TFUG Meeting

Topic: Advances in Display Technology

Meeting Date: September 28, 2017

Time: 12:30 pm - 3:00 pm

Location: **SEMI Headquarters (*new address*)**
673 South Milpitas Blvd.
Milpitas, CA 95035

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FREE TO ATTEND, JUST SHOW UP!

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Co-Chairs:
Jacques Matteau, Protech Materials,
jacques.matteau@protechmaterials.com

Michael Oye, University of California Santa Cruz,
moye@ucsc.edu

This meeting focuses on technologies and applications related to Advances in Display Technology. The purpose of this meeting is to bring together leading researchers in academia, government, and industry with innovative technologies to nurture a free exchange of triumphs and challenges in the advances in Display Technology applications.

Platinum Sponsors:

Kurt J. Lesker Company

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AGENDA

12:30 pm FREE LUNCH & COFFEE - Provided by Kurt J. Lesker Company and UC Components

1:00 pm Introduction and Welcome

1:05 pm *Quantum Dots' Next Act: Moving to the Mainstream,* Jason Hartlove, Nanosys

Quantum Dots have officially arrived. In 2016, Quantum Dot enhanced displays out-shipped OLEDs on a screen-area basis. The technology has clearly entered a new phase of growth and proliferation. What's next for Quantum Dots?

Nanosys was the first to commercialize Quantum Dots and is the market share leader today. In this presentation, Nanosys CEO Jason Hartlove takes a look ahead at the next steps on the Quantum Dot roadmap from ultra low-cost photo-enhanced LCDs to photo-emissive displays and electro-emissive (EL) implementations of the technology.

Topics include:

- *Improvements to Quantum Dot cost and performance enabled by these new implementations*
- *How new manufacturing processes such as photolithography and printing may enable Quantum Dot to address new display markets*
- *The state of truly emissive Quantum Dot displays- will they enter the mainstream in the near term and in what form?*

Bio: Jason Hartlove, President and CEO

Jason Hartlove joined Nanosys in 2008 with a proven track record of turning emerging technologies into successful commercial products. His vision for Nanosys has led the company to focus on high-growth markets with urgent pain points that Nanosys technologies are uniquely positioned to solve such as vibrant, efficient displays for portable devices. Prior to joining Nanosys, he was President of the Imaging Solutions Division of MagnaChip Semiconductor in Seoul, South Korea, where he turned an internally focused semiconductor group into a multinational company on track for an IPO. Before MagnaChip, Jason was Vice President and General Manager of the Sensor Solutions Division of Agilent Technologies, a Hewlett-Packard owned company. At Agilent, he led the commercial development and application of optical position sensing technology, which resulted in everyday products like the optical mouse and image sensors for digital cameras. He is the author of more than 20 patents, including the winner of the Hewlett Award in 2004 for Best Patent. He holds a B.S. in electrical engineering from UCLA and has completed graduate work at the Anderson School of Management at UCLA.

1:40 pm ***Advanced Display Manufacturing Technology,*** John D. Busch, Applied Materials

Mr. Busch will address various inflection points in display manufacturing and why we are currently in the midst of a boom period for display equipment suppliers. He will discuss how smartphones shifted the emphasis from scaling up to display performance which has led to the adoption of more advanced underlying technologies such as new transistor materials and design, in-cell touch, OLED, and flexible device processing. Even as smartphone technology continues to advance, new applications such as virtual reality and augmented reality devices are emerging which require even higher resolution. These new technologies pose significant challenges for productization and mass production. Additionally, there is a trend for display makers to replace externally purchased materials and components (such as touch panels, backlight, liquid crystal, color filter and polarizers) with in-fab processes (in-cell/on-cell touch, OLED, and wire-grid polarizers). Mr. Busch will also discuss how Applied is bringing yield management techniques from the semiconductor industry to the display industry. As an industry we must combine (1) large-substrate manufacturing experience, (2) techniques from semiconductor manufacturing, and (3) completely new materials engineering innovations to overcome the challenges and enable a new visual experience for consumers.

Bio: *John D. Busch, VP, New Business & Strategic Initiatives, Display & Flexible Technologies, Applied Materials, Inc.*

John Busch is a 30-year veteran of the vacuum equipment and thin-film technology industries, and is appointed vice president and growth business driver for the Display & Flexible Technologies group within Applied Materials, Inc. His mission is to identify, evaluate and develop exciting new business opportunities for the Display group that go beyond today's core products. Prior to this role, he managed the company's large area sputter deposition solutions for display backplane (thin film transistor), color filter and touch panel applications, overseeing a broad international organization across Asia, U.S. and Europe. Under his leadership, he has captured ITO touch business generating $300M in revenue and driven market gains in a-Si, LTPS and Metal Oxide backplane applications against a long-established competitor. John also served as General Manager of Applied's Roll-to-Roll Product Group and Strategic Programs and Marketing manager for the Solar Business Group. Prior to Applied, he served as Vice President and General Manager of the Rapid Thermal Processing (RTP) Product Group at Photon Dynamics, and director of Marketing at Intevac, where he was responsible for managing a variety of product lines, including RTP, flat panel PVD and hard disk PVD equipment. He launched his career in thin film technology by pioneering early work in Micro-Electro-Mechanical Systems (MEMS) devices using sputtered thin film shape memory alloy. He received his mechanical engineering degree from UC Berkeley and an MBA degree from Santa Clara University, graduating with honors. He holds five patents and has authored numerous technical and business papers throughout his career.

2:15 pm ***Advanced inkjet printing: Enabling the OLED display revolution,*** Jeff Hebb, Kateeva

The OLED revolution is already well underway in the smartphone market, rapidly displacing LCDs as the display of choice. The market share of OLED smartphones is forecasted to increase from 31% in 2017 to almost 60% in 2021 (DSCC, SID 2017). But the OLED revolution is still in its infancy. In the next decade, OLED technology will enable products which feature foldable and rollable displays, as well as large displays with fantastic contrast and color (TVs, signs).

Advanced inkjet printing (IJP) is already playing a critical role in today's OLED products. It's the technology of choice used to protect and extend the lifetime of these displays by enabling the thin film encapsulation process (TFE). For the TFE process, IJP provided numerous technical and cost advantages over alternate organic film deposition techniques. Looking forward, IJP will continue to play a critical role in enabling the next two inflections in the OLED technology roadmap. For smartphone technology, the next inflection is the foldable display, which will require improved TFE processes to achieve the lifetimes and yields required for mass production. Extending the current TFE process, including IJP for the critical organic interlayer, is the most likely path forward to meet the requirements of foldable displays. The next inflection in TV technology is the mass production of RGB OLED TVs, which cannot be manufactured at low cost using conventional pixel patterning techniques used on small area display. Advanced IJP is the most promising candidate for cost-effective pixel patterning, with R&D and pilot tools already in the field.

This presentation will discuss the application of Kateeva's advanced IJP technology to the manufacturing of current and future OLED displays.

Bio: Dr. Jeff Hebb joined Kateeva in 2016 as Vice President of Global Marketing, leading all marketing activities for Kateeva's breakthrough inkjet printing products in the flat panel display industry. Before Kateeva, he held various technical and marketing roles at Applied Materials, Ultratech and Axcelis, focusing on laser annealing, rapid thermal processing, and epitaxial deposition for logic and memory devices. He received his M.S. and Ph.D. degrees, both in mechanical engineering, from Massachusetts Institute of Technology.

2:50 pm Closing Remarks

3:00 pm Meeting adjourn

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All presentations will be requested to be posted on the TFUG Proceedings webpage approximately 1-2 weeks following the meeting.

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