



ADVANCE PROGRAM

2019 DISPLAY WEEK INTERNATIONAL SYMPOSIUM

May 14-17, 2019 (Tuesday – Friday)
San Jose McEnery Convention Center
San Jose, California,, US

Session 1: Annual SID Business Meeting
Tuesday, May 14, 2019 / 8:00 – 8:20 am / Room 220A

Session 2: Opening Remarks / Keynote Addresses
Tuesday, May 14, 2019 / 8:20 – 10:20 am / Room 220A
Chair: Rashmi Rao, Harman/Samsung, Novi, MI, US

- 2.1: **Keynote Address 1:** *Shaping the Future with Information Displays*, Jinoh Kwag, Executive Vice President, Head of Display Research Center, Samsung Display Corporation
- 2.2: **Keynote Address 2:** *Bringing Together the Best of Hardware, Software, and AI to Create Amazing User Experiences*, Rick Osterloh, Senior Vice President, Devices & Services, Google LLC
- 2.3: **Keynote Address 3:** *Technical Innovation Empowers a Win-Win Future*, Gao Wenbao, CEO, BOE Display and Sensor Business Group

Session 3: Visual Factors Towards Compelling VR/AR Experiences (*Augmented, Virtual and Mixed Reality / Applied Vision*)

Tuesday, May 14, 2019 / 11:10 AM - 12:40 PM / Room 220B

Chair: Sakuichi Ohtsuka, Kagoshima University

Co-Chair: James Larimer, ImageMetrics LLC

- 3.1: **Psychophysical Evaluation of Persistence- and Frequency-Limited Displays for Virtual and Augmented Reality**
T. Scott Murdison, Facebook Reality Labs, Redmond, WA, US
- 3.2: **Importance of Object Contour Retention in 3D Space Based on “The Law of Inertia” Hypothesis in Human Perception: Through Analysis of 2D- and 3D- Footsteps Illusion**
Sakuichi Ohtsuka, Kagoshima University, Kagoshima, Japan
- 3.3: **The Effect of Larger Field-of-View on Visual Search Times for World-Locked Augmented Reality Objects**
John Gaspar, Google, Mountain View, CA, US
- 3.4: **Stereoscopic Image Quality Assessment**
Domenic Au, York University, Toronto, ON, Canada
- 3.5: **Late-News Paper: Visual Fatigue Reducing 3D Glasses by Extending Depth of Field of Eyes**
Yasuhiro Takaki, Tokyo University of Agriculture and Technology, Koganei, Tokyo, Japan

Session 4: MicroLED and Color Converting Technology (*Emissive, MicroLED, and Quantum-Dot Displays*)

Tuesday, May 14, 2019 / 11:10 AM - 12:50 PM / Room 220C

Chair: Qun Yan, Fuzhou University:

Co-Chair: Ioannis Kymissis, Columbia University

- 4.1: **Invited Paper: MicroLED Displays: Can the Monolithic Approach Produce Full-Color?**
Kei May Lau, Hong Kong University of Science and Technology, Hong Kong, Hong Kong
- 4.2: **Distinguished Student Paper: High Efficiency Color-Converted MicroLED Displays**
Fangwang Gou, University of Central Florida, Orlando, FL, US
- 4.3: **Distinguished Paper: 10 um Pixel, Quantum-dots Color Conversion Layer for High Resolution and Full Color Active Matrix MicroLED Display**
Jin Jang, Kyung Hee University, Seoul, South Korea
- 4.4: **Flexible Quantum Dot Color Converter Film for MicroLED Applications**
Xue Bai, Southern University of Science and Technology, Shenzhen, China
- 4.5: **Quantum Dot Design Criteria for Color Conversion in MicroLED Displays**
Julian Osinski, Opticalogic Advisors, Woodside, CA, US

Session 5: OLED Devices I (*OLEDs*)

Tuesday, May 14, 2019 / 11:10 AM - 12:40 PM / Room LL21CD

Chair: Yasunori Kijima, Huawei Technologies Co Ltd.

Co-Chair: Sven Zimmermann, Novaled GmbH

- 5.1: **Multi-Mode Top-Emitting Organic Light Emitting Diodes with No Viewing Angle Dependent Color Shift and Enhanced Efficiency**
Franky So, North Carolina State University, Raleigh, NC, US
- 5.2: **Fluorescent OLED Achieving External Quantum Efficiency over 20% and Longer Lifetime than Phosphorescent OLED**

- Satoshi Seo, Semiconductor Energy Laboratory Co., Ltd., Atsugi, Japan
- 5.3: **3-Stacked Top-Emitting White OLEDs with Super-Wide Color Gamut and High Efficiency**
Wenfeng Song, BOE Technology Group Co., Ltd., Beijing, China
- 5.4: **High Efficiency Top-Emission Organic Light Emitting Diodes Realized Using Newly Developed Low Absorption Pure Ag Cathode Configuration**
Seong Keun Kim, Kyung Hee University, Seoul, South Korea
- 5.5: **Late-News Paper: Low Power Consumption Flexible AMOLED Display with Highly Efficient TE-Type Blue OLED**
Tokiyoshi Umeda, Sharp Corporation, Display Device Company, Sakai-shi, Osaka, Japan

Session 6: 8K LC Technologies (*Liquid-Crystal Technology*)

Tuesday, May 14, 2019 / 11:10 AM - 12:10 PM / Room LL21EF

Chair: Koichi Miyachi, JSR Corporation

Co-Chair: Jenn Jia Su, AU Optronics Corporation

- 6.1: **Invited Paper: UBplus: New Solution for High Resolution TV**
Sven Laut, Merck KGaA, Darmstadt, Germany
- 6.2: **Novel Liquid Crystal Display Mode "UV2AII" with Photo Alignment Technology for a Large-Screen 8K Display**
Shinichi Terashita, Sharp Corporation, Nara, Japan
- 6.3: **Distinguished Paper: Alignment Control of Liquid Crystal in 1- μ m-Pitch Spatial Light Modulator by Lattice-Shaped Dielectric Wall Structure**
Yoshitomo Isomae, Tohoku University, Sendai, Japan

Session 7: Advances in Automotive UX and Displays (*Automotive/Vehicular Displays and HMI Technologies*)

Tuesday, May 14, 2019 / 11:10 AM - 12:10 PM / Room LL20BC

Chair: Philippe Coni, THALES Avionics

Co-Chair: Toshihisa Sato, National Institute of Advanced Industrial Science and Technology

- 7.2: **WITHDRAWN**
- 7.3: **Invited Paper: Automotive Grade Qualification for Quantum Dot Enhanced Liquid Crystal Displays**
Rashmi Rao, Harman/Samsung Inc, Novi, MI, US
- 7.4: **Late-News Paper: Holographic Head-Up Display with Adaptive Brightness of Ambient Light**
Yueda Liu, Shanghai Jiao Tong University, Shanghai, China

Session 8: Display Artifacts Compensation (*Display Electronics*)

Tuesday, May 14, 2019 / 11:10 AM - 2:30 PM / Room LL20A

Chair: Wei Yao, Apple Inc

Co-Chair: Paul Oh, LG Display

- 8.1: **The Method to Compensate IR-Drop of AMOLED Display**
Jongwoong Park, Samsung Display Co., Ltd., Yongin, South Korea
- 8.2: **Training Multi-scale Networks for Compression Artifacts Reduction**
Yufan Deng, Shenzhen China Star Optoelectronics Technology Co., Ltd., Shenzhen, China
- 8.3: **A Novel Degradation Compensation Method for AMOLED Panel Based on CTP Model**
Haining Xu, Shenzhen Yunyinggu Technology Co. Ltd., Beijing, China
- 8.4: **An Improved Image Data Compensation Method for Circular Display**
Jiang Zhu, Shenzhen China Star Optoelectronics Technology Co., Ltd., Shenzhen, China

Session 9: Novel Applications (*Active-Matrix Devices*)

Tuesday, May 14, 2019 / 11:10 AM - 2:30 PM / Room LL20D

Chair: Roger Stewart, Sourland Mountain Associates

Co-Chair: Takashi Nakamura, Japan Display Inc.

- 9.1: **Invited Paper: Metal-Oxide Readout Electronics Based on Indium-Gallium-Zinc-Oxide and Indium-Tin-Zinc-Oxide for In-Panel Fingerprint Detection Application**
Nikolaos Papadopoulos, imec, Heverlee, Belgium
- 9.2: **Invited Paper: Flexible Sensors and Memory Integration Toward Electronic Wallpaper**
Kuniharu Takei, Osaka Prefecture University, Osaka, Japan
- 9.3: **Blue-Laser-Annealed TFT MicroLED Display with Integrated Digital Driving**
Jin Jang, Kyung Hee University, Seoul, South Korea
- 9.4: **Late-News Paper: Alleviation of Recoverable Residual Image Phenomenon of Flexible Organic Light-emitting Diode Display**
Hyun Jae Kim, Yonsei University, Seoul, South Korea

Session 10: Challenges in Making AR/MR Headsets (*Augmented, Virtual and Mixed Reality / Display Systems / Display Manufacturing*)

Tuesday, May 14, 2019 / 2:00 PM - 3:00 PM / Room 220B

Chair: William Cummings, Microsoft

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

- 10.1: **Can We Overcome the Challenges on the Path to Consumer Adoption of AR Headsets?**
Zine Bouhamri, Yole Developpement, Lyon, France
- 10.2: **Waveguide Manufacturing for AR Displays: Past, Present and Future**
Jonathan Waldern, DigiLens Inc., Sunnyvale, CA, US
- 10.3: **High Refractive Index Glass Wafers for Augmented Reality Devices using Waveguide Technology: Recent Advances in Control of Quality Parameters and their Correlation with Device Properties**
Ruediger Sprengard, SCHOTT AG, Mainz, Germany

Session 11: MicroLED Displays (Emissive, MicroLED, and Quantum-Dot Displays)

Tuesday, May 14, 2019 / 2:00 PM - 3:30 PM / Room 220C

Chair: Kevin Gahagan, Corning Incorporated

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

- 11.1: **Invited Paper: Technologies for the Crystal LED Display System**
Goshi Biwa, Sony Corporation, Kanagawa, Japan
- 11.2: **Micro LEDs Efficiency Targets for Displays**
Khaled Ahmed, Intel Corporation, Santa Clara, CA, US
- 11.3: **Overlooked Technical Challenges for microLED Displays**
Eric Virey, Yole Developpement, Portland, OR, US
- 11.4: **Improvement of Ambient Contrast of MicroLED Devices with High Reliability**
Ke Zhang, Hong Kong University of Science and Technology, Hong Kong, China
- 11.5: **Late-News Paper: High PPI Micro LED Display for Small and Medium Size**
Sho Nakamitsu, Kyocera Corporation, Shiga, Japan

Session 12: OLED Devices II (OLEDs)

Tuesday, May 14, 2019 / 2:00 PM - 3:30 PM / Room LL21CD

Chair: Nicholas Thompson, Universal Display Corporation

Co-Chair: Yifan Zhang, Apple, Inc.

- 12.1: **Analysis of Key factors Affecting the Lifetime of Blue Phosphorescent OLED Using CN Modified Blue Host Materials**
Chang Yoon Yang, Sungkyunkwan University, Suwon, South Korea
- 12.2: **3D Pixel Configurations for Optical Out-Coupling of OLED Displays – Part II: Experimental Validation**
Byung Sung Kwak, Applied Materials, Inc., Santa Clara, CA, US
- 12.3: **A Highly Mass-Produced Nano-Lens Array Technology for Optically Efficient Full-Color Organic Light Emitting Diode Display Application**
Young-Sam Park, Electronics and Telecommunications Research Institute (ETRI), Daejeon, South Korea
- 12.4: **Blue OLEDs Fabricated by Close-Space Sublimation**
Bryan Siu Ting Tam, The Hong Kong University of Science and Technology, Hong Kong, Hong Kong
- 12.5: **Late-News Paper: Study on Characteristics of OLED Devices with Different Position of EML Dopant**
Heemin Park, Process Research Team, SDC, Yongin-City, South Korea

Session 13: Fast-Switching LC Technology (Liquid-Crystal Technology)

Tuesday, May 14, 2019 / 2:00 PM - 3:20 PM / Room LL21EF

Chair: Takahiro Ishinabe, Tohoku University

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

- 13.1: **Invited Paper: Optimized AH-IPS Liquid Crystal Display for Gaming Applications**
Dong-Jin Lee, LG Display, Paju, South Korea
- 13.2: **Novel Pixel Design In-Plane Super-Fast Response LCD for Smart Phone and PC Monitor**
Kazutaka Hanaoka, Sharp Corporation, Nara, Japan
- 13.3: **Development of High-Performance TFT-LCDs Using Optically-Isotropic Nano-Size Encapsulated Liquid Crystals**
Kyeong-Jin Kim, LG Display, Seoul, South Korea
- 13.4: **Passively Addressed Helix Free Ferroelectric Liquid Crystal for Fast Response Bi-stable Display**
Zhibo Sun, Hong Kong University of Science and Technology, Hong Kong, Hong Kong

Session 14: In-Vehicle User Experience & Safety (Automotive/Vehicular Displays and HMI Technologies)

Tuesday, May 14, 2019 / 2:00 PM - 3:20 PM / Room LL20BC

Chair: Toshihisa Sato, National Institute of Advanced Industrial Science and Technology

Co-Chair: Haruhiko Okumura, Toshiba Corporation

- 14.1: **Invited Paper: Advances in Automotive Interior Lighting**
Karlheinz Blankenbach, Pforzheim University, Pforzheim, Germany
- 14.2: **Dynamic Peripheral Communication for Advanced Automotive Applications**
Kimberly Peiler, OSRAM Opto Semiconductors, Inc., Novi, MI, US
- 14.3: **Invited Paper: Investigation of visual characteristics and the driving skill of senior drivers**
Hirofumi Aoki, Nagoya University, Nagoya, Japan
- 14.4: **Effect of Anti-Glare Coating on Driver Monitoring Camera Optical Transfer Function**
Pawel Murzyn, Visteon Corporation, Chelmsford, United Kingdom

Session 15: Driver Electronics (*Display Electronics*)

Tuesday, May 14, 2019 / 2:00 PM - 3:20 PM / Room LL20A

Chair: Prof. Hyoungsik Nam, Kyung Hee University

Co-Chair: Jae-Hoon Lee, Samsung Display Co

- 15.1: **PWM Pixel Circuit with LTPS TFTs for MicroLED Displays**
Jin-Ho Kim, Samsung Electronics Co., Ltd., Suwon, South Korea
- 15.2: **Distinguished Paper: Integrated Gate Driver Circuit Technology with IGZO TFT for sensing operation**
In June Kim, LG Display Co., Seoul, South Korea
- 15.3: **A High Image Quality OLED Display with Integrated Gate Driver using MPRT Enhancement Technology for Large Size Premium TVs**
Hong Jae Shin, LG Display, Paju, South Korea
- 15.4: **Multi-Output Oxide TFT Shift Register Circuit without Bootstrapping Degradation**
Hyoungsik Nam, Kyung Hee University, Seoul, South Korea

Session 16: Flexible TFTs (*Active-Matrix Devices / E-Paper and Flexible Displays*)

Tuesday, May 14, 2019 / 2:00 PM - 3:20 PM / Room LL20D

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

Co-Chair: Paul Drzaic, Apple, Inc.

- 16.1: **The Role of Hydrogen and Surface Potential in the Performance and Stability of Poly-Si TFTs on Plastic Substrates**
Jaeseob Lee, Samsung Display Co., Ltd., Yongin, South Korea
- 16.2: **Remarkable Improvement of Electro-Mechanical Stabilities in Flexible Oxide TFTs under Bulk-Accumulation Operation**
Mohammad Billah, Kyung Hee University, Dongdaemun-Gu, Seoul, South Korea
- 16.3: **Investigation of Mechanical Stress and Gate Bias Stress on Flexible Dual-gate a-IGZO Thin Film Transistors**
Qun Zhang, Fudan University, Shanghai, China
- 16.4: **Invited Paper: Process Design Kit and Design Automation for Flexible Hybrid Electronics**
Tsung-Ching Huang, Hewlett Packard Labs, Palo Alto, CA, US

Session 17: AR/MR Display Systems (*Augmented, Virtual and Mixed Reality / Display Systems*)

Tuesday, May 14, 2019 / 3:40 PM – 4:40 PM / Room 220B

Chair: Frederic Kahn, Kahn International, Inc.

Co-Chair: Grace Lee, Google

- 17.1: **Invited Paper: Objective Requirements for Displays in Near-to-Eye Headsets**
Joshua Freeney, IMMY Inc., Troy, MI, US
- 17.2: **Invited Paper: Laser Safety in Beam Scanned, Light Field Displays**
Zhangyi Zhong, Dreamworld USA Inc., Millbrae, CA, US
- 17.3: **Low-Power High-Definition Wireless Near-Eye Displays Based on Prism Optics**
Luke Pillans, Intevac Photonics, Santa Clara, CA, US

Session 18: MicroLED-Transfer (*Emissive, MicroLED, and Quantum-Dot Displays / Display Manufacturing*)

Tuesday, May 14, 2019 / 3:40 PM - 5:00 PM / Room 220C

Chair: Francois Templier, CEA-LETI

Co-Chair: Yajie Dong, University of Central Florida

- 18.1: **Invited Paper: Evaluating In-Process Test Compatibility of Proposed Mass-Transfer Technologies to Achieve Efficient, High-Yield MicroLED Mass-Production**
Francois Henley, Tesoro Scientific, Inc., Saratoga, CA, US
- 18.2: **Ultra-Fine High Efficiency MicroLEDs with Testability and Transferability using Layer-Transfer Technology**
Dong Lee, QMAT Inc., Santa Clara, CA, US
- 18.3: **A New Approach for Fabricating High-Performance MicroLED Displays**
Francois Templier, CEA-LETI, Grenoble, France
- 18.4: **MicroLED Displays based on Transfer with Microtube Interconnections**
Jeannet Bernard, CEA-LETI, Grenoble, France

Session 19: OLED Physics and Mechanisms (*OLEDs*)

Tuesday, May 14, 2019 / 3:40 PM - 5:10 PM / Room LL21CD

Chair: Denis Kondakov, DuPont

Co-Chair: Nicholas Thompson, Universal Display Corporation

- 19.1: **Invited Paper: Atom Probe Tomography for Understanding OLED Morphology**
Jeremy Zimmerman, Colorado School of Mines, Golden, CO, US
- 19.2: **Impact of Chemical Degradation at HTL/EML Interface on Device Performance of Blue OLEDs**
Shou-Cheng Dong, Hong Kong University of Science and Technology, Kowloon, Hong Kong
- 19.3: **Examination in Application of TOF-SIMS with MS/MS to a Degradation Analysis of OLED**
Daichi Shirakura, Toray Research Center, Inc., Shiga, Japan
- 19.4: **Boosting OLED Development with ab-Initio Computation of Roll-Off and Quenching Processes.**
Tobias Neumann, Nanomatch GmbH, Eggenstein-Leopoldshafen, Germany

- 19.5: **Late-News Paper:** Characterization of Carrier Transport Properties in Working Polymer Light-Emitting Diodes
Hiro Yoshi Naito, Osaka Prefecture University, Sakai, Japan

Session 20: Low-Power Liquid-Crystal Displays (Liquid-Crystal Technology)

Tuesday, May 14, 2019 / 3:40 PM - 5:00 PM / Room LL21EF

Chair: *Xiao-Yang Huang, Ebulent Technologies Corp*

Co-Chair: *Linghui Rao, Microsoft*

- 20.1: **Fast Switching Twisted-Vertically Aligned Mode Reflective LCD using Mortar-shaped Pixel Structure**
Takahiro Ishinabe, Tohoku University, Sendai, Japan
- 20.2: **Novel LCD Frame Frequency Switching Method with Minimized Flicker**
Mitsuru Chida, Sharp Corporation, Nara, Japan
- 20.3: **High Efficiency Wire Grid Polarizer for QDCF LCD**
Yujie Liu, BOE Technology Group Co., Ltd., Beijing, China
- 20.4: **High Performance and Low-Power Full Color Reflective LCD for New Applications**
Hiroyuki Hakoi, SHARP, Nara, Japan

Session 21: Emerging Automotive Applications (Automotive/Vehicular Displays and HMI Technologies / Interactive Displays and Systems)

Tuesday, May 14, 2019 / 3:40 PM - 5:00 PM / Room LL20BC

Chair: *Karlheinz Blankenbach, Pforzheim University*

Co-Chair: *David Barat, PSA Groupe*

- 21.1: **Active Circular Polarizer OLED E-Mirror**
Paul Weindorf, Visteon Corporation, Van Buren Township, MI, US
- 21.2: **Free-form Incell-Touch TFT-LCD Vehicle Displays Based on LTPS**
Wei Wu, Xiamen Tianma Microelectronics Co., Ltd., Xiamen, China
- 21.3: **Touchscreen for Eyes-Free Interaction Utilizing Electrostatic Force, Lateral Motion and a Force sensor**
Hiroshi Haga, Tianma Japan, Ltd., Kawasaki, Japan
- 21.4: **Plasmonic Nanostructure Array with Correlated Disorder for Augmented Reality**
Beatrice Dagens, CNRS, Palaiseau, France

Session 22: Image Quality Enhancement (Display Electronics)

Tuesday, May 14, 2019 / 3:40 PM - 4:40 PM / Room LL20A

Chair: *Taesung Kim, Google LLC*

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

- 22.1: **Image Enhancement with Visual Saturation Preserving on Adaptive Histogram Model**
Chaochao Shi, Shenzhen China Star Optoelectronics Technology Co., Shenzhen, China
- 22.2: **HDR Dynamic Tone Mapping with Enhanced Rendering Control**
Ike Ikizyan, Qualcomm Technologies, Inc., San Diego, CA, US
- 22.3: **2400 Nits Edge-Lit LCD and Adaptive EOTF for HDR and Brilliant Images**
Michael Grüning, Saarland University, Saarbrücken, Germany

Session 23: Ultra-High Resolution (Active-Matrix Devices)

Tuesday, May 14, 2019 / 3:40 PM - 5:00 PM / Room LL20D

Chair: *Norbert Fruehauf, University of Stuttgart*

Co-Chair: *James Chang, Apple, Inc.*

- 23.1: **5291-ppi OLED Display With C-Axis Crystalline Oxide Semiconductor**
Shuichi Katsui, Semiconductor Energy Laboratory Co., Ltd., Atsugi, Japan
- 23.2: **2351-ppi OLED Display with Stacked OS-FETs with L = 0.36 μ m**
Hideaki Shishido, Semiconductor Energy Laboratory Co., Ltd., Atsugi, Japan
- 23.3: **The New Route for Realization of 1 μ m-Pixel-Pitch High Resolution Displays**
Ji Hun Choi, ETRI, Daejeon, South Korea
- 23.4: **Channel Dimension Scalable Oxide Thin-Film Transistor for High Resolution Pixel and Integrated Gate Driver**
Hiroshi Hayashi, JOLED Inc., Kyoto, Japan

Session 24: AR/MR Display Electronics (Augmented, Virtual and Mixed Reality / Display Electronics)

Wednesday, May 15, 2019 / 9:00 AM - 10:00 AM / Room 220B

Chair: *Dr. Achin Bhowmik, Starkey Hearing Technologies*

Co-Chair: *Won Jun Choe, Samsung Display*

- 24.1: **Mira Display Processor for VR/AR Systems**
Damian Modrzyk, Arm Limited, Katowice, Poland
- 24.2: **Latency Compensation for Optical See-Through Head-Mounted with Scanned Display**
Hiroyuki Aga, Sony Corporation, Tokyo, Japan
- 24.3: **10Gbps Low Power Transceiver PHY for Next Generation Display Interface**

Session 25: MicroLED Manufacturing Development (*Display Manufacturing / Emissive, MicroLED, and Quantum-Dot Displays*)

Wednesday, May 15, 2019 / 9:00 AM - 10:30 AM / Room 220C

Chair: Ion Bita, Google LLC

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

- 25.1: **Invited Paper:** Achieving High Uniformity and Yield of 200 mm GaN-On-Si LED Epiwafers for Micro LED Applications with Precise Strain-Engineering
Burkhard Slischka, ALLOS Semiconductors GmbH, Dresden, Germany
- 25.2: **Enabling MOCVD Technology for Micro LED High Volume Manufacturing**
Adam Boyd, AIXTRON SE, Herzogenrath, Germany
- 25.3: **Highly Efficient, All-Inkjet-Printed, Deep Red Quantum Dot Light Emitting Diodes from Positive Aging**
Shuren Zhang, Shenzhen China Star Optoelectronics Semiconductor Display Technology Co., Ltd., Shenzhen, China
- 25.4: **Late-News Paper:** Xerographic MicroAssembly Printer for LEDs and Beyond
Eugene Chow, PARC, Palo Alto, CA US
- 25.5: **Late-News Paper:** 1,053 ppi Full-Color “Silicon Display” Based on Micro-LED Technology
Hiroaki Onuma, Sharp Corporation, Hiroshima, Japan

Session 26: OLED Materials I (*OLEDs*)

Wednesday, May 15, 2019 / 9:00 AM - 10:20 AM / Room LL21CD

Chair: Franky So, North Carolina State University

Co-Chair: Denis Kondakov, DuPont

- 26.1: **Invited Paper:** Thermally Activated Delayed Fluorescence Organic Light-Emitting Diodes Comprising Ultrastable Glass Layers
Sebastian Reineke, Technische Universität Dresden, Dresden, Germany
- 26.2: **Invited Paper:** Hyperfluorescence™- and TADF-based OLEDs Development Update
Ping Kuen Daniel Tsang, Kyulux Inc., Fukuoka, Japan
- 26.3: **Highly Efficient Boron Acceptor Based Blue Thermally Activated Delayed Fluorescent Emitter**
Jee Hyun Maeng, Kyung Hee University, Seoul, South Korea
- 26.4: **Late-News Paper:** Development of Positive-type Photoresists based on Polysilsesquioxanes for the Pixel Defining Layer (PDL) in OLED Structures
Seunghyun Jang, IT & E materials R&D Center, Samyang Corporate, Daejeon, South Korea

Session 27: Polymer Stabilized LCDs (*Liquid-Crystal Technology*)

Wednesday, May 15, 2019 / 9:00 AM - 10:00 AM / Room LL21EF

Chair: Linghui Rao, Microsoft

Co-Chair: Hoi-Sing Kwok, Hong Kong University of Science & Technology

- 27.1: **Study on the Effect of Controlling the Pretilt Angle using RM with Multipolymerizable Functional Group**
Qian Li, Shenzhen China Star Optoelectronics Technology Co. Ltd., Shenzhen, China
- 27.2: **Novel Pixel Design to Improve Color Shift of Multi-Domain Polymer Sustained Alignment LCD**
Kun-Cheng Tien, AU Optronics, Hsinchu, Taiwan Roc
- 27.3: **Heterogenous LC Alignment in a 8-domain sub-pixel with PSVA Curing Process**
Xinyuan Che, Shenzhen China Star Optoelectronics Technology Co. Ltd., Shenzhen, China

Session 28: Backlight and Frontlight Systems (*Display Systems*)

Wednesday, May 15, 2019 / 9:00 AM - 10:20 AM / Room LL20BC

Chair: Masaru Suzuki, Kriya Materials

Co-Chair: Akihiro Tagaya, Tokyo Institute of Technology

- 28.1: **Ultra-Slim Backlight with High Luminance Using Multiple Advanced Light Guide Plates**
Junichi Masuda, Sharp Corporation, Osaka, Japan
- 28.2: **A Novel Local Dimming Algorithm with HDR for VR System Based on GPU**
Zhihua Ji, BOE Technology Group Co., Ltd., Beijing, China
- 28.3: **Mini-LED Backlight for HDR Compatible Mobile Displays**
Takeshi Masuda, Sharp Corporation, Nara, Japan
- 28.4: **Fabrication and Operation of an Energy-Harvesting Color Projector**
Ichiro Fujieda, Ritsumeikan University, Shiga, Japan

Session 29: Application Technologies for e-Paper (*E-Paper and Flexible Displays*)

Wednesday, May 15, 2019 / 9:00 AM - 10:20 AM / Room LL20A

Chair: Jang Lin Chen, DTC/ITRI

Co-Chair: Keisuke Hashimoto, E Ink Holdings

- 29.1: **Invited Paper:** International Standards Development of Electronic Paper Displays
Tatsumi Takahashi, Electronic Paper Consortium JBMA, Tokyo, Japan

- 29.2: **Simultaneous Optimization of Halftoning Image Quality and TFT Power Consumption for Multi-Tonal Color e-Papers**
Hsin-I Wang, National Chiao Tung University, Hsinchu, Taiwan Roc
- 29.3: **Late-News Paper: Improvement of Chroma and Theoretical Analysis of Silver Deposition-Based Multicolor Electrochromic Device**
Norihisa Kobayashi, Graduate School of Engineering, Chiba University, Chiba, Japan
- 29.4: **Late-News Paper: Stepped and Tiered Line Text Layout for Improving Reading Rate in Japanese Electronic Text Reader**
Jumpei Kobayashi, Dai Nippon Printing Co., Ltd., Tokyo, Japan

Session 30: Oxide TFTs I (Active-Matrix Devices)

Wednesday, May 15, 2019 / 9:00 AM - 10:00 AM / Room LL20D

Chair: *Yusin Lin, Applied Materials, Inc.*

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

- 30.1: **Invited Paper: Solution-Processing of CuI Thin-film for Transparent p-Type Electronics**
Myung-Gil Kim, Chung-Ang University, Seoul, South Korea
- 30.2: **Top-Gate Self-Aligned InGaZnO TFTs with High Reliability with a H-Incorporation Process**
Yun Long Jiang, Shenzhen China Star Optoelectronics Semiconductor Display Technology Co., Guangdong, China
- 30.3: **High-Performance All-Solution-Processed Oxide TFTs via Photo-induced Semiconductor-to-Conductor a-InZnO Transformation**
Juan Paolo Bermundo, Nara Institute of Science and Technology, Nara, Japan

Session 31: Characterization of Near-to-Eye Displays I (Augmented, Virtual and Mixed Reality / Display Measurement)

Wednesday, May 15, 2019 / 10:40 AM - 12:00 PM / Room 220B

Chair: *Chuck Yin, FACEBOOK INC*

Co-Chair: *Marja Salmimaa, Nokia Bell Labs*

- 31.1: **Distinguished Paper: Measurement and Categorization of Alternate Subpixel Layout Near-Eye Display Systems**
David Hoffman, Google, Mountain View, CA, US
- 31.2: **Measuring Interocular Geometric Distortion of Near-To-Eye Displays**
John Penczek, University of Colorado, Boulder, CO, US
- 31.3: **Eyebox Evaluation in AR/VR Near-To-Eye Display Testing**
Kun Li, Rokid Inc., San Carlos, CA, US
- 31.4: **Invited Paper: 3D Eyebox in Augmented and Virtual Reality Optics**
Ozan Cakmakci, Google, Mountain View, CA, US

Session 32: High Dynamic Range MicroLED Displays (Liquid-Crystal Technology / Emissive, MicroLED, and Quantum-Dot Displays)

Wednesday, May 15, 2019 / 10:40 AM - 12:10 PM / Room 220C

Chair: *Gang Xu, Huawei*

Co-Chair: *Khaled Ahmed, Intel Corporation*

- 32.1: **Invited Paper: Review of MicroLED Technology for Microdisplay Applications**
Taeil Jung, LG Display Co., Ltd., Seoul, South Korea
- 32.2: **Surface Ligands Optimization of Semiconductor CdSe/CdS Nanorods Aligned in Liquid Crystal Polymer Matrix**
Wanlong Zhang, Hong Kong University of Science and Technology, Hong Kong, Hong Kong
- 32.3: **Invited Paper: 12.1-inch 169-ppi Full-Color MicroLED Display Using LTPS-TFT Backplane**
Norio Sugiura, AU Optronics Corporation, Hsinchu, Taiwan Roc
- 32.4: **High Transparent Active Matrix Mini-LED Full Color Display with IGZO TFT Backplane**
Jack Fan, Shenzhen China Star Optoelectronics Semiconductor Display Technology Co., Ltd., Shenzhen, China

Session 33: OLED Materials II (OLEDs)

Wednesday, May 15, 2019 / 10:40 AM - 12:00 PM / Room LL21CD

Chair: *Chihaya Adachi, Kyushu University*

- 33.1: **Invited Paper: TADF Based OLED Devices**
Joong-Hwan Yang, LG Display, Seoul, South Korea
- 33.2: **Invited Paper: Lifetime Improvement of Thermally Activated Delayed Fluorescent Organic Light-Emitting Diodes**
Jun Yeob Lee, Sungkyunkwan University, Suwon, South Korea
- 33.3: **TADF Emitter Selection for Deep-Blue Hyper-Fluorescent OLEDs**
Thomas Baumann, cynora GmbH, Bruchsal, Germany
- 33.4: **Invited Paper: A Chemical Structure Approach Enhancing Light Outcoupling of Dopant OLEDs and Internal Quantum Efficiency of Non-Dopant OLEDs Having Bluish TADF Emitters**
Chin-Ti Chen, Academia Sinica, Taipei, Taiwan Roc

Session 34: Self-Aligned LCDs (Liquid-Crystal Technology)

Wednesday, May 15, 2019 / 10:40 AM - 11:40 AM / Room LL21EF

Chair: *Hoi-Sing Kwok, Hong Kong University of Science & Technology*

Co-Chair: Koichi Miyachi, JSR Corporation

- 34.1: **A Novel Reactive Monomer for Self-Vertical-Alignment Liquid Crystal Displays**
Yuichi Inoue, DIC Corporation, Saitama, Japan
- 34.2: **PI-less IPS/FFS Liquid Crystal Displays Utilizing Reactive LC with Diphenylacetylene Moiety**
Myong-Hoon Lee, Chonbuk National University, Jeonju, South Korea
- 34.3: **Development of Self-Alignment Advanced Super Dimensional Switching Technology and Prototype**
Ruizhi Yang, Beijing BOE Display Technology Co., Ltd., Beijing, China

Session 35: 3D and Holographic (Display Systems)

Wednesday, May 15, 2019 / 10:40 AM - 11:40 AM / Room LL20BC

Chair: Shinichi Uehara, AGC Inc.

Co-Chair: Brian Schowengerdt, University Of Washington

- 35.1: **WITHDRAWN**
- 35.2: **3D/ 2D Switchable Display System Based on Integral Imaging**
Qiong-Hua Wang, Beihang University, Beijing, China
- 35.3: **Polarization Dependent Switchable Micro-Lenticular Lens Arrays Using Optically Isotropic Liquid Crystals**
Seung Hee Lee, Chonbuk National University, Jeonju, South Korea
- 35.4: **Color Holographic Display Using Quantum-dot Doped Liquid Crystal**
Yunfeng Wang, Shanghai Jiao Tong University, Shanghai, China

Session 36: Display Technologies for e-Paper (E-Paper and Flexible Displays)

Wednesday, May 15, 2019 / 10:40 AM - 12:00 PM / Room LL20A

Chair: Makoto Omodani, Tokai University

Co-Chair: Norihisa Kobayashi, Chiba University, Department of Image and Materials Science

- 36.1: **Variable-Transmission Electrophoretic Films**
Michael McCreary, E Ink Corporation, Billerica, MA, US
- 36.2: **Magnetically Written Electrophoretic Display**
Michael McCreary, E Ink Corporation, Billerica, MA, US
- 36.3: **Tablet-Size eTIR Display for Low-Power ePaper Applications with Color Video Capability**
Peter Kazlas, CLEARink Displays, Fremont, CA, US
- 36.4: **Full Color Active Matrix Video E-paper**
Alex Henzen, South China Normal University, Guangzhou, China

Session 37: Oxide TFTs II (Active-Matrix Devices)

Wednesday, May 15, 2019 / 10:40 AM - 11:40 AM / Room LL20D

Chair: Sang Hee Park, KAIST

Co-Chair: Mike Hack, Universal Display Corporation

- 37.1: **Liquid Crystal Display Panel with a Pixel Including Oxide Semiconductor Field-effect Transistor Memory (Pixel AI)**
Koji Kusunoki, Semiconductor Energy Laboratory Co., Ltd., Atsugi, Japan
- 37.2: **Development of High Mobility Top-Gate IGZO-TFT for OLED Displays**
Yujiro Takeda, Sharp Corporation, Nara, Japan
- 37.3: **Late-News Paper: Achieving High Field-Effect Mobility Exceeding 60 cm²/Vs in IZTO Transistor via Metal-Assisted Crystallization**
Nuri On, Hanyang University, Seoul, South Korea

Session 38: Characterization of Near-to-Eye Displays II (Augmented, Virtual and Mixed Reality / Display Measurement)

Wednesday, May 15, 2019 / 3:30 PM - 4:50 PM / Room 220B

Chair: Dr. Michael Becker, Display-Messtechnik&Systeme

Co-Chair: Thomas Fiske, Microsoft

- 38.1: **Transverse Chromatic Aberrations in Virtual Reality Devices**
Aldo Badano, OSEL/CDRH/FDA, Silver Spring, MD, US
- 38.2: **Single-Shot Scan-less Method for Virtual Image Distance Measurement for Near-To-Eye Display Systems**
Kaikai Guo, Rokid Inc., San Carlos, CA, US
- 38.3: **Evaluating Augmented Reality (AR) Eyewear Display Under Ambient Environment**
Xi Mou, Hangzhou SANT Technology Co., Ltd., Zhejiang, China
- 38.4: **Ambient Color Volume Measurements for Augmented Reality Displays**
Shao-Tang Hung, Industrial Technology Research Institute, Hsinchu, Taiwan Roc

Session 39: Low-Power AMDs (Active-Matrix Devices)

Wednesday, May 15, 2019 / 3:30 PM - 4:30 PM / Room 220C

Chair: Hyun Jae Kim, Yonsei University

Co-Chair: Kwon-Shik Park, LG Display

- 39.1: **A Low-Power Reflective LCD based on a-Si:H TFT Process**
Lei Wang, Tianma Micro-Electronics Group, Shanghai, China
- 39.2: **Development of Advanced LTPS TFT Technology for Low Power Consumption and Narrow Border LCDs**
Hajime Watakabe, Japan Display Inc., Chiba, Japan
- 39.3: **Invited Paper: LTPO TFT Technology for AM-OLEDs**
Ting-Kuo Chang, Apple Inc., Cupertino, CA, US

Session 40: OLED Materials III (OLEDs)

Wednesday, May 15, 2019 / 3:30 PM - 4:00 PM / Room LL21CD

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

Co-Chair: *Yasunori Kijima, Huawei Technologies Co Ltd.*

- 40.1: **Invited Paper: Blue Emitting Square Planar Metal Complexes for Displays and Lighting Applications**
Jian Li, Arizona State University, Tempe, AZ, US
- 40.2: **Invited Paper: Polymer-Diluted Small Molecule Organic Semiconductors with Extreme Thermal Stability**
Noel Giebink, Penn State University, University Park, PA, US
- 40.3: **Highly Stable Deep-Blue OLED Achieved by Hole-Transport Material with Deep HOMO Level**
Takumu Okuyama, Semiconductor Energy Laboratory Co., Ltd., Atsugi, Japan
- 40.4: **High-Temperature Operational Stability of Deep-Red Phosphorescent OLED with Exciplex-Forming Host Material and Guest Material**
Tomoya Yamaguchi, Semiconductor Energy Laboratory Co., Ltd., Atsugi, Japan

Session 41: MiniLED Displays (Liquid-Crystal Technology / Display Systems)

Wednesday, May 15, 2019 / 3:30 PM - 4:30 PM / Room LL21EF

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

- 41.1: **Invited Paper: Active Matrix, Mini-LED, 130,000 Nit Backlights for 1000PPI VR LCD**
Yang-En Wu, AU Optronics Corporation, Hsinchu, Taiwan Roc
- 41.2: **Invited Paper: An Advanced High Dynamic Range LCD for Smartphone**
Binyi Zheng, Xiamen Tianma Microelectronics Co., Ltd., Xiamen, China
- 41.3: **Mini-LED Enhanced LCD for High Dynamic Range Displays**
Yuge Huang, University of Central Florida, Orlando, FL, US

Session 42: Projection and Projection Screens (Display Systems)

Wednesday, May 15, 2019 / 3:30 PM - 4:50 PM / Room LL20BC

Chair: *David Eccles, Rockwell Collins*

Co-Chair: *Sergei Yakovenko, Apple*

- 42.1: **Invited Paper: Bit-Depth Constrained Black Level for High Dynamic Range Displays**
Ronan Boitard, Barco - MTT Innovation, Vancouver, BC, Canada
- 42.2: **The Evaluation for Visibility of a Back Image on a Transparent Screen**
Yukihiro Tao, AGC Inc., Yokohama, Japan
- 42.3: **Novel Transparent Screen Combined with Light Guide System**
Shusuke Arita, FUJIFILM Corporation, Minamiashigara, Japan
- 42.4: **360-Degree Tabletop Type 3D Screen System Using Linear Blending of Viewing Zones and Spatially Imaged Iris Plane**
Motohiro Makiguchi, NTT Corporation, Yokosuka, Japan

Session 43: Flexible Liquid-Crystal Displays (E-Paper and Flexible Displays / Liquid-Crystal Technology / Bendable, Foldable and Rollable Displays)

Wednesday, May 15, 2019 / 3:30 PM - 4:30 PM / Room LL20A

Chair: *Bo-Ru Yang, Sun Yat-Sen University*

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

- 43.1: **Invited Paper: Flexible Nano-Phase-Separated LCDs for Future Sheet-Type Display Applications**
Takahiro Ishinabe, Tohoku University, Sendai, Japan
- 43.2: **Optical Characteristics of Curved Flexible Light Sources (FLSs) with Small Radius and Metrology Issues**
K Kälántár, CEREBBA, Tsukuba, Japan
- 43.3: **14 inch Flexible LCD Display with Colorless Polyimide**
Yu Shi, Shenzhen China Star Optoelectronics Semiconductor Display Technology Co., Ltd, Shenzhen, China

Session 44: Interactive Displays (Interactive Displays and Systems)

Wednesday, May 15, 2019 / 3:30 PM - 4:50 PM / Room LL20D

Chair: *Steven Bathiche, Microsoft*

Co-Chair: *Jeff Han, Consultant*

- 44.1: **Photo Sensors Embedded within TFT-LCD with Three Primary Colors Touch Function**
Chia-Wei Kuo, AU Optronics Corporation, Hsinchu, Taiwan Roc
- 44.2: **Distinguished Paper: A Full Integration of Electromagnetic Resonance Sensor and Capacitive Touch Sensor into LCD**
Satoshi Uchino, Japan Display Inc., Ebina City, Japan

- 44.3: **3-layer Capacitive Touch + Piezo-electric Force Sensor Utilizing Shared Electrodes and Transparent P(VDF-TrFE) Film**
Jean de Dieu Mugiraneza, Sharp Corporation, Nara, Japan
- 44.4: **In-Cell Capacitive Hover Touch Development for a Non-Contact Application**
Naoki Takada, Japan Display Inc., Ebina, Japan

Session 45: Advanced Technologies for Near-to-Eye Displays (Augmented, Virtual and Mixed Reality / Display Systems)

Thursday, May 16, 2019 / 9:00 AM - 10:00 AM / Room 220B

Chair: *Brian Schowengerdt, University Of Washington*

Co-Chair: *David Eccles, Rockwell Collins*

- 45.1: **WITHDRAWN**
- 45.2: **Achromatic Test of Pancharatnam Phase lens for VR/AR Applications**
Comrun Yousefzadeh, Kent State University, Kent, OH, US
- 45.3: **A Four Depth Plane Near-Eye Display Without Sacrificing Frame Rate**
Jianghao Xiong, University of Central Florida, Orlando, FL, US
- 45.4: **Near-Eye Foveated Display for Achieving Human Visual Acuity**
Guanjun Tan, University of Central Florida, Orlando, FL, US

Session 46: Foldable AMOLEDs (Bendable, Foldable and Rollable Displays / E-Paper and Flexible Displays)

Thursday, May 16, 2019 / 9:00 AM - 10:20 AM / Room 220C

Chair: *Kyung Cheol Choi, KAIST*

Co-Chair: *Jennifer Lin, AU Optronics*

- 46.1: **Invited Paper: High Impact Resistance Out-Fold Touch AMOLED Display Module**
Glory Chen, Industrial Technology Research Institute (ITRI), Hsinchu, Taiwan Roc
- 46.2: **Invited Paper: A Flexible OLED Display with Robustness and Bendability**
Shingo Eguchi, Semiconductor Energy Laboratory Co., Ltd., Atsugi, Japan
- 46.3: **5.5-inch Full HD Foldable AMOLED Display Based on Neutral-Plane Splitting Concept**
Masumi Nishimura, Japan Display Inc., Mobara, Japan
- 46.4: **WITHDRAWN**

Session 47: QLED I (Emissive, MicroLED, and Quantum-Dot Displays)

Thursday, May 16, 2019 / 9:00 AM - 10:20 AM / Room LL21CD

Chair: *Ruiqing Ma, Nanosys*

Co-Chair: *Poopathy Kathirgamanathan, Brunel University*

- 47.1: **Invited Paper: Lifetime: The Key to the Bright Future of QLED Displays**
Chaoyu Xiang, TCL Corporate Research, Shenzhen, China
- 47.2: **A Calibrated Simulation of Electroluminescent QLEDs**
Tim Smeeton, Sharp Laboratories of Europe Ltd., Oxford, United Kingdom
- 47.3: **AMQLED Display with Highly Efficient Oxide N-P Charge Generation Junction**
Jin Jang, Kyung Hee University, Seoul, South Korea
- 47.4: **Aging Behaviors of QLED with Different Structures**
Zinan Chen, Southern University of Science and Technology, Shenzhen, China

Session 48: Display Substrates and Materials (Display Manufacturing)

Thursday, May 16, 2019 / 9:00 AM - 10:20 AM / Room LL21EF

Chair: *Dr. Andriy Romanyuk, Glas Troesch AG*

Co-Chair: *Yukio Endo, AGC Inc.*

- 48.1: **Impact of Carrier Glass Substrate Characteristics on Flexible OLED Display Production**
Kazutaka Hayashi, AGC Inc., Yokohama, Japan
- 48.2: **MOVED TO P.216**
- 48.3: **Edge Strength Measurement of Ultra-Thin LCD Panels**
Bosun Jang, Corning Incorporated, Corning, NY, US
- 48.4: **Analysis of Fracture Mechanism in Sand Paper Drop Test for Cover Glass**
Akio Koike, AGC Inc., Yokohama, Japan

Session 49: Augmented Reality HUD I (Automotive/Vehicular Displays and HMI Technologies / Display Systems)

Thursday, May 16, 2019 / 9:00 AM - 10:20 AM / Room LL20BC

Chair: *David Hermann, Volvo Car Corporation AB*

Co-Chair: *Hidekazu Hatanaka, Ushio Inc.*

- 49.1: **Invited Paper: Analog LCOS SLM Devices for Display Applications**
Kuan-Hsu Fan-Chiang, Himax Display Inc., Tainan, Taiwan Roc
- 49.2: **Distinguished Student Paper: High-Efficiency Switchable Optical Elements for Advanced Head-Up Displays**

Tao Zhan, University of Central Florida, Orlando, FL, US

49.3: **Invited Paper: Holographic Augmented Reality Head up Display for Vehicle Application**

Cheng-Huan Chen, National Chiao Tung University, Hsinchu, Taiwan Roc

49.4: **Late-News Paper: Intermediate Screen Considered Negative Impact by Ambient Light for Augmented Reality Head-Up Display Systems**

Atsushi Nagasawa, KURARAY CO., LTD., Chiyoda-ku, Tokyo, Japan

Session 50: Temporal Measurement: Flicker & Image Retention (Display Measurement)

Thursday, May 16, 2019 / 9:00 AM - 10:20 AM / Room LL20A

Chair: Stephen Atwood, Eaton Corporation

Co-Chair: Jürgen Neumeier, Instrument Systems GmbH

50.1: **Flicker from Electronic Displays - Reconsidering the Confusion**

Michael Becker, Instrument Systems GmbH, München, Germany

50.2: **Towards Modern Burn-in Assessment Method for HDR Displays**

Jae Sung Park, Samsung Electronics, Suwon, South Korea

50.3: **Aspects of Image Sticking Evaluations Using Imaging Luminance Measurement Devices**

Ingo Rotscholl, TechnoTeam Bildverarbeitung GmbH, Ilmenau, Germany

50.4: **A Novel Evaluation Method for Short-Residual Image of AMOLED Display**

Jintao Peng, BOE Technology Group Co., Ltd., Beijing, China

Session 51: 8K AMLCDs (Active-Matrix Devices / Liquid-Crystal Technology)

Thursday, May 16, 2019 / 9:00 AM - 10:00 AM / Room LL20D

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

Co-Chair: Shui Chih Lien, CSOT

51.1: **Novel Pixel Structure for 8K QUHD LCD Panel with the Enhanced Optical Performances**

Kwang Soo Bae, Samsung Display, Yongin, South Korea

51.2: **Pixel Design Solutions for Transmittance Improvement in 8k VA LCD**

Yinfeng Zhang, Shenzhen China Star Optoelectronics Technology Co., Ltd., Shenzhen, China

51.3: **New ADS Pixel Design with Black Post Spacer for 8k Application**

Hong-run Wang, BOE Technology Group Co., Ltd., Beijing, China

Session 52: OLED AR/VR Applications (Augmented, Virtual and Mixed Reality / OLEDs)

Thursday, May 16, 2019 / 10:40 AM - 12:00 PM / Room 220B

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

Co-Chair: Tariq Ali, EMagin Corporation

52.1: **Invited Paper: Microdisplays for Wearable Augmented Reality – OLED vs LED based systems**

Gunther Haas, MICROOLED S.A.S., Grenoble, France

52.2: **Invited Paper: A New 0.64” 720p OLED Microdisplay for Application in Industrial See-Through AR HMD**

Uwe Vogel, Fraunhofer Institute for Organic Electronics, Dresden, Germany

52.3: **Distinguished Paper: High-Efficiency OLED Microdisplay with Microlens Array**

Yosuke Motoyama, Sony Semiconductor Solutions Corporation, Kanagawa, Japan

52.4: **Highest PPI Micro-OLED Display Sustain for Near-Eye Application**

Pengcheng Lu, BOE Technology Group Co., Ltd., Kunming, China

Session 53: Foldable Display Components (E-Paper and Flexible Displays / Bendable, Foldable and Rollable Displays)

Thursday, May 16, 2019 / 10:40 AM - 12:00 PM / Room 220C

Chair: Paul Drzaic, Apple, Inc.

Co-Chair: Simon Kang, Apple

53.1: **Invited Paper: Advanced Materials for Flexible Displays**

Daniel LeCloux, DuPont Electronics & Imaging, Wilmington, DE, US

53.2: **Highly Self-Healable Coating Materials with Improved Mechanical Surface Properties for Flexible Electronic Displays**

Sung Woo Hong, Korea Institute of Industrial Technology, Cheonan, South Korea

53.3: **Invited Paper: Out-Foldable Smartphone Will Be Real?: Challenges for Developing Glass-Like Cover Plastic Films**

Byeong-Soo Bae, Korea Advanced Institute of Science and Technology, Daejeon, South Korea

53.4: **Rigid/Soft/Rigid type cover window for foldable display**

Yong-Cheol Jeong, KITECH, Ansan, South Korea

Session 54: QDEL II (Emissive, MicroLED, and Quantum-Dot Displays)

Thursday, May 16, 2019 / 10:40 AM - 12:20 PM / Room LL21CD

Chair: Masayuki Nakamoto, Shizuoka University

Co-Chair: Yajie Dong, University of Central Florida

54.1: **Invited Paper: Development of Electroluminescent QLED Displays**

- Tim Smeeton, Sharp Laboratories of Europe Ltd., Oxford, United Kingdom*
- 54.2: Fabrication of Ink-Jet Printing Quantum-Dots Light Emitting Diodes using Optimization of Co-Solvent Condition**
Young Joon Han, Korea Institute of Industrial Technology (KITECH), Ansan, South Korea
- 54.3: Bright Quantum Dots LEDs Enabled by Imprinted Random Nanostructures**
Hao Chen, University of Central Florida, Orlando, FL, US
- 54.4: Intense Pulsed Light Annealed ZnO for the Production of High Efficiency Inverted QLEDs**
Poopathy Kathirgamanathan, Brunel University, London, United Kingdom
- 54.5: New Technologies for Colouring in Displays**
Armin Wedel, Fraunhofer Institute for Applied Polymer Research, Geiselbergstrasse, Germany

Session 55: Enabling High-Resolution TFTs (Display Manufacturing)

Thursday, May 16, 2019 / 10:40 AM - 12:00 PM / Room LL21EF

Chair: *Dr. Chi Woo Kim, Seoul National University*

Co-Chair: *Joerg Winkler, Plansee SE*

- 55.1: Roadmapping Strategies for Rapidly Diversifying FPD Applications and Manufacturing Technologies**
Charles Annis, IHS Markit, Tokyo, Japan
- 55.2: Essential Mask Quality for High-End Resolution Displays**
Myung Yong Kim, PKL Ltd./Photronics, Cheonan, South Korea
- 55.3: Distinguished Paper: Development of G6 Exposure Tool for 1.2 µm Resolution**
Kouhei Nagano, Canon Inc., Utsunomiya, Japan
- 55.4: XTPL Approach to Print Conductive Structures in Microscale for Next Generation Displays**
Piotr Kowalczewski, XTPL S.A., Wroclaw, Poland

Session 56: Augmented Reality HUD II (Automotive/Vehicular Displays and HMI Technologies / Display Systems)

Thursday, May 16, 2019 / 10:40 AM - 12:10 PM / Room LL20BC

Chair: *Satoshi Ouchi, Hitachi, Ltd*

Co-Chair: *Haruhiko Okumura, Toshiba Corporation*

- 56.1: A Multiplane Holographic HUD Using Light Selectivity of Bragg Grating**
Philippe Coni, Thales Avionics, Merignac, France
- 56.2: Triple Viewing Zone Tabletop Holographic 3D Display**
Wen Qiao, Soochow University, Suzhou, China
- 56.3: A Novel Emissive Projection Display (EPD) on Fully-Transparent Phosphor Screen**
Ted Sun, Sun Innovations Inc., Fremont, CA, US
- 56.4: High-Heat-Resistant Nano/Micro-Structured Optical Elements Fabricated by Sol-Gel Imprinting**
Ayano Takeshita, JXTG Nippon Oil & Energy Corp., Yokohama, Japan
- 56.5: Late-News Paper: Table Top Visually Equivalent Light Field 3D Display Using 15.6-inch 4K LCD Panel**
Munekazu Date, NTT Media Intelligence Laboratories, Nippon Telegraph and Telephone Corporation, Kanagawa, Japan

Session 57: Novel & Emerging Technologies (Emerging Technologies and Applications)

Thursday, May 16, 2019 / 10:40 AM - 12:20 PM / Room LL20A

Chair: *Gary Jones, Nanoquantum Corporation*

Co-Chair: *Fang-Cheng Lin, Apple Inc*

- 57.1: Invited Paper: AirTouch System: Hand Skeleton Modelling for Augmented HMI Interactions**
Marc Pastre, Advanced Silicon SA, Lausanne, Switzerland
- 57.2: Distinguished Paper: Laser-Addressed Full-Color Photo-Quality Rewritable Sheets Based on Thermochromic Systems with Leuco Dyes**
Yuriko Kaino, Sony Corporation, Atsugi, Japan
- 57.3: Distinguished Student Paper: EEG Analysis of Mixed Reality Music Rehabilitation System for Post-Stroke Lower Limb Therapy**
Li-Wei Ko, National Chiao Tung University, Hsinchu, Taiwan Roc
- 57.4: Solid State Reflective Display (SRD®) with LTPS Diode Backplane**
Ben Broughton, Bodle Technologies Ltd, Oxford, United Kingdom
- 57.5: An Enhancement of Sound Quality by Using the Single Exciter in OLED Panel**
Sungtae Lee, LG Display, Paju, South Korea

Session 58: Narrow Bezel (Active-Matrix Devices)

Thursday, May 16, 2019 / 10:40 AM - 11:40 AM / Room LL20D

Chair: *Dr. Kalluri Sarma, Honeywell, Inc*

Co-Chair: *Junho Song, Korea University*

- 58.1: Bezel Free Design of Organic Light Emitting Diodes via a-InGaZnO Gate Driver Circuit Integration within Active Array**
Kyung Min Kim, LG Display, Seoul, South Korea
- 58.2: Low Power and Narrow Border 8K Notebook Display with SmartView**
Hui Zhang, BOE Technology Group Co., Ltd., Beijing, China
- 58.3: Development of 4 side Narrow Border UHD Display with TopGate IGZO-TFT and DeMUX Technology**
Tetsuo Kikuchi, Sharp Corporation, Kameyama, Japan

Session 59: Diffractive LC Technologies for AR/VR (Augmented, Virtual and Mixed Reality / Liquid-Crystal Technology)

Thursday, May 16, 2019 / 1:30 PM - 2:50 PM / Room 220B

Chair: Philip Bos, Kent State University

Co-Chair: Michael Wittek, Merck KGaA

- 59.1: **Invited Paper:** Liquid-Crystal Technology for Solving Key Optics Challenges in Virtual and Augmented Reality
Lu Lu, Facebook Reality Labs, Redmond, WA, US
- 59.2: **Distinguished Student Paper:** Stretchable, Flexible and Adherable Polarization Volume Grating Film for Waveguide-Based AR Displays
Kun Yin, University of Central Florida, Orlando, FL, US
- 59.3: **Active Refractive and Diffractive Liquid-Crystal Microlens Arrays Enabled by Two-Photon Polymerization**
Ziqian He, University of Central Florida, Orlando, FL, US
- 59.4: **Fast-Response Polarization Volume Gratings for AR/VR Displays**
Ran Chen, University of Central Florida, Orlando, FL, US

Session 60: OLED Displays I (OLEDs)

Thursday, May 16, 2019 / 1:30 PM - 3:00 PM / Room 220C

Chair: Yifan Zhang, Apple, Inc.

Co-Chair: Jang Hyuk Kwon, Kyung Hee University

- 60.1: **Invited Paper:** Highly Transparent AMOLED Display with Interactive System
Kuan-Ting Chen, Industrial Technology Research Institute (ITRI), Hsinchu, Taiwan Roc
- 60.2: **Panel Design Technology for a 31-inch GOA Drived AMOLED Display with BYYB OLED Structure and Slim Border**
Yan Xue, Peking University, Shenzhen, China
- 60.3: **Study on the Efficiency Improvement of OLED TVs with High Transmittance Technology of the Polarizer**
Seong Han Hwang, LG Display, Seoul, South Korea
- 60.4: **WITHDRAWN**
- 60.5: **Late-News Paper:** 17-inch Transparent AMOLED Display With Self-Assembled Auxiliary Electrode
Zhibin Wang, OTI Lumionics Inc., Toronto, ON Canada

Session 61: Color (Applied Vision)

Thursday, May 16, 2019 / 1:30 PM - 2:50 PM / Room LL21CD

Chair: Jennifer Gille, Oculus

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

- 61.1: **Invited Paper:** Enhanced Viewing Experience Considering Chromatic Adaptation
Jiaying Wu, Apple Inc., Cupertino, CA, US
- 61.2: **Color Gamut of Multi-Chromatic Displays**
Kenichiro Masaoka, NHK Science & Technology Research Laboratories, Tokyo, Japan
- 61.3: **Invited Paper:** CIE Activities on Wide Color Gamut and High Dynamic Range Imaging
Po-Chieh Hung, Apple Inc., Cupertino, CA, US
- 61.4: **LER Constrained Primary Color Optimization for an Ultra-Wide Gamut Display**
Hongya Song, Zhejiang University, Hangzhou, China

Session 62: Oxide TFT Manufacturing (Display Manufacturing / Active-Matrix Devices)

Thursday, May 16, 2019 / 1:30 PM - 2:50 PM / Room LL21EF

Chair: Dr. Chi Woo Kim, Seoul National University

Co-Chair: Kenichi Takatori, Huawei Technologies Japan K.K.

- 62.1: **Invited Paper:** Highly Stable Self-Aligned Coplanar InGaZnO Thin-Film Transistors and Investigation on Effective Channel Length
Jung Bae Kim, Applied Materials, Santa Clara, CA, US
- 62.2: **Highly Reliable Shift Register with Coplanar a-IGZO TFTs by Splitting Top Gate into Dual Gates**
Jin Jang, Kyung Hee University, Seoul, South Korea
- 62.3: **A 120Hz 8-Domain 8k4k LCD with Oxide TFT**
BoLiang Yeh, AU Optronics Corporation, Hsinchu, Taiwan Roc
- 62.4: **Late-News Paper:** Evaluation of Polycrystalline Silicon after Eximer Laser Annealing by Retardation Measurement Method
Nakcho Choi, OLED Panel Development Team, Samsung Display Co., Ltd., Yongin-City, South Korea

Session 63: Novel Auto Materials & Shapes (Automotive/Vehicular Displays and HMI Technologies)

Thursday, May 16, 2019 / 1:30 PM - 2:50 PM / Room LL20BC

Chair: Rashmi Rao, Harman/Samsung Inc

Co-Chair: David Hermann, Volvo Car Corporation AB

- 63.1: **High Brightness Bendable Backlight Including a Glass Light Guide**
Xiang-Dong Mi, Corning Research & Development Corporation, Corning, NY, US

- 63.2: **Room Temperature Curable Liquid Optical Clear Adhesive for Automotive Display**
Brandon Swatowski, Dow Chemical, Midland, MI, US
- 63.3: **Advances In Driving Technology For Free-Form LCDs**
Cheng-Kuang Wang, AU Optronics Corporation, Hsinchu, Taiwan Roc
- 63.4: **Invited Paper: New Technology for Improving Automotive Head-Up Displays (HUDs)**
John VanDerlofske, 3M, St. Paul, MN, US

Session 64: Novel Imaging Applications (Emerging Technologies and Applications)

Thursday, May 16, 2019 / 1:30 PM - 2:30 PM / Room LL20A

Chair: *Timothy Large, Microsoft Corp*

Co-Chair: *Vincent Gu, Apple, Inc.*

- 64.1: **Lensless Microscope Using High-Resolution Display**
Yusuke Negoro, Semiconductor Energy Laboratory Co., Ltd., Atsugi, Japan
- 64.2: **Movable Electrowetting Optofluidic Lens for Imaging System**
Qiong-Hua Wang, Beihang University, Beijing, China
- 64.3: **An Intelligent System for Vision Screening and Training**
Xiaoke Li, Sun Yat-sen University, Guangzhou, China
- 64.4: **WITHDRAWN**

Session 65: Advanced Materials for Lighting (Lighting)

Thursday, May 16, 2019 / 1:30 PM - 2:50 PM / Room LL20D

Chair: *Marina Kondakova, OLEDWorks*

Co-Chair: *Larry Sadwick, INNOSYS*

- 65.1: **Invited Paper: Narrow Spectrum Deep Red Emitters for OLED Lighting and Display**
Eric Margulies, UDC, Inc., Ewing, NJ, US
- 65.2: **Invited Paper: Enabling Technology for MicroLED Display Based on Quantum Dot Color Converter**
Jung Han, Yale University, New Haven, CT, US
- 65.3: **Light Diffusing, Down-Converting Perovskite-on-Polymer Microspheres**
Caicai Zhang, University of Central Florida, Orlando, FL, US
- 65.4: **Perovskite Downconverters for Optimized Solid-State Lighting**
Ziqian He, University of Central Florida, Orlando, FL, US

Session 66: Fast-Response LC for AR/VR (Augmented, Virtual and Mixed Reality / Liquid-Crystal Technology)

Thursday, May 16, 2019 / 3:10 PM - 4:30 PM / Room 220B

Chair: *Dr. Philip Chen, National Chiao Tung University*

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

- 66.1: **Invited Paper: Fast-Response IPS-LCDs Used in VR Applications**
Toshiharu Matsushima, Japan Display Inc., Mobara, Japan
- 66.2: **High Transmittance and Fast Response FFS LCD for AR and VR Displays**
Javed Talukder, University of Central Florida, Orlando, FL, US
- 66.3: **Submillisecond-Response 10-Megapixel 4K2K LCoS for Microdisplay and Spatial Light Modulator**
Jhou Pu Yang, National Chiao Tung University, Hsinchu, Taiwan Roc
- 66.4: **Late-News Paper: Fast Dichroic-Dye-Doped Cholesteric Liquid Crystals Light Shutter**
Philip Bos, Kent State University, Kent, OH US

Session 67: OLED Displays II (OLEDs)

Thursday, May 16, 2019 / 3:10 PM - 4:30 PM / Room 220C

Chair: *DZ Peng, Tianma*

Co-Chair: *Neetu Chopra, Kateeva*

- 67.1: **Invited Paper: Design of an Advanced Bottom-Emission AMOLED Display for TVs with High Ppi and Large Size**
Yuan-Chun Wu, Shenzhen China Star Optoelectronics Semiconductor Display Technology Co., Ltd., Shenzhen, China
- 67.2: **5.5-inch Full Screen Flexible High-resolution OLED display Fabricated by Ink Jet Printing Method**
Dejiang Zhao, BOE Technology Group Co., Ltd., Beijing, China
- 67.3: **Unique Belt Plane Source Evaporation Techniques for the mass production of 2250ppi AMOLED and 77**
Changhun Hwang, OLEDON, Yongin, South Korea
- 67.4: **Electrical and Optical Modeling for Cross-Talk between adjacent pixels in Organic Light-Emitting Diode Displays**
Daniele Braga, Fluxim AG, Winterthur, Switzerland

Session 68: Machine Learning and Image Quality (Applied Vision / Display Electronics)

Thursday, May 16, 2019 / 3:10 PM - 4:30 PM / Room LL21CD

Chair: *Yi Pai Huang, National Chiao Tung University*

Co-Chair: *Mainak Biswas, Google*

- 68.1: **A Machine Learning Based Approach to Objective Image Quality Evaluation**
Gregory Cook, Samsung Display America Lab, San Jose, CA, US

- 68.2: **Data-driven Image Enhancement Using Deep Neural Networks for a Display Image Pipeline**
Sewhan Na, Samsung Electronics, Hwaseong, South Korea
- 68.3: **DeepFatigueNet: A Model for Automatic Visual Fatigue Assessment Based on Raw Single-Channel EEG**
Danli Wang, Chinese Academy of Sciences, Beijing, China
- 68.4: **Speedy and Quantitative Evaluation of Luminance Non-Uniformity Based on Deep Neural Networks**
Kazuki Tsutsukawa, ELZO Corporation, Hakusan, Japan
- 68.5: **WITHDRAWN**

Session 69: Processes for Cost-Down Manufacturing (*Display Manufacturing*)

Thursday, May 16, 2019 / 3:10 PM - 4:10 PM / Room LL21EF

Chair: *Dr Robert Visser, Applied Materials*

Co-Chair: *Greg Gibson, nTact*

- 69.1: **Etch Properties of Silicon Nitride Films Using a New In-Line Equipment with Atmospheric Glow Plasma for The OLED Flexible Display**
Jang Sick Park, APP Co., Ltd., Hwaseong, South Korea
- 69.2: **Invited Paper: Improved ZnO Based Materials for To-Date Flat Panel Displays**
Victor Belyaev, Moscow Region State University, Lobnya, Russian Fed.
- 69.3: **Distinguished Paper: Large-Area Spatial Atomic Layer Deposition of Amorphous Oxide Semiconductors at Atmospheric Pressure**
Ilias Katsouras, TNO / Holst Centre, Eindhoven, Netherlands

Session 70: Active Contact Lenses (*Emerging Technologies and Applications*)

Thursday, May 16, 2019 / 3:10 PM - 4:30 PM / Room LL20BC

Chair: *Ian Underwood, University of Edinburgh*

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

- 70.1: **Invited Paper: Design of Active Liquid Crystal Based Contact Lenses**
Dieter Cuyppers, imec and Ghent University, Ghent, Belgium
- 70.2: **Invited Paper: Developments in Electroactive Lens Technology for Vision Correction**
Harry Milton, eVision Optics, Sarasota, FL, US
- 70.3: **Invited Paper: Polarisation Independent Liquid Crystal Lenses using Embossed Reactive Mesogens**
J. Cliff Jones, University of Leeds, Leeds, United Kingdom
- 70.4: **Late-News Paper: Electronic Contact Lens for Senses Beyond Sight**
Matthew Donora, University of Edinburgh, School of Engineering, Edinburgh, United Kingdom

Session 71: Optical Fingerprint Sensing Displays (*Interactive Displays and Systems*)

Thursday, May 16, 2019 / 3:10 PM - 4:30 PM / Room LL20A

Chair: *Patrick Worfolk, Synaptics*

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

- 71.1: **Large-Area Optical Fingerprint Sensors for Next Generation Smartphones**
Hylke Akkerman, TNO / Holst Centre, Eindhoven, Netherlands
- 71.2: **Novel Optical Photo Sensor Array using LTPS-TFT Backplane Technology as Fingerprint Recognition**
Bozhi Liu, XiaMen Tianma Microelectronics, Xiamen, China
- 71.3: **Organic Photolithography for Displays with Integrated Fingerprint Scanner**
Pawel Malinowski, imec, Leuven, Belgium
- 71.4: **Distinguished Paper: OLED Display Incorporating Organic Image Sensor**
Taisuke Kamada, Semiconductor Energy Laboratory Co., Ltd., Atsugi, Japan

Session 72: Advanced Solid-State Lighting Systems (*Lighting*)

Thursday, May 16, 2019 / 3:10 PM - 4:50 PM / Room LL20D

Chair: *Eric Margulies, Universal Display Corporation*

Co-Chair: *Jay Liu, ShineOn (Beijing) Technology Co., Ltd.*

- 72.1: **Invited Paper: Critical Components in Solid-State Lighting**
Larry Sadwick, InnoSys, Inc., Salt Lake City, UT, US
- 72.2: **Invited Paper: Prospect for the Integration of Illumination and Display Technologies**
Robert Karlíček, Rensselaer Polytechnic Institute, Troy, NY, US
- 72.3: **Invited Paper: Dynamic Color Control in Multiprimary Tunable LED Lighting Systems**
Michael Murdoch, Rochester Institute of Technology, Rochester, NY, US
- 72.4: **Design of Diffractive Optical Element for Laser Phosphor Lighting with Uniform Illumination without Zero-Order Effect**
Min-Chian Wu, National Taiwan University, Taipei, Taiwan Roc
- 72.5: **Effect of LED Tunable White Light with Different Blue-components on Visual Fatigue**
Yan Tu, Southeast University, Nanjing, China

Session 73: Light-Field and Holographic Waveguide AR Displays (*Augmented, Virtual and Mixed Reality / Display Systems*)

Friday, May 17, 2019 / 9:00 AM - 10:30 AM / Room 220B

Chair: *W. Hendrick, Rockwell Collins Optronics*

Co-Chair: *K Kälantär, Global Optical Solutions*

- 73.1: **Direct See-Through AR HMD Based on Light Field Technology with LC MLA**
Yu-Ting Chen, National Chiao Tung University, Hsinchu, Taiwan Roc
- 73.2: **Wearable Display System Combined Directional Scattering Holographic Waveguide with Goggle**
Juan Liu, Beijing Engineering Research Center for Mixed Reality and Advanced Display, Beijing, China
- 73.3: **High Refractive Index Photopolymer Fabricated Holographic Grating used for RGB Waveguide-Type Display**
Yuning Zhang, Southeast University, Nanjing, China
- 73.4: ***Distinguished Paper:* Image Formation Modeling and Analysis of Near-Eye Light Field Displays**
Zong Qin, National Chiao Tung University, Hsinchu, Taiwan Roc
- 73.5: ***Late-News Paper:* Simplified Implementation of Super Multi-View Head-Mounted Display**
Yasuhiro Takaki, Tokyo University of Agriculture and Technology, Koganei, Tokyo, Japan

Session 74: Bendable OLEDs (OLEDs)

Friday, May 17, 2019 / 9:00 AM - 10:00 AM / Room 220C

Chair: *JJ Lih, CPT Technology Group*

Co-Chair: *DZ Peng, Tianma*

- 74.1: **A New Flexible Thin Film Encapsulation Structure with High Reliability and Better Optical Performance**
Tian Fu Guo, Wuhan China Star Optoelectronics Semiconductor Display Technology Co. Ltd., Wuhan, China
- 74.2: **A Highly Bending Performance Polymer Film for The Foldable AMOLED Displays**
Gu Peng Hao, BOE Technology Group Co., Ltd., Beijing, China
- 74.3: **Study on Mechanical Behavior and Effect of Adhesive Layers in Foldable AMOLED Display by Finite Element Analysis**
Aries Cheng, Tianma Microelectronics Group, Shanghai, China

Session 75: Quantum-Dot LCDs (Emissive, MicroLED, and Quantum-Dot Displays / Liquid-Crystal Technology)

Friday, May 17, 2019 / 9:00 AM - 10:20 AM / Room LL21CD

Chair: *John Van Derlofske, 3M*

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

- 75.1: ***Invited Paper:* Hybrid Backlight System based on Blue, Red LEDs and Perovskite Quantum Dots for Liquid Crystal Display Application**
Honglei Ji, University of Chinese Academy of Sciences, Ningbo, China
- 75.2: **Quantum Dots on Color Filter LCD Design Study**
Songfeng Han, Corning Research & Development Corporation, Erwin, NY, US
- 75.3: **Ultrawide Color Gamut LCD Display with CdSe Nanoplatelets**
Xiao Wei Sun, Southern University of Science and Technology, Shenzhen, China
- 75.4: **Inkjet-Printed Quantum Dot Display with Blue OLEDs for Next Generation Display**
Zhiping Hu, Peking University, Shenzhen, China

Session 76: OLED Manufacturing (Display Manufacturing)

Friday, May 17, 2019 / 9:00 AM - 10:30 AM / Room LL21EF

Chair: *Toshiaki Arai, JOLED Inc*

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

- 76.1: ***Invited Paper:* FMM Material and Manufacturing Process for UHD Resolution AMOLED Displays**
Chiwoo Kim, APS Holdings, Hwaseong, South Korea
- 76.2: **Fine Glass Masks (FGM) for OLED Manufacturing Made by Laser Induced Deep Etching (LIDE)**
Daniel Dunker, LPKF AG, Garbsen, Germany
- 76.3: **Development of Novel Induction Heating Evaporator Technique for Fabrication of OLED**
Shin-ichiro Kobayashi, Fukuoka i3-Center for Organic Photonics and Electronics Research (i3-opera), Fukuoka, Japan
- 76.4: **Development of Gas-Barrier-Property Evaluation System for High Sensitivity and Short Evaluation Time**
Shigeki Hara, National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan
- 76.5: ***Late-News Paper:* Enhanced Productivity Performance through Detecting Defects on Surface of AMOLED Display**
Yongun Park, Mobile Display Inspection Technology Team, Samsung Display, A-san, South Korea

Session 77: Display Enhancement Technologies (Emerging Technologies and Applications / Liquid-Crystal Technology)

Friday, May 17, 2019 / 9:00 AM - 10:30 AM / Room LL20BC

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

Co-Chair: *Matthew Sousa, 3M*

- 77.1: ***Invited Paper:* Liquid Crystals Beyond Displays: Smart Antennas and Digital Optics**
Carsten Fritzscht, Merck KGaA, Darmstadt, Germany
- 77.2: **Anisotropic Nano-Structure Light Control Film**
Pei-Hsun Wu, BenQ Materials, Taoyuan, Taiwan Roc

- 77.3: **High-Performance Smart Window with Haze Enhancement via Micro-Domains Manipulation on Alignment Surface**
Cuiling Meng, The Hong Kong University of Science and Technology, Hong Kong, China
- 77.4: **Large Form Birefringence Realized by Dielectric Subwavelength Grating**
Dunhang Quan, Hong Kong University of Science and Technology, Hong Kong, China
- 77.5: **Late-News Paper: Advanced Phase Distribution Algorithm in Blazed Grating for Continuous Beam Steering**
Young Kim, Samsung Advanced Institute of Technology, Samsung Electronics, Suwon, South Korea

Session 78: Topics in Display Measurement I (*Display Measurement*)

Friday, May 17, 2019 / 9:00 AM - 10:20 AM / Room LL20A

Chair: Marja Salmimaa, Nokia Bell Labs

Co-Chair: Michael Becker, Display-Messtechnik&Systeme

- 78.1: **Specular Reflection Measurements on Reflective E-paper Using a Variable Aperture Source**
Dirk Hertel, E Ink Corporation, Billerica, MA, US
- 78.2: **Measurement and Evaluation of Subpixel Luminance for Mura Reduction**
Xiaofan Feng, Jingce Electronic (USA), Camas, WA, US
- 78.3: **Optimized Condition for Display Sparkle Contrast Measurement of Anti-Glare Cover Glass**
Masanobu Isshiki, AGC Inc., Yokohama, Japan
- 78.4: **Evaluation of the Color Moving Picture Response Time for Motion Blur by Brightness and Color**
Seung-Won Jung, LG Display, Paju, South Korea

Session 79: Applications of High Resolution (*Applied Vision*)

Friday, May 17, 2019 / 9:00 AM - 10:20 AM / Room LL20D

Chair: Cheng Chen, Apple, Inc.

Co-Chair: Kevin MacKenzie, Facebook

- 79.1: **Framework for Evaluating Display Resolution and Size in the Context of Video Compression and Visual Acuity**
Sean McCarthy, Dolby Laboratories, Inc., San Francisco, CA, US
- 79.2: **Hyperrealism in Full Ultra High-Definition 8K Display**
YungKyung Park, Ewha Womans University, Seoul, South Korea
- 79.3: **Display Resolution and Human Factors for Presence and Motion Sickness in HMD Experiences**
HyungSeok Kim, Konkuk University, Seoul, South Korea
- 79.4: **Low Resolution Light Field Display for Improving the Perceived Openness of Confined Spaces**
Robin Atkins, University of British Columbia, San Jose, CA, US

Session 80: Printable OLEDs (*OLEDs*)

Friday, May 17, 2019 / 10:40 AM - 11:40 AM / Room 220C

Chair: Neetu Chopra, Kateeva

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

- 80.1: **Invited Paper: Recent Development of Soluble Hole Injection Material for OLED Display**
Kazuhiro Monzen, Nissan Chemical Corporation, Tokyo, Japan
- 80.2: **Invited Paper: Ink Jet Printed Film Formation and its Impact on OLED Device Performance**
Georg Bernatz, Merck KGaA, Darmstadt, Germany
- 80.3: **All Organic Layers Inkjet Printed OLEDs with a Printable Electronic Transport Layer**
Shipan Wang, Shenzhen China Star Optoelectronics Semiconductor Display Technology Co., Ltd., Shenzhen, China

Session 81: Cadmium-Free Materials & Devices (*Emissive, MicroLED, and Quantum-Dot Displays*)

Friday, May 17, 2019 / 10:40 AM - 12:10 PM / Room LL21CD

Chair: Chang Hee Lee, Samsung Display Corporation

Co-Chair: Jonathan Steckel, Apple, Inc.

- 81.1: **Invited Paper: Quantum Dot Phosphors Containing None of Hazardous Element; ZnTe-Based Alloy Quantum Dots**
Takahisa Omata, IMRAM, Tohoku University, Sendai, Japan
- 81.2: **High Performance Red Cadmium-free Inverted Quantum Dot Light Emitting Diodes**
Jang Hyuk Kwon, Kyung Hee University, Seoul, South Korea
- 81.3: **Distinguished Paper: Developing High Efficiency Heavy Metal Free QD-LEDs for Next Generation Displays**
Christian Ippen, Nanosys, Inc., Milpitas, CA, US
- 81.4: **Perovskites: Most Viable Material for Color Conversion Pixels**
Norman Lüchinger, Avantama AG, Stäfa, Switzerland
- 81.5: **Late-News Paper: Pb-Free Blue-Emitting 0D Cs₃Cu₂I₅ with High PLQY of ~90%**
Taehwan Jun, Tokyo Institute of Technology, Yokohama, Japan

Session 82: Flexible Electronics Manufacturing (*Display Manufacturing / E-Paper and Flexible Displays*)

Friday, May 17, 2019 / 10:40 AM - 12:20 PM / Room LL21EF

Chair: Tian Xiao, NEXT Biometrics Inc.

Co-Chair: Chao-Yuan Chen, Jiangsu Hecheng Display Technology

- 82.1: **Development of Full Roll to Roll Process for Flexible Display Backplane**

- Yunho Kook, LG Display, Seoul, South Korea*
- 82.2: *Invited Paper*: Roll-to-Roll Processing of Polysilicon TFTs on Flexible Large Area Stainless Steel Substrates**
Aditi Chandra, Thinfilm Electronics, San Jose, CA US
- 82.3: *Late-News Paper*: Intense Pulsed Light-Induced Highly Flexible Transparent Electrodes and Their Applications**
Kyoohee Woo, Korea Institute of Machinery & Materials, Daejeon, South Korea
- 82.4: *Late-News Paper*: Characterization of Metal Thin Film-Wiring Materials for Foldable Devices**
Chiharu Kura, Applied Physics Research Laboratory, Kobe Steel, Ltd., Hyogo, Japan
- 82.5: *Late-News Paper*: Three Dimensionally Stretchable AMOLED Display for Freeform Displays**
Sangwoo Kim, Display Research Center, Samsung Display Co., Ltd., Yongin-si, Gyeonggi-do, South Korea

Session 83: Topics In Display Measurement II (Display Measurement)

Friday, May 17, 2019 / 10:40 AM - 12:00 PM / Room LL20A

Chair: *Thomas Fiske, Microsoft*

Co-Chair: *Stephen Atwood, Eaton Corporation*

- 83.1: OLED vs. LC Displays - The Race Toward Rec2020 and HDRI**
Michael Becker, Instrument Systems GmbH, München, Germany
- 83.2: Recent Developments in IEC TC 110, Electronic Display**
Kei Hyodo, Yuasa System, Okayama, Japan
- 83.3: Calibration of Colorimeters for RGBW Displays**
Ben Bodner, LG Electronics, San Jose, CA, US
- 83.4: High Resolution Optical Characterization of NIR Light Sources for 3D Imaging**
Pierre Boher, Eldim S.A., Hérouville-Saint-Clair, France

Poster Session

Thursday, May 16, 2019 / 5:00 PM - 8:00 PM / Room 220A

Active-Matrix Devices

- P.1: Novel Oxide TFT Technology for Ultra-high Definition and Super-Narrow Border Notebook Displays**
Wenda Zhao, Nanjing CEC Panda FPD Technology Co., Ltd., Nanjing, China
- P.2: Effect of Buffer Layer on Performance and Reliability of Flexible a-IGZO TFTs Fabricated on Colorless Polyimide of G4.5**
Huafei Xie, Peking University, Shenzhen, China
- P.3: A Study on The Hot Carrier Effect in InGaZnO Thin Film Transistors**
Hyun-Woo Park, LG Display, Paju, South Korea
- P.4: High-Mobility Back-Channel-Etched IGZTO-TFT and Application to Dual-Gate Structure**
Mitsuru Nakata, NHK Science & Technology Research Laboratories, Tokyo, Japan
- P.5: A New Optical Compensation Scheme for AMOLED Displays with a-IGZO TFT and a-Si:H PIN Diode**
Ling Wang, BOE Technology Group Co. Ltd., Beijing, China
- P.6: Development of 1HZ 17.3-inch Oxide UD HADS Display**
Jin Xiang Zhu, Chongqing BOE Optoelectronics Technology Co., Ltd., Chongqing, China
- P.7: Highly-Ordered Indium-Gallium-Zinc Oxide Thin Film Transistor via Atomic Layer Deposition Process.**
Hyeonjoo Seul, Hanyang University, Seoul, South Korea
- P.8: A New Depletion-mode Compatible Gate Driver on Array for a-IGZO TFTs based AMOLED Displays**
Ying Wang, Peking University, Shenzhen, China
- P.9: Reduction and Mechanism of ESD Defect in IGZO-TFT Formation**
Tianzhen Liu, Hefei BOE Optoelectronics Technology Co., Ltd., Hefei, China
- P.10: A 5.5-inch High Definition AMOLED Smartphone with IGZO Backplane**
Chih-Yu Su, Mantix Display Technology, Putian, Taiwan Roc
- P.11: Carrier Concentration Reduction by Fluorine Doping in P-type SnO Thin Film Transistors**
Sisi Wang, The Hong Kong University of Science and Technology, Hong Kong, Hong Kong
- P.12: High Performance Dual-Gate Dual-Layer Amorphous Oxide Semiconductors TFTs on PI Foil for Display Application**
Manoj Nag, imec, Leuven, Belgium
- P.13: High Performance a-IGZO Thin-Film Transistors Grown by Atomic Layer Deposition: Cation Combinatorial Approach**
Min Hoe Cho, Hanyang University, Seoul, South Korea
- P.14: Highly Robust Oxide TFT with Bulk Accumulation and Source/Drain/Active Layer Splitting**
Jin Jang, Kyung Hee University, Seoul, South Korea
- P.15: Gate-Bias-Stress-Induced Instability in Hybrid-Phase Microstructured ITO-Stabilized ZnO TFTs**
Meng Zhang, Shenzhen University, Shenzhen, China
- P.16: Stacked PECVD SiO₂ Gate Insulators for Top-Gate Metal Oxide Thin-Film Transistors in Enhancement Operation Mode**
Sunbin Deng, The Hong Kong University of Science and Technology, Hong Kong, Hong Kong
- P.17: IGZO TFT Gate Driver with Independent Bootstrapping and Control Units for AMOLED Display**
Jie Huang, Peking University, Shenzhen, China
- P.18: Improving Switching Characteristics of p-type Copper Oxide Thin-Film Transistors by Germanium Oxide Passivation through Reactive Sputtering**
Hyun Jae Kim, Yonsei University, Seoul, South Korea
- P.19: IGZO Thin-Film Transistors on Corrugated Substrate for High-Resolution Display**
Yoonyoung Chung, POSTECH, Pohang, South Korea

- P.20: The Voltage-Based Modulation Technique Using Potassium Superoxide for Amorphous Indium–Gallium–Zinc Oxide Thin-Film Transistors**
Hyun Jae Kim, Yonsei University, Seoul, South Korea
- P.21: Selective Modulation of Electrical Characteristics for Transparent Conducting Oxides by Electro-Hydro-Dynamic Printing Technology**
Hyun Jae Kim, Yonsei University, Seoul, South Korea
- P.22: The Pixel Circuit of Out-pixel Compensation for LTPS PMOS OLED Displays**
Xin She Yin, BOE Technology Group Co., Ltd., Beijing, China
- P.23: Enhancement in the Mobility and the Stability of Solution-Processed Zinc-Tin Oxide Thin-Film Transistors Using Alkali Metal Superoxide**
Hyun Jae Kim, Yonsei University, Seoul, South Korea
- P.24: Impact of Vss Signal Line Structures in Gate Driver-On-Array for Narrow Bezel AMOLED Displays**
Hongwei Tian, BOE Technology Group Co., Ltd., Beijing, China
- P.25: Phenomenon of Periodic Cross Striation for Common Electrode Voltage Distortion**
Hongtao Lin, Fuzhou BOE Optoelectronics Technology Co., Ltd., Fuqing, UNK China
- P.26: A Multi-functional Scan Driver for High-Resolution AMOLED Display with LTPS TFTs**
Di Geng, Chinese Academy of Sciences, Beijing, China
- P.27: A Novel Pixel Circuit with Threshold Voltage Variation Compensation in Three-Dimensional AMOLED on Silicon Microdisplay**
Min Zhang, Peking University, Shenzhen, China
- P.28: Novel Asymmetric Source-Drain Thin Film Transistors Deposited by Atomic Layer Deposition**
Yi Wang, Peking University, Beijing, China
- P.29: Solution-Processed Single-Walled Carbon Nanotube Thin Film Transistors In-Situ Patterned by Inkjet-Printing of Surface Treatment Material**
Yongtaek Hong, Seoul National University, Seoul, South Korea
- P.30: Novel Driving Circuit Designs and Driving Methods for Organic Light Emitting Diode (OLED) Display**
Jing Gu, Shenzhen Yunyinggu Technology Co., Ltd., Shenzhen, China
- P.31: Pixel Circuit with Backgate Feedback for Deep and Rich Black Expressions on Light-Emitting Display**
Takayuki Nishiyama, Sharp Corporation, Nara, Japan
- P.193: *Late-News Poster*: Low Temperature Solution Processed InZnO TFT Annealed in Wet Ambient**
Michael Paul Jallorina, Nara Institute of Science and Technology, Ikoma, Japan
- P.194: *Late-News Poster*: Highly Stable Thin-Film Transistors Based on Amorphous Perovskite Semiconductors**
Hyun-Suk Kim, Chungnam National University, Daejeon, South Korea
- P.195: *Late-News Poster*: Switch Array Type Gate Drive Circuit Using A-IGZO TFT for Stretchable Display**
Byung Seong Bae, Hoseo University, Asan, South Korea
- P.196: *Late-News Poster*: Stretching Compensation Pixel Circuit for AMOLED**
Byung Seong Bae, Hoseo University, Asan, South Korea
- P.197: *Late-News Poster*: NBS-Free Oxide TFTs with High Mobility of 40 cm²/Vs: Origin of NBS Instability**
Yu-Shien Shiah, Tokyo Institute of Technology, Yokohama, Japan
- P.198: *Late-News Poster*: Off-Current Reduction in p-Type SnO Thin-Film Transistors through Fermi-Level Unpinning**
Taikyu Kim, Hanyang University, Seoul, South Korea

Applied Vision

- P.32: Investigation of the Color Mura Mechanism and Simulation Models**
Xu Xiaona, BOE Technology Group, Beijing, China
- P.33: Effects of Luminance, Contrast and Saturation of HDR QLED Display on Visual System Based on Eye Movement**
Yan Tu, Southeast University, Nanjing, China
- P.34: Ambient Picture Quality and Visual Performance Analysis for Reflected Glare Evaluation**
Yu Hung Chen, AU Optonics Corp., Hsinchu, Taiwan Roc
- P.35: Human Visual System Inspired Artifact Reduction in Projector Compensation**
Vignesh Sankar, University of Waterloo, Waterloo, ON, Canada
- P.36: Design of Simulation Tools for Light-field Near-eye Displays with a Pinhole Array**
Weitao Song, Nanyang Technological University, Singapore, Singapore
- P.37: MOVED TO 72.5**
- P.199: *Late-News Poster*: Color Mismatches Across Commercial Displays: Modeling the Effect of Observer Metamerism**
Hao Xie, Munsell Color Science Laboratory, Rochester Institute of Technology, Rochester, NY US

Automotive/Vehicular Displays and HMI Technologies

- P.38: Improved Contrast Ratio of TFT-LCDs for Automotive Applications by Optimizing Retardation Films and Color Filters**
Takuya Higashi, Mitsubishi Electric Corporation, Kumamoto, Japan
- P.39: Development of High Performance LCD for Advanced 3D-HUD**
Yu Mochizuki, KYOCERA Corporation, Yasu, Japan
- P.40: E-Mirror Automatic Dimming Reflectance Control**
Paul Weindorf, Visteon Corporation, Van Buren Township, MI, US
- P.41: Border Fade Pattern for a Segmented Active Polarizer Dimmable Lens**
Paul Weindorf, Visteon Corporation, Van Buren Township, MI, US
- P.42: Visibility Analysis in Vehicle Rear Mirror OLED using Fourier Optics**
Ju-Un Park, LG Display, Seoul, South Korea
- P.43: A Head-Up Display with Time-Division Multiplexing Parallax Barrier with Magnified Virtual Image Generation**
Ayuki Hayashishita, University of Tsukuba, Tsukuba, Japan

- P.44: Long Lifetime and High Performance OLED Display with Wide Temperature Range for Automotive Application**
Masanobu Mizusaki, Sharp Corp., Nara, Japan
- P.45: Position Correction against Vehicle Vibration for Augmented Reality on Head-Up Display**
Takefumi Hasegawa, Mitsubishi Electric Corporation, Kanagawa, Japan
- P.46: Multi-Plane Displays Based on Dynamic Phase-only Holography**
Neil Collings, Envisics Ltd., Milton Keynes, United Kingdom
- P.47: Improvement of Image Sticking for High Standard Automotive Application**
Jiandong Wang, Tianma Microelectronics Co., Ltd., Shanghai, China

Display Electronics

- P.48: A Novel “Always-on” Spread Spectrum Clock Technique for Reducing EMI in Display Electronics**
Xiangye Wei, BOE Technology Group Co., Ltd., Beijing, China
- P.49: TFT-LCD Advanced Adaptive De-Mura System**
Wenqin Zhao, Chongqing HKC Optoelectronics Technology Co., Ltd., Chongqing, China
- P.50: Principle and Improvement of Shaking Stripe**
Hongtao Lin, Fuzhou BOE Optoelectronics Technology Co., Ltd., Fuqing, UNK China
- P.51: Design of Integrated Gate drivers with Low Temperature Poly-Silicon Thin Film Transistor**
Can Zheng, BOE Technology Group Co., Ltd., Beijing, China
- P.52: Novel LED Boost Architecture Enables Higher Efficiency and Thinner Display Panels**
Jason Ngai, pSemi, San Diego, CA, US
- P.53: A Slim Display System for OLED TV Using TCON Memory Merged IC**
Byung-Jae Lee, LG Display Co., Ltd., Seoul, South Korea
- P.54: An Oxide-Semiconductor-FET-Based Dynamic Logic Circuit for Wearable Systems**
Toshiki Hamada, Semiconductor Energy Laboratory Co., Ltd., Atsugi, Japan
- P.55: Quasi-Stereoscopic Perspective for Real-Time 2D-3D Video Conversion Without Image Content Analysis**
Vasily Ezhov, Prokhorov General Physics Institute of the Russian Academy of Sciences, Moscow, Russian Fed.
- P.56: What is the Best Way to Reduce Power Consumption at Low Frame Frequency on Still Image and Some Moving Image?**
Haksu Kim, LG Display, Gumi, South Korea
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