Brand Colors for Video**
Erica Walker, Clemson University, Clemson, SC US
67.4: **Visual Simultaneous Localization and Mapping with Deep Neural Network Based Loop Detection for Augmented Reality**
Chao Ping Chen, Shanghai Jiao Tong University, Shanghai, China

Session 68: Light Field 3D (Display Systems)

Chair: Shinichi Uehara, AGC Inc.

Co-Chair: K Kälantär, Global Optical Solutions

- 68.1: **Investigation on Defocusing-Induced Accommodation Shift in Microlens Array-Based Near-Eye Light Field Displays**
Zong Qin, Sun Yat-Sen University, Guangzhou, China
- 68.2: **View-Dependent Light-Field Display that Supports Accommodation Using a Commercially-Available High Pixel Density LCD Panel**
Ronald Azuma, Intel Labs, Santa Clara, CA US
- 68.3: **A Super-Multiview Display with Horizontal and Vertical Parallax by Time Division and Color Multiplexing**
Yuta Watanabe, University of Tsukuba, Tsukuba, Japan
- 68.4: **Late-News Paper: 3D/2D Partially Convertible Integral Imaging Display Using Geometric Phase Lens Array**
Hayato Watanabe, NHK (Japan Broadcasting Corporation), Tokyo, Japan

Session 69: OLED Devices IV (OLEDs)

Chair: Franky So, North Carolina State University

Co-Chair: Chihaya Adachi, Kyushu University

- 69.1: **Invited Paper: Trap-Dependent Electrical Properties of Organic Semiconductor Devices**
Jaesang Lee, Seoul National University, Seoul, South Korea
- 69.2: **Transparent Conductive Hybrid Cathode Structure for Top-Emitting Organic Light-Emitting Devices**
Wei Quan, Hefei BOE Joint Technology Co., Ltd., Beijing, China
- 69.3: **Examination of Degradation Analysis of p-i-n Type OLEDs Device**
Daichi Shirakura, Toray Research Center, Inc., Otsu, Shiga, Japan
- 69.4: **Late-News Paper: High Transparency Adhesive Encapsulation Film for OLED Device**
Satoru Ohashi, Ajinomoto Fine-Techno Co., Inc., Kawasaki, Japan

Session 70: Flexible Technologies III (Flexible Displays and E-paper)

Chair: Yong Taek Hong, Seoul National University

Co-Chair: Simon Kang, Apple

- 70.1: **Invited Paper: Advances in the Development of Flexible AMOLED Display**
Ze Yuan, Royole Corporation, Fremont, CA US
- 70.2: **Invited Paper: Low Temperature Process and Material Development for Flexible/Stretchable Transparent Conductor**
Seung Hwan Ko, Seoul National University, Seoul, South Korea
- 70.3: **Distinguished Paper: Flexible OLED Display with 620 Degree Celsius LTPS TFT and Touch Sensor Manufactured by Weak Bonding Method**
Tsung-Ying Ke, AU Optronics Corp., Hsinchu, Taiwan Roc
- 70.4: **Distinguished Paper: Flexible OLED-based Photonic Skin for Attachable Phototherapeutics**
Kyung Cheol Choi, Korea Advanced Institute of Science and technology (KAIST), Daejeon, South Korea

Session 71: Spatial Uniformity (Display Measurement)

Chair: Thomas Fiske, Microsoft

Co-Chair: Frank Rochow, Adviser

- 71.1: **Fractional Pixel Method for Improved Pixel-Level Measurement and Correction (Demura) of High-Resolution Displays**
Douglas Kreysar, Radiant Vision Systems LLC, Redmond, WA US
- 71.2: **Subpixel Non-Uniformity Correction for Displays**
Xiaofan Feng, Jingce Electronic (USA), Camas, WA US
- 71.3: **Meeting Optical Testing Challenges of High-Resolution μ LED-Displays**
Martin Wolf, Instrument Systems GmbH, Munich, Germany
- 71.4: **Imaging Luminance Measuring Devices (ILMDs) – Characterization and Standardization with Respect to Display Measurements**
Udo Krüger, TechnoTeam Bildverarbeitung GmbH, Ilmenau, Germany

Session 72: Quantum Dot Electroluminescence IV (Emissive, Micro-LED, and Quantum-Dot Displays)

Chair: Kevin Gahagan, Corning Incorporated

Co-Chair: Yanzhao Li, BOE Technology Group Co., Ltd.

- 72.1: **Invited Paper: Realizing Long Lifetime Blue Quantum Dots Light Emitting Diodes (QLEDs) through Quantum Dot Structure Tailoring**
Longjia Wu, TCL Corporate Research, Shenzhen, China
- 72.2: **Highly Efficient Cadmium-Free Quantum Dot Light-Emitting Diodes Employing Top-Emitting Architecture**
Myoungjin Park, Samsung Display Co., Ltd., Yongin, South Korea
- 72.3: **Influence of Mobility Effect on Top-Emission Red Quantum Dot Light Emitting Diode with Weak-Cavity Structure**
Ming-Yi Lin, National United University, Miaoli, Taiwan Roc
- 72.4: **Spectrum Narrowing and Efficiency Enhancement of Quantum Dot Light-Emitting Diodes by Microcavity**
Xiao Wei Sun, Southern University of Science and Technology, Shenzhen, China

Session 73: Displays and Health (*Applied Vision / Lighting*)

Chair: Chien-Yu Chen, National Taiwan University of Science & Technology

Co-Chair: Marina Kondakova, OLEDWorks

- 73.1: **Invited Paper:** Pediatric Device Use: Implications for Myopia Development
Elise Harb, UC Berkeley School of Optometry, Berkeley, CA US
- 73.2: **Invited Paper:** Effects of Displays on Myopia and Possible Countermeasures Based on Epidemiology in Japan
Takushi Kawamorita, Kitasato University, Sagamihara, Japan
- 73.3: **Invited Paper:** Influences of Circadian Illuminances from Lighting and TV on the Human Locomotor Activity, Sleep Disorder, EEG, HRV, and Melatonin Secretion
Dae Hwan Kim, Kookmin University, Seoul, South Korea
- 73.4: **Invited Paper:** Are Displays Giving Us the Blues?
John Bullough, Rensselaer Polytechnic Institute, Troy, NY US

Session 74: Seeing Through the Display Image Reconstruction Techniques (*Machine Learning for Displays / Interactive Displays and Systems*)

Chair: Steven Bathiche, Microsoft

Co-Chair: Jeff Han, Consultant

- 74.1: **Image Restoration for Display-Integrated Camera**
Sehoon Lim, Microsoft Applied Sciences, Redmond, WA US
- 74.2: **Diffracted Image Retrieving with Deep Learning**
Seungin Baek, Samsung Display, Yongin, South Korea
- 74.3: **WITHDRAWN**

Session 75: Display Systems and Backlights (*Display Systems*)

Chair: Jean-Pierre Guillou, Apple, Inc.

Co-Chair: Masaru Suzuki, Kriya Materials

- 75.1: **Invited Paper:** Digital Signage: Advances, Requirements, and Solutions
Michael Schmid, Ströer SE & Co. KGaA, Köln, Germany
- 75.2: **Design Criteria in the Development of Anti-Glare Surfaces**
Brett Sitter, 3M, Saint Paul, MN US
- 75.3: **Highly Collimated Backlight for Liquid Crystal Displays**
Brecht Berteloot, Ghent University, Ghent, Belgium
- 75.4: **All-Glass Light Guide Plate with Tapered Lenticular Lens Array by Mask and Etch**
Shenping Li, Corning Research & Development Corporation, Corning, NY US

Session 76: OLED Displays I (*OLEDs*)

Chair: Yifan Zhang, Apple, Inc.

Co-Chair: DZ Peng, Tlanma

- 76.1: **Invited Paper:** Electroforming Fine Metal Mask for High Resolution OLED Displays
Xialing Chen, Changzhou U.G.Oled Technology Co., Ltd., Changzhou, China
- 76.2: **Distinguished Paper:** A High Image Quality OLED Display with Motion Blur Reduction for Ultra-High Resolution and Premium TVs
Hong-Jae Shin, LG Display, Paju, South Korea
- 76.3: **Ultra High Efficiency OLED Display by 3D Pixel Configuration**
Robert Visser, Applied Materials, Santa Clara, CA US
- 76.4: **Late-News Paper:** Aromatic Hydrocarbon Macrocycles for Highly Efficient Organic Light-Emitting Devices with Simple-Layer Architectures
Tomoo Izumi, Konica Minolta, Inc., Hachioji, Japan

Session 77: Free Form Displays I (*Flexible Displays and E-paper*)

Chair: Jennifer Lin, AU Optonics

Co-Chair: Hajime Yamaguchi, Japan Display Inc.

- 77.1: **Design of Stretchable AMOLED Display with Transitional Area**
Qian Yang, BOE Technology Group Co., Ltd., Beijing, China
- 77.2: **Stretchability Improvement of stretchable OLED by Rotation Plate Structure and Pillar Array Substrate**
Young Hyun Son, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea
- 77.3: **Wearable Organic Light-Emitting Diode Displays – From Fibers to Textiles**
Sung-Min Lee, Kookmin University, Seoul, South Korea
- 77.4: **High Efficiency Flexible Fiber-Based Light-Emitting Devices Processed by Phosphorescent Solution**
Kyung Cheol Choi, Korea Advanced Institute of Science and technology (KAIST), Daejeon, South Korea

Session 78: Novel Display Applications (*Emerging Technologies and Applications*)

Chair: Gary Jones, Nanoquantum Corporation

Co-Chair: Vincent Gu, Apple, Inc.

- 78.1: **Invited Paper:** Application of OLED Area Light in Textiles: Approaches, Challenges, Limitations and Perspectives
Jan Hesse, Fraunhofer FEP, Dresden, Germany
- 78.2: **Using Physical Books as Interfaces to Digital Displays**
Georgios Bairaktaris, University of Surrey, Guildford, United Kingdom
- 78.3: **Distinguished Paper:** Vein Detection with Near-infrared Organic Photodetectors for Biometric Authentication
Daniel Tordera, TNO / Holst Centre, Eindhoven, Netherlands
- 78.4: **IGZO-Based Identification Tags Communicating with Everyday Touchscreens**
Nikolaos Papadopoulos, imec, Leuven, Belgium

Session 79: Quantum Dot Color Conversion I (Emissive, Micro-LED, and Quantum-Dot Displays)

Chair: John Van Derlofske, 3M

Co-Chair: Seth Coe-Sullivan, Luminit, LLC

- 79.1: **Invited Paper:** A New Generation of QD Diffusion Plate Technology for TV
Honglei Ji, TCL Electronics Holdings Limited, Shenzhen, China
- 79.2: **Ambient Light Excitation in Quantum Dot-Converted Micro-LED Displays**
Fangwang Gou, University of Central Florida, Orlando, FL US
- 79.3: **Invited Paper:** The Past, the Present and the Future of Perovskite QDs
Norman Lüchinger, Avantama AG, Stafa, Switzerland
- 79.4: **Theoretical Prediction of Changes in Spectra of InP- and InGaP-Based Quantum Dots and Comparison with Experimental Measurement of InP-Based Quantum Dots**
Seungin Baek, Samsung Display, Yongin, South Korea
- 79.5: **Late-News Paper:** Bright and Narrow Green Emitting InP-based Quantum Dots for Wide Color Gamut Displays
Eunjoon Jang, Samsung Electronics, Suwon, South Korea

Session 80: Color Perception (Applied Vision)

Chair: Youngshin Kwak, Ulsan National Institute of Science and Technology

Co-Chair: Youn Jin Kim, Xiaomi Corporation

- 80.1: **OLED Gamut Mapping Method to Generate Exact Standard Color Results**
Jongwoong Park, Samsung Display Co., Ltd., Yongin, South Korea
- 80.2: **Spatiochromatic Model for Image Quality Prediction of High Dynamic Range and Wide Color Gamut Content**
Robert Wanat, Dolby Laboratories, Inc, Sunnyvale, CA US
- 80.3: **Immanent Dichromaticity in Trichromatic Observer: 2nd Coordinate in MDS Analyses of R-G Neutral- and Y-B Only Changed-Stimuli Reflects Chromatic Saliency**
Shoko Hira, Kagoshima University, Kagoshima, Japan
- 80.4: **Human Visual System Uses Just a Few Transfer Functions Depending on Various Environments to Realize Normalized Visual Percept: Investigation Using Real Photographic Images**
Sakuichi Ohtsuka, Kagoshima University, Kagoshima, Japan
- 80.5: **An Experimental Study of the Effect of Subpixel Arrangements on Subjective Spatial Resolution**
Midori Tanaka, Chiba University, Chiba, Japan

Session 81: Machine Learning for Manufacturing and Calibration (Machine Learning for Displays / Display Manufacturing / Display Measurement)

Chair: Dr. Andriy Romanyuk, Glas Troesch AG

Co-Chair: Stephen Atwood, Consultant

- 81.1: **Invited Paper:** Data Augmentation for Applying Deep Learning to Display Manufacturing Defect Detection
Wei Xiong, Samsung Electronics, Co., Ltd., San Jose, CA US
- 81.2: **Invited Paper:** Neural Network Based Quantitative Evaluation of Display Non-Uniformity Corresponds Well with Human Visual Evaluation
Yusuke Bamba, EIZO Corporation, Hakusan, Japan
- 81.3: **Display Graylevel Gamma Tuning Algorithm and System Implementation**
Gang Xu, Jingee Electronic (USA) Inc., San Jose, CA US
- 81.4: **Array Defect Detection and Repair Based on Deep Learning**
Kai Guo, BOE Technology Group Co., Ltd., Beijing, China
- 81.5: **Image Quality Prediction System in Display Fabrication Process**
Yongwoo Lee, Samsung Display, Yongin, South Korea

Session 82: Projectors and Light Sources (Display Systems)

Chair: David Eccles, Collins Aerospace

Co-Chair: Hidekazu Hatanaka, Ushio Inc.

- 82.1: **Invited Paper:** Latest Status of Blue and Green Laser Diodes and Laser Packages for Display Applications
Eiichiro Okahisa, Nichia Corporation, Tokushima, Japan
- 82.2: **Invited Paper:** Latest Progress of Laser Phosphor Projection Display
Fei Hu, Appotronics, Shenzhen, China
- 82.3: **Red-Enhanced Laser Phosphor Light Source with Quantum Dot Conversion Layer**
Tomohiro Kaji, Sony Corporation, Atsugi, Japan
- 82.4: **Invited Paper:** Speckle Reduction in Laser Projectors by Angular, Wavelength, and Polarization Diversities

Hirota Yamada, Ushio Inc., Hyogo, Japan

Session 83: OLED Displays II (OLEDs)

Chair: Chihaya Adachi, Kyushu University

Co-Chair: Chang-Wook Han, LG Display Co., Ltd

- 83.1: **Invited Paper:** Optimization of High Performance Deep Red OLEDs Using Tandem Structure for Automotive Lighting Application
Huiqing Pang, Beijing Summer Sprout Technology Co., Ltd., Beijing, China
- 83.2: Reliability Characterization of Luminance Degradation of OLED Mobile Display Considering Color Difference Index Based on Usage Patterns
Yoonsuk Choi, Technology Quality Reliability, Samsung Display Co. Ltd., Yongin, South Korea
- 83.3: TE-Type AMOLED Display with Wide Viewing Angle and Ultra-Low Reflectance
Kaoru Abe, Sharp Corporation, Sakai, Japan
- 83.4: Techniques to Achieve an AMOLED Display with Ultra-Narrow Border
Quan Liu, Kunshan Govisionox Optoelectronics Co., Ltd., Kunshan, China

Session 84: Free Form Displays II (Flexible Displays and E-paper)

Chair: Paul Drzaic, Apple, Inc.

Co-Chair: Joon Young Yang, LG Display Co. Ltd

- 84.1: **Invited Paper:** 30-inch 4K Rollable OLED Display
Tohru Sonoda, Sharp Corporation, Osaka, Japan
- 84.2: Study on Reliability for Impact and Rolling of Film Stacks in Rollable AMOLED Display by Finite Element Analysis
Aries Cheng, Tianma Micro-Electronics Group, Wuhan, China
- 84.3: **Invited Paper:** Advanced Cover Window and Thin-film Encapsulation Technologies for Foldable AMOLED Display
Kuang-Jung Chen, ITRI, Hsinchu, Taiwan Roc
- 84.4: New Barrier Fabrication Method Based on an Infiltration Technology for Flexible OLED Displays
Seung Hun Kim, Samsung Display, Yongin, South Korea
- 84.5: **Late-News Paper:** Flexible Cover Window Film with Improved Optical Clarity
Min Sang Park, SK Innovation, Daejeon, South Korea

Session 85: Novel Displays and Optics (Emerging Technologies and Applications)

Chair: Timothy Large, Microsoft Corp

Co-Chair: Adi Abileah, Adi - Displays Consulting LLC

- 85.1: **Invited Paper:** Organic LCDs Using Polarizers as Substrates - Enabling Pixel Level Dimming in Dual Cell LCDs
James Harding, FlexEnable, Cambridge, United Kingdom
- 85.2: **Invited Paper:** Fourth Gen Optics - Planar Optics Revolutionized by LCD Technology
Nelson Tabiryan, BEAM Engineering for Advanced Measurements Co., Orlando, FL US
- 85.3: In-Cell Optical Compensation Technology for OLED Demura Application
Yunke Qin, BOE Technology Group Co., Ltd., Beijing, China
- 85.4: Enhancing Ambient Viewing Performance of Anisotropic Nano-Structure Light Control Film
Lung-Hai Wu, BenQ Materials, Taoyuan, Taiwan Roc
- 85.5: **Late-News Paper:** Real Time Dynamic Holographic Display Based on Perovskite Doped Liquid Crystal
Gufeng He, Shanghai Jiao Tong University, Shanghai, China

Session 86: Quantum Dot Color Conversion II (Emissive, Micro-LED, and Quantum-Dot Displays)

Chair: Jean-Jacques Drolet, Osram Opto Semiconductors

Co-Chair: John Van Derlofske, 3M

- 86.1: **Invited Paper:** Nano-particle heat sinking for quantum-dot colour conversion
Jinhyun Cho, Samsung Electronics, Suwon, South Korea
- 86.2: Color Conversion Using Quantum Dots for LCD, OLED and MicroLED Displays
Ravisubhash Tangirala, Nanosys Inc, Milpitas, CA US
- 86.3: Ultra-Stable Deep-Dyed Perovskite-Polymer Composites as Tunable Downconverters
Caicai Zhang, University of Central Florida, Orlando, FL US
- 86.4: Color Conversion Enhancement of Perovskite Quantum Dots by Integrating with Cholesteric Liquid Crystals
Su Pan, TCL China Star Optoelectronics Technology Co. Ltd., Shenzhen, China
- 86.5: **Late-News Paper:** Giant Shell Quantum Dots for Color Conversion and as Active Material in QLEDs
Jan Niehaus, Fraunhofer CAN, Hamburg, Germany

Poster Session

Active Matrix Devices

- P.1: New P-Type LTPS Pixel Circuit with Negative Feedback for AMOLED Smartwatch Displays
Chih-Lung Lin, National Cheng Kung University, Tainan, Taiwan Roc
- P.2: Hydrogenated SnO for p-Channel Oxide Thin Film Transistor
Kenji Nomura, University of California, San Diego, La Jolla, CA US

- P.3: Effects of Negative Bias Illumination Stress on IGZO Device and Luminance Behaviors in OLED Display Panel Operated by AC Conditions**
Kiju Im, Samsung Display Co.,Ltd., Yongin, South Korea
- P.4: Enhanced the Scalability and the Reliability of High Mobility Elevated-Metal Metal-Oxide Thin-Film Transistors with Bandgap Engineering**
Zhihe Xia, Department of Electronic and Computer Engineering, The Hong Kong University of Science and Technology, Hong Kong, Hong Kong
- P.5: Compact Modeling of Independent Dual Gate TFTs and OLED for Display Panel Circuit Simulations**
Jiahao Kang, Royole Corporation, Fremont, CA US
- P.6: Four-Sided Micro-Border 8K4K LCD with Oxide-TFT Gate Driver Embedded Array**
ManHong Na, AU Optronics Corp., Hsinchu, Taiwan Roc
- P.7: Improvement of Electrical Stability of In-Ga-Zn-O Thin-Film Transistors by Incorporation of Polytetrafluoroethylene in the Back Channel Region**
Hyun Jae Kim, Yonsei University, Seoul, South Korea
- P.8: Degradation Model of LTPS TFT under Off-State Bias Stress on Flexible Substrate**
Kihwan Kim, Samsung Display, Yongin, South Korea
- P.9: Timing Model and Maximum-Aperture Pixel Design of an Active-Matrix Display**
Xuchi Liu, Department of Electronic and Computer Engineering, The Hong Kong University of Science and Technology, Hong Kong, Hong Kong
- P.10: Advantages of Active Pixel Circuit Using Gap-Type TFT as the Photo Device to Sense Low Intensity Light**
Cheng-Che Tu, National Chiao Tung University, Hsinchu, Taiwan Roc
- P.11: High Performance All-Solution Processed InZnO Thin-Film Transistors via Photo-Functionalization at Varying Fluence and Annealing Environment**
Dianne Corsino, Nara Institute of Science and Technology, Ikoma, Japan
- P.12: A Robust a-IGZO TFT Integrated Scan/Emission Driver with Dynamic Inverter for AMOLED Display**
Lei Teng, Peking University, Shenzhen, China
- P.13: Large Subthreshold Swing of LTPS TFTs by Efficient Annealing Method for Light Emitting Diode Displays**
Takao Saito, Sharp Corporation, Taki, Japan
- P.14: Electrical Characteristics of P3HT:TIPS-Pentacene Blend Organic Thin-Film Transistor Under Light Irradiation**
Hyunji Shin, Hongik University, Seoul, South Korea
- P.15: Thermal Conductivity Measurement of Indium-Gallium-Zinc-Oxide Thin Films Utilizing Three-Omega Method**
Reiji Hattori, Kyushu University, Fukuoka, Japan
- P.16: Selective Activation Method of Homo Junction Indium-Gallium-Zinc Oxide Thin-Film Transistors by Selective Simultaneous UV and Thermal Treatment**
Hyun Jae Kim, Yonsei University, Seoul, South Korea
- P.17: Low-Temperature, Solution-Processed Inorganic p-Channel Cu-based Thin-Film Transistors and Circuits**
Ao Liu, POSTECH, Pohang, South Korea
- P.18: Ultra-Compact Multi-Level Digital-to-Analog Converter Based on Linear Multimodal Thin-Film Transistors**
Eva Bestelink, University of Surrey, Guildford, United Kingdom
- P.19: A Study of Oxide TFT V_{th} Shift Behavior by Characterizing with Nano-Scale SIMS**
Jung Hwa Park, Samsung Display Co. Ltd., Youngin, South Korea
- P.191: *Late-News Poster*: Effects of Channel Doping on Flexible LTPS TFTs: Density of State, Generation Lifetime and Image Sticking**
Hyojung Kim, Sungkyunkwan University, Suwon, South Korea
- P.192: *Late-News Poster*: Study of IGZO Dual Gate with BCE Structure in a Touch In-Cell Smartphone**
Ping Sheng Kuo, Mantix Display Technology, Putian, China
- P.193: *Late-News Poster*: A Novel Charge Based TFT Compact Model Applicable to Image Retention Simulation of AMOLEDs**
Genshiro Kawachi, Tianma Japan, Saiwai, Japan
- P.194: *Late-News Poster*: Selenium 4p Orbital Enables High Mobility p-Type Tin Oxyselenide Semiconductor for the Thin-Film Transistor Application**
Jae Kyeong Jeong, Hanyang University, Seoul, South Korea
- P.195: *Late-News Poster*: Data Retention in Pixel Drivers Based on Source-Gated Transistors**
Eva Bestelink, University of Surrey, Guildford, United Kingdom
- P.196: *Late-News Poster*: Amorphous Metal Thin-Film Transistors: High Mobility IGZO TFT Fabricated by a Low-Temperature All Sputter PVD Process**
Sean Muir, Amorphyx Inc., Corvallis, OR US

Applied Vision

- P.20: Image Distortion and Image Correction of Curved OLED Displays**
Po-Jui Chen, National Taiwan University, Taipei, Taiwan Roc
- P.21: A New Perceptual-Driven Approach to Foveated Head-Mounted Displays**
Hong Hua, University of Arizona, Tucson, AZ US
- P.22: Correlation Analysis for Subjective and Non-Subjective Evaluation of Holograms Generated by Digital and Analog Spatial Light Modulators**
Chih-Hao Chuang, National Taiwan University, Taipei City, Taiwan Roc
- P.23: A Subjective Method for Evaluating Foveated Image Quality in HMDs**
Vijayaraghavan Thirumalai, Samsung Display America Lab, San Jose, CA US
- P.24: The Visual Effect Evaluation of High Frame Rate Gaming LCD**
Jian Chen, Xiamen Tianma Microelectronics Co., Ltd., Xiamen, China
- P.197: *Late-News Poster*: Visual Advantages of Curved Displays for Working Efficiency**

Automotive/Vehicular Displays and HMI Technologies

- P.25: Effects of Image Distance on Cognitive Tunneling with Augmented Reality Head Up Displays**
Joe Pullukat, NS International, Ltd., Troy, MI US
- P.26: Development of Image Enhancement Technology for 3D-HUD**
Ryo Tadauchi, KYOCERA Corporation, Shiga, Japan
- P.27: See-Through Projection System with Dot Matrix Phosphor Screen**
Yu-Chen Chueh, National Chiao Tung University, Hsinchu, Taiwan Roc
- P.28: Investigating the Usability of Touchscreens in a Turbulent Flight Deck**
Mark Smith, GE Aviation Systems, Cheltenham, United Kingdom
- P.29: Wide Visual Angle Anti-Reflection Film**
Ya-Chun Chang, BenQ Materials Corporation, Taoyuan, Taiwan Roc
- P.30: Ray Tracing Simulation of Automotive Displays using Spectroscopic Polarized Emissive and Reflective Measurements**
Pierre Boher, United Visual Researchers, Paris, France
- P.199: Late-News Poster: Intelligent Automotive Projection Headlight with Non-Uniform DMD Illumination**
Kenneth Li, Optonomous Technologies Inc., Westlake Village, CA US
- P.200: The Influence of Mechanical Characteristics on the Performance of Optical laminating Materials in Automotive applications**
Seung-A Lee, Sungkyunkwan University, Suwon, South Korea
- P.201: Late-News Poster: Synchronization Technique of Multi-Chip Cascade Architecture for Automotive TDDI**
Daisuke Ito, Synaptics Japan G.K., Tokyo, Japan

Display Electronics

- P.31: Full Screen with High Refresh Frequency-120HZ and Low Power Consumption-30HZ for 5G**
Liu Ping, XiaMen Tianma Microelectronics Co., Ltd., Xiamen, China
- P.32: Novel Gate Driving Circuit Integrated within Active Area Based on Amorphous Oxide TFT**
MingXin Wang, Nanjing CEC Panda LCD Technology Co., Ltd., Nanjing, China
- P.33: A High Current-Drive, Step-Up Capacitive Power Converter for Display Driver**
Min Zhang, Peking University, Shenzhen, China
- P.34: New P-type Gate Driver Circuit with Simultaneous and Progressive Output Waveforms Per Frame for AMOLED Displays with Simultaneous Emission Driving**
Chih-Lung Lin, National Cheng Kung University, Tainan, Taiwan Roc
- P.35: Applying Human Vision Science to Construct a Subpixel Rendering Algorithm for Displays with non-RGB-Stripe Patterns**
Baojun Wang, TCL China Star Optoelectronics Technology Co., Ltd., Guangdong, China
- P.36: Highly Reliable a-IGZO TFT Gate Driver Circuit to Prevent Leakage Path in Depletion Mode**
Yong-Sang Kim, Sungkyunkwan University, Suwon, South Korea
- P.37: WITHDRAWN**
- P.38: A New Pixel Architecture for Low-Power LCDs with Oxide TFTs**
Seung-Woo Lee, Kyung Hee University, Seoul, South Korea
- P.39: A Current-Sensing Comparator for AMOLED Displays with External Compensation**
Hailong Jiao, Peking University, Shenzhen, China

Display Manufacturing

- P.40: Glass Substrate Charging in Flat Panel Display Manufacturing**
Robert Manley, Corning Incorporated, Corning, NY US
- P.41: Mechanical Reliability of Glass in Curved Displays**
Bosun Jang, Corning Incorporated, Corning, NY US
- P.42: Novel Stress Profile for Chemically Strengthened Glass with High Drop Strength**
Tomonori Ichimaru, Nippon Electric Glass Co. Ltd., Otsu, Japan
- P.43: Application of High Stiffness Glass Substrate for Multi-Functional Large Area Displays**
Kazutaka Hayashi, AGC Inc., Yokohama, Japan
- P.44: Polysulfide Elastomers as Highly Elastic Materials for Flexible Displays**
Radu Reit, Ares Materials, Plano, TX US
- P.45: Effect of Gas Flow Ratio of Ar and O₂ During Sputtering of InZnO Active Layer on Photocurrent and Responsivity Characteristics of a-InZnO TFT**
Changhui Fan, Peking University, Shenzhen, China
- P.46: Fabrication and Characterization of Thick Copper Film Deposited on G8.5 LCD Glass Substrate for 8k and Large TV Panel**
Li Guo, Peking University, Shenzhen, China
- P.47: Influences of Molybdenum Film Residual Stress on Copper/Molybdenum Interface and Undercut Performance**
Li Guo, Peking University, Shenzhen, China
- P.48: ITO Electrode Impact on the White Color Uniformity of TFT-LCD**
Hui An, BOE Technology Group co., Ltd., Hefei, China
- P.49: The Ultimate Solution: Belt Plane Source Evaporators for Future AMOLED and QD OLED TV**
Changhun Hwang, OLEDON, Yongin, South Korea
- P.50: New Monitoring Method for Ion Implanter Using Microwave Photoconductive Response in Large-Size Glass**
Steve Jeons, BOE Display Technology Co., Ltd, Chong qing, China
- P.51: Investigation on ICP-CVD as a Polyvalent Low Cost Technology Dedicated to Low Temperature μ -Si TFT Prototyping**
Olivier de Sagazan, University of Rennes. Rennes, France

- P.52: A Novel Six-Mask Low-Temperature Polycrystalline Silicon Architecture for TFT-LCD Application**
Chengzhi Luo, Wuhan China Star Optoelectronics Technology Co., Ltd., Wuhan, China
- P.53: WITHDRAWN**
- P.54: Smooth Edge Curve Compensation Method for Circular Display**
Yani Chen, Peking University Shenzhen Graduate School, Shenzhen, China
- P.55: A Laser Etching System for Mini-LED Backlight with High Reflection Silver Film**
Bing Zhang, Hefei BOE Optoelectronics Technology Co., Ltd., Hefei, China
- P.56: Hybrid Correlated-Color-Temperature (CCT) and Gamma Automatic Adjustment System based on Efficient Algorithm and Machine Learning Model for AMOLED Display**
Chien Ming Ko, AU Optronics Corporation, Hsinchu, Taiwan Roc
- P.57: Preparation of Patternable High Resolution and High Refractive Index Materials for AR/VR**
Jiro Hikida, Tokyo Ohka Kogyo Co. Ltd., Samukawa, Japan
- P.58: Properties of Diffraction Optical Elements on the Base of Discotic Liquid Crystal for Display Applications**
Victor Belyaev, Moscow Region State University, Lobnya, Russian Fed.
- P.59: An Analytical Method of Small Size Module Waving Based on the Finite Element Simulation**
xiaohua li, Wuhan China Star Optoelectronics Technology Company Limited, Wuhan, China
- P.60: Single-Step Plasma-Enhanced Chemical Vapor Deposition of Graphene on Cu Ink and Sputtered Cu Thin Films**
Nai-Chang Yeh, California Institute of Technology, Pasadena, CA US
- P.61: Research on the Key Factors Affecting the LC Margin Lower Limit of LCD**
Le Liu, TCL China Star Optoelectronics Technology Co., Ltd., Shenzhen, China
- P.232: Late-News Poster: Laser Assisted Plasma Enhanced Chemical Vapor Deposition for Damage-Resistive and Reliable Thin Film Encapsulation of Organic Light Emitting Diodes**
Kyungtae Kang, Korea Institute of Industrial Technology, Ansan, South Korea

Display Measurement

- P.62: Effect of Viewpoints of Integral Image 3D Display on Human Eye Accommodation Response**
Huan Deng, Sichuan University, Chengdu, China
- P.63: Measurements of Viewing Angle and Angular Resolution of Electronic Holographic Display**
JEHO NAM, Electronics and Telecommunications Research Institute (ETRI), Daejeon, South Korea
- P.64: Micro Optics Array for Aerial Display System and its Imaging Performance Evaluation Method**
Hayato Kikuta, Japan Electronics and Information Technology Industries Association (JEITA), Tokyo, Japan
- P.65: Analysis on Local Area Cell Parameter Distribution Caused by Different Dosage on Photo Alignment PI of FFS Mode LCD**
Kun Tsai Huang, HSD, Tainan, Taiwan Roc
- P.66: Overview of International Standardization for Optical Fundamental Measurement of Eyewear Displays**
tongsheng mou, Zhejiang Sensing Optronics Co., Ltd, Zhejiang, China

Display Systems

Display Systems

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