FlexTech Alliance
for Displays & Flexible, Printed Electronics

FlexTech Trends

News from the world of displays and flexible, printed electronics

Q2 2011

FlexTech Trends

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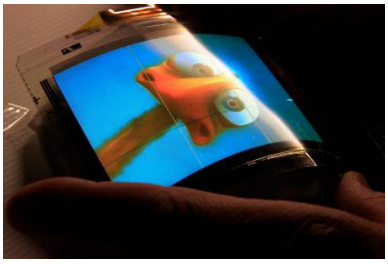
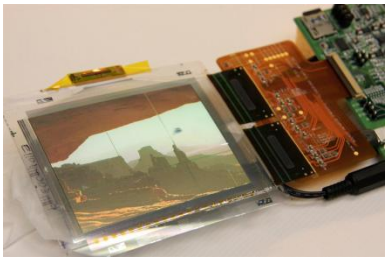
Note from the President

by *Michael Ciesinski*

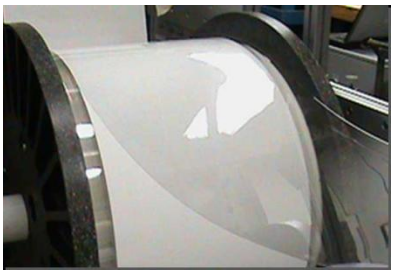
Wanted: Product demonstrators

In the emerging field of flexible, printed electronics, product demonstrators will show the capabilities of this exciting technology. For this reason, FlexTech Alliance extends congratulations to the Flexible Display Center (FDC) at Arizona State University and Universal Display Corporation for fabricating the first full-color, flexible active matrix organic light emitting diode (AMOLED) display prototype. The prototype was built using the FDC's bond/de-bond manufacturing process, Universal Display's full-color, top-emission phosphorescent OLED technology and materials, and DuPont Teijin Films' Teonex® polyester film. The prototype was demonstrated at the recent Society for Information Display (SID) Conference in Los Angeles, Calif.

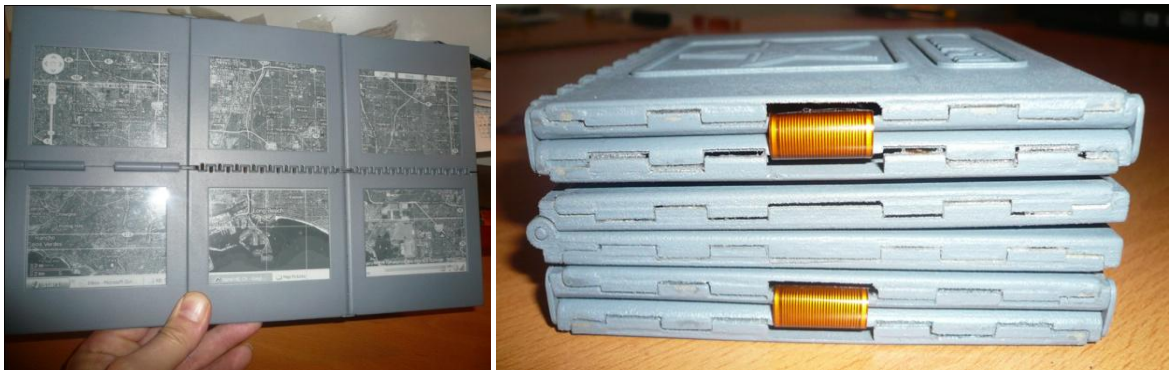




Also at the SID Conference, Corning demonstrated their new flexible glass which can be utilized in a variety of applications. These include displays, sensors, and photovoltaic structures. At just 75 micrometers thick, this material is a true innovation for the flexible electronics industry and FlexTech is pleased to support its development.



Finally, earlier this year NYX completed a FlexTech-funded project for a foldable screen. Partnering with E Ink, the tiled display panels (6 in all – see image below) demonstrate what an expanded map view might eventually look like for soldier portable applications. It fits in a shirt pocket!



Flex Conference 2012

The 2011 Flex Conference certainly raised the bar for impressive technical and marketing content, as well as product displays. We appreciate the 450+ registrants who helped us sent a new attendance record. FlexTech Alliance is pleased to announce the dates for the ***2012 Flexible Electronics and Displays Conference and Exhibition.*** The Flex Conference will return to the Arizona Grand Resort in Phoenix, Arizona February 6-9, 2012. The Call for Papers is now open and preference will be given to presentations featuring original research and new product introductions. For details, please see page 9 of this newsletter or visit www.flextech.org .

In this edition of FlexTech Trends:

-Market update from Lawrence Gasman, Principal Analyst, NanoMarkets. Don't miss our free webinar on Transparent Conductors happening June 16, 2011. See page 5 for information on how to register.

-Details of the FlexTech Alliance Extreme Electronics session at SEMICON West 2011 – Printed Electronics: Real Deal Technologies

-A case study on metal-based inks on flexible substrates from NovaCentrix

-FlexTech Tech Alliance recently launched its Knowledge Portal. Currently available on the portal are 2011 Flex Conference Short Course Recordings and 2011 Flex Conference Proceedings. To order your copies visit the following URL.

https://live.blueskybroadcast.com/bsb/client/CL_DEFAULT.asp?Client=360540

Market Update:
Transparent Conductors and the Rise of the Nanomaterials

Lawrence Gasman, Principal Analyst and Co-Founder,
NanoMarkets LC

When NanoMarkets first started providing analysis of the transparent conductor (TC) industry, some six years or so ago, the industry was easy to characterize. Indium Tin Oxide (ITO) ruled the roost, except where the market was looking for especially low-cost solutions; in antistatic applications. True, executives in the display industry – and even in the transparent conductor industry itself – knew all the unkind things to say about ITO. It cracked, it cost a lot, it even had a yellowish tinge, etc., etc.

When one examined all the alternatives, ITO began to look pretty good. None of them could compete with ITO on the crucial transparency and conductivity parameters. In any case, most of the alternatives to ITO were not ready for prime time; at best they were in that limbo phase called sampling. The threat to ITO from its rivals was negligible.

The one exception to this rule was in the thin-film PV (TFPV) application, where alternative transparent conducting oxides (TCOs) quickly made their mark. First Solar, the dominant supplier, has adopted fluorine-doped tin oxide (FTO) as its transparent conductor, while most of the firms in the CIGS space use aluminum zinc oxide (AZO). In the a-Si PV sector, FTO and AZO are also used. As an aside, there is an important takeaway from all this. Applications that are relatively new – such as TFPV – are more likely to adopt new TCs. By contrast consider the conventional – and highly established -- LCD industry, which continues to demonstrate considerable reluctance to ITO alternatives.

While the use of TCOs other than ITO in the TFPV industry is proof positive that, ITO doesn't always get to win; it hardly represented a paradigm shift. It was, after all, a just a switch from one TCO to another. In the past year to two years, we have seen something genuinely new in the TC space; the rise of the nanomaterials.

Nano-TCs: More Firms, More Materials, More Applications

By rise, I have in mind three things. First, while there have been firms around developing nanomaterial approaches to rival ITO, there are now a lot more such firms and they appear to have been quite successful in attracting capital. Second, there is now considerable diversity in the nanomaterials being offered in this sector. A few years back, nanomaterial challenges to ITO consisted entirely of carbon nanotube inks. Take a look at this space now and you will also see silver nanostructures in solution, silver grids, copper-based solutions and graphene. As NanoMarkets discusses in its upcoming report, we would not be surprised to see nanostructured polymers also enter this fray.

The third aspect of the rise of the nanomaterials materials that needs to be considered is that some of these materials might now reasonably be considered to be commercialized. True, some of these materials remain well within the lab, but some are out there is products that you can buy now. One of the important messages that have come out of the interview program that NanoMarkets has just completed with manufacturers of TCs is that several nanomaterials are now commercialized. They are being used in a very small number of products and often in limited quantities. But in the past year they have crossed an important barrier.

Marketing, Messaging and Conductive Nanomaterials

What all this means is that firms that have in the past focused on developing materials that can be sold into the TC space must now change track and focus on marketing. Until now such firms have largely been able to get away with vague statements about targeting the touch screen market, or "flexible displays," or something of this sort. But this won't get them very far in terms of actually generating new business revenues.

One part of the marketing strategy for "nano-TCs" will certainly be to match the material's capability to the opportunities. A material that will make a superb antistatic coating for the outside of a touch panel may be completely unsuitable for the transparent conductive material in the touch sensor itself. In a few cases, nanomaterials may actually facilitate new applications. The example that is usually mentioned in this context is that of flexible displays; but flexible displays have challenges other than the TC one. Where we are seeing nano-TCs going where ITO fears to tread is in the large panel sector, where ITO isn't sufficient to bring the electricity to the outer limits of the panel. Such panels exist in the PV sector and it is easy to imagine similar problems appearing in large displays or in the OLED lighting sector.

Above all, the nano-ITO firms are going to have to message effectively and this is something that they have never done especially well. For example, we often hear about how ITO suffers from a yellow tinge. But how much does this really matter in the marketplace, especially when your nano-TC has a blue tinge or a grey tinge! One factor that does matter of course is cost and if you can show that your nano-ITO is lower cost than ITO you are in good shape. But what does that really mean? Are the old stories about the impact on the price on indium on the price of ITO just old wives' tales? Some people think they are. But NanoMarkets analysis suggests that we just don't know!

Messaging and marketing are going to be major challenges for firms offering new solutions (both literally and figuratively) in the TC marketplace.

For more information on transparent conductors,
join FlexTech Alliance and NanoMarkets for a free webinar on June 16
"New Opportunities in the Transparent Conductor Market".
Register at http://www.flextech.org/fe-flextech-events.aspx
In addition, FlexTech Alliance is producing a
transparent conductor workshop August 17th and 18th .
Visit www.flextech.org for details.

Case Study:
Processing Inkjet vs. Screen Printed Metal-Based Inks on Low-Temperature Substrates

Stan Farnsworth, VP Marketing, NovaCentrix

One of the key challenges for printed electronics has been how to solve the problems of processing metal-based inks on substrates such as paper and polymer films. This has historically been a challenge due the required processing temperatures for the metal-based inks being higher than the temperatures tolerable by the substrate. Less-than-optimal solutions included utilizing relatively expensive high Tg polymers such as polyimide, or relatively-high-priced inks such as the set of nanoparticle-based silver inks which have particle sizes below 10 nm to realize a depressed melting-point effect. For some applications these material-based solutions are satisfactory. For many other applications, however, the combination of high cost and high sheet-resistance is unacceptable. For example, in smart packaging applications, paper-based materials are often the required substrate, and those applications cannot generally support the use of high-priced ultra-fine nanoparticle silver-based inks.

The solution then comes from looking beyond solely the existing materials possibilities and instead also considering the processing options. In 2007 NovaCentrix unveiled the first purpose-built printed electronics thermal processing equipment, the PulseForge® tools. Pulse Forge tools are the *High Temperature Processing on Low Temperature Materials*™ tool. After several years of internal development and use, the PulseForge set of tools dry, sinter, and anneal printed-electronics materials on paper, plastic, and other temperature-sensitive substrates, and in fact NovaCentrix was awarded a patent for this type of processing in 2010.

Processing New Applications using New Applications of Light

Processing conducting inks has until recently been a challenge across printed electronics. High-performance conductive inks usually require elevated temperature to attain the final desired optimal electrical conductivity. The complication arises in that typically the required processing temperatures exceed the working temperature limits of the substrate materials. NovaCentrix has previously described the PulseForge® processing tools which heat the desired target materials without collateral thermal damage to surrounding or underlying materials and substrates. Using specially-designed water-cooled flash lamps and power supplies, the PulseForge tools are able to heat a wide-range of desired target materials, including functional inks and thin films, without damaging the substrates. NovaCentrix' Chief Scientist Dr. Kurt Schroder recently presented an in-depth theory of operation at the Nanotech 2011 event in Boston June 15, and explained several important concepts around how the energy from the tools affects the target materials, and some important design guidelines and application points for designers considering this processing approach for their product development and manufacture.

Theory aside, it is known from the use in the lab and by every PulseForge tool customer that the exposure conditions dramatically affect the final results of the materials. From our own use of the tools as both an ink formulator and as the original photonic curing tool developers (we coined the term in 2005), we understand that product results are heavily dependent upon process conditions such as:

- Pulse intensity
- Pulse duration
- Separation of pulses
- Pulse wavelength
- and numerous others.

NovaCentrix has identified over 12 exposure parameters that truly impact the product results. A difference of 10% or less in an exposure setting can be the difference between success (good conductivity and adhesion) or failure (delamination of the thin film from the substrate, or improper removal of residual organics from the initial deposition formulation).

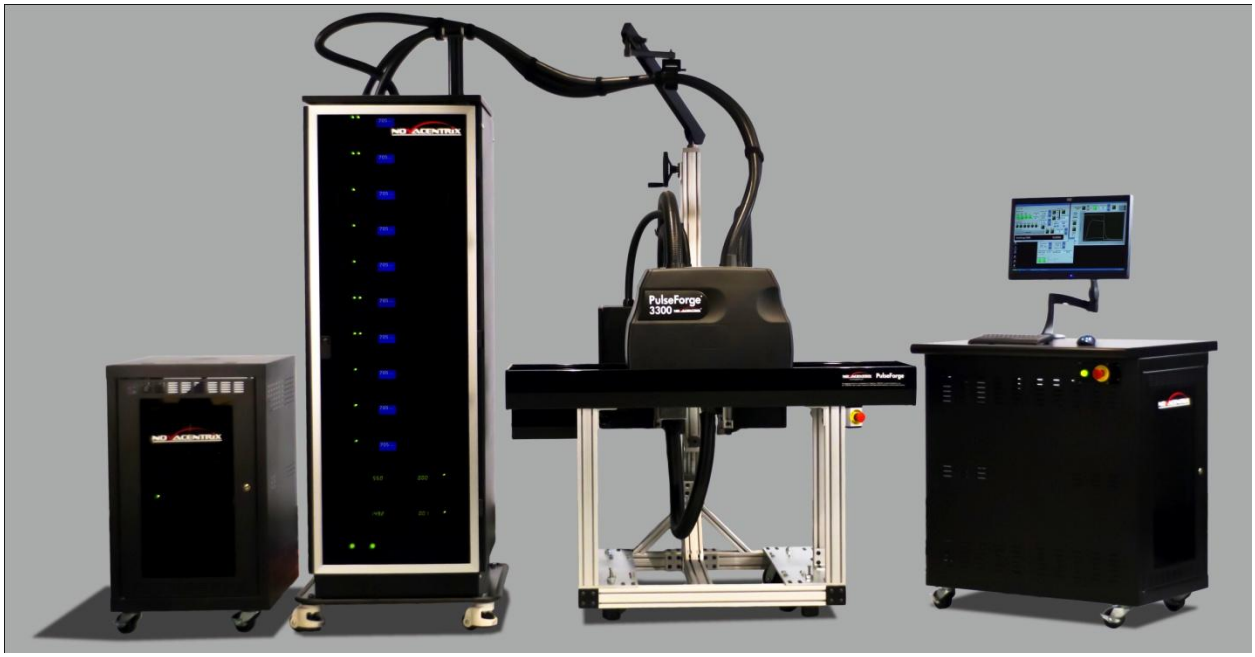


Figure 1: PulseForge 3200 in 6" width configuration (from left):

- *Cooling system module*
- *Power cabinet*
- *Lamp housing mounted over conveyor for stand-alone operation*
- *Control module and operator station with touch-screen interface*
- *This unit is capable of stand-alone development-use.*
- *This unit can also be integrated for roll-to-roll production at >100m/minute.*

Inkjet versus Screen-Print

A number of methods are used for depositing functional materials for printed electronics, with inkjet and screen-print among the foremost used. Other methods such as flexo, gravure, and aerosol also have important roles in printed electronics, and those will be addressed in a follow-on article. Inkjet-based material deposition offers several compelling benefits. By not requiring print fixturing as needed by screen-printing, inkjet has the allure of very rapid and low-cost manufacturing set-up, minimizing or eliminating change-over between jobs, and enabling lower-volume lower-value jobs to be accepted and still be good business. Another strength of inkjet is the relative performance of silver-based inkjet inks against the bulk resistance of silver. The following table indicates that the electrical performance of silver inkjet inks is quite good: within 2x bulk silver resistivity, or ½ the conductivity. Inkjet inks are also a non-contact deposition method, and may therefore be suitable for use with fragile film surfaces.

Table 1: Inkjet Electrical Resistance

Material	Bulk resistivity	Resistivity against bulk silver
Bulk silver	1.6×10^{-6} Ohm-cm	1
Silver nanoparticle inks	$<2.5 \times 10^{-6}$ Ohm-cm	1.5x
Organic ink	1.5×10^{-3} Ohm-cm	1000x

The inks presented in the following discussion of processing results, while nanoparticle-based inks, are not specifically low-temperature sintering inks as the particle sizes are generally >10 nm. The inks are nanoparticle-based simply so they can be printed with inkjet nozzles. These inks are also water-based, and are produced by NovaCentrix as commercial products. The following table summarizes key properties of the inks used for this evaluation.

Table 2: Properties of Inkjet Inks Used in Evaluation

Ink Type	Avg Dispersion Cluster Size	Full Cure Temp	Solids Loading %
JS-BxxP	55-75 nm	375^{o}C	15%-35%
ICI-003	85-115 nm	NA*	12%

** ICI-003 is not curable thermally and requires the use of PulseForge tools to reach conductive performance.*

Screen-Print Inks

Screen-print has distinct advantages as well in printed electronics applications, including the improved sheet resistance values in comparison with inkjet stemming from the much thicker depositions (>5 micron for screen versus <1 micron for inkjet). Screen-print silver inks routinely achieve <5 milliohm/sq values when fired on high-temperature substrates such as glass or silicon. On low-temperature substrates incapable of withstanding high-temperature firing, sheet resistance values at or below 50 milliohm/sq are considered quite good. For this discussion, we'll consider three screen inks. All three of these inks are low VOC water-based, and are produced by NovaCentrix as commercial products. The following table summarizes key properties of the inks.

Table 3: Properties of Screen Inks Used in Evaluation

Ink Type	Average Particle/Flake size	Loading % wt
HPS-021 (Ag)	2000 nm	65
ICI-020 (CuO/Cu)	200 nm	53

Processing and Results

Each of the above inkjet and screen-print inks was processed with an in-house PulseForge tool, on a conveyor at approximately 10 meters/minute, in open air. This is a typical processing speed in our laboratory for developmental work, though installed tools can operate at or in excess of 100 meters/minute. The 10 meters/minute speed means that the curing time for the test traces passing under the PulseForge tool's lamps was less than 1 second. During that 1 second, each spot on the test trace was exposed to a series of sub-millisecond bright flashes and intervening off periods. No hardware was reconfigured between inks, and the only changes to the tool set-up and exposure conditions were made using the touch-screen interface, with the parameters identified above.

The following table summarizes certain of the cure conditions typically used for the inks in the NovaCentrix applications lab. The total "on" time of the lamps for a given point on the target material is indicated as "Total Exposure Duration". All of the samples were processed in open air, including the copper oxide reduction inks. The total energy delivered is calculated based on measurements using a calibrated in-house bolometer, with "Average Power" determined from energy and exposure time.

Table 4: Summary of Processing and Results

Print Method	Ink	Print Thickness-Dried (microns)	Total Exposure Duration *milliseconds*	Total Energy Delivered *J/cm²*	Average Power Delivered *(kW/cm²)*	Final Sheet Resistance *mOhms/sq*
Inkjet	JS-B35P (Ag)	0.6	6	5	1	55
	ICI-003 (CuO/Cu)	<0.5	10	8	1	100
Screen	HPS-021 (Ag)	5	3	5	2	18
	ICI-020 (CuO/Cu)	4-5	3	8	3	60

The substrate used for the inkjet inks is a commercial PET coated to be especially receptive to water-based inks. For depositing the inkjet inks, a commercial Epson C88+ Photo Stylus Inkjet Printer was used. This printer is readily available at low cost (~$100 USD) and is a good platform for basic printing of off-the-shelf Metalon® inkjet inks. Metalon ink variants specifically formulated for other print heads such as Dimatix are also available, and exhibit similar properties. The specific printer settings are beyond the scope of this evaluation, but are available from the author.

The substrate used for the silver screen-print inks is PET ST505 produced by DuPont. The substrate used for the screen-printed copper oxide reduction ink is Wausau Paper Exact® Index 110 lbs smooth finish. The screen inks were deposited using a 325 mesh screen. Ink thicknesses were approximately 4-5 microns when dried.

Discussion

Initial review of the data shows that screen inks require additional power for processing versus the inkjet inks, which is certainly part of the solution for processing screen-print inks. Yet, if a reader attempts to replicate these results adjusting only the indicated parameters, their samples will most likely fail. In actuality controlling only these parameters on a processing tool is not enough to result in the indicated performance data. The differences required in the exposure conditions require additional exposure settings to be altered beyond the exposure duration and energy delivery- additional exposure parameters which may not immediately be obvious to early users. Further, implementing these necessary processing attributes in an easy-to-use tool requires significant equipment engineering to achieve, especially to allow changing these parameters without requiring hardware reconfiguration. The required differences in the exposure settings are largely driven by the significant differences in the particle characteristics, layer thicknesses, and percentage of solids, as well as differences in the formulation components, and are incorporated into the PulseForge tools. In future publications we will show more details on the thermal profiles during the material processing using the SimPulse™ Thermal Simulation software, which mimics the PulseForge tool exposure through complex numerical simulation methods.

For questions or comments, contact the author at:

stan.farnsworth@novacentrix.com

For additional information, video clips of the processing can be seen at www.youtube.com/novacentrix

CALL FOR PAPERS

11th Annual FLEXIBLE ELECTRONICS AND DISPLAYS CONFERENCE

February 6 - 9, 2012
Arizona Grand Resort
Phoenix, AZ

Submission Due Date: August 19, 2011

FlexTech Alliance invites you to submit an abstract for its **11th Annual Flexible Electronics and Displays Conference and Exhibition** (www.flextech.org). This is a premier event to share the latest technical and market advances in flexible, printed, and organic electronics and displays.

The conference will address global technical and business issues, and advancements impacting the flexible electronics and displays value and supply chains. Join this field of international experts from industry, academia and R&D by entering your submission. **Preference will be given to original research and new toolset, process and materials introductions.**

The conference attracts over 450 registrants from more than 200 companies, universities, R&D labs, and government agencies. Attendees span the roles of technical, marketing, product development, manufacturing, executive and business planning functions.

Topic areas sought in the **Call for Papers** are:

- Strategic Market and Business Overviews
- Materials Advancements for Flexible Electronics
- Manufacturing on Flexible Substrates
  - Roll-to-Roll / Web processes
  - Production / In-situ Analytics
  - Barriers / Encapsulants
- Flexible Displays
- Flexible Electronics-Based Applications and Products including
  - Solar/Photovoltaics
  - Solid State Lighting and OLEDs
  - Equipment for High-Throughput Electronics Manufacturing
  - Medical Devices
  - Smart Sensors - bio-medical, security, civil and military infrastructure
  - Energy Storage/Batteries
  - RFID
  - Touch Technology
- Printing Processes and Technologies including
  - Functional Inks
  - Products now in production
  - Printing techniques & toolsets (Flexo, Gravure, Screen Printing, Inkjet)
  - Novel integrated-function demonstrators
  - Roll-to-Roll / Web processes
  - Production / In-situ Analytics

Important Deadlines:

- Submission of Abstracts August 19, 2011
- Notification of Abstract Acceptance September 19, 2011
- Presenter Commitment to Present September 26, 2011
- **Final PowerPoint Submission December 16, 2011**

Instructions for Submission:

Download, complete and submit the Abstract Submission Form online at www.flextech.org .
For questions contact monica.newman@flextech.org

NOTE: Accepted speakers will receive a significantly reduced conference registration fee.

FlexTech Alliance presents
Printed/Flexible Electronics:
Beyond R&D to Real Deal Technologies
San Francisco, California
July 14, 2011

Recent progress on developing printable conductive inks, flexible substrates, and associated continuous processes for making electronics means there's now an advancing infrastructure ready for the practical manufacture of disruptive new products.

Join us at SEMICON West 2011 for **Printed/Flexible Electronics: Beyond R&D to Real Deal Technologies** where industry experts will present current market and projected growth areas, the state of materials development including the new materials registry database, the status of equipment technology for sintering and annealing to improve performance of the solution-based circuits, and the real products now taking advantage of these disruptive technologies.

Extreme Electronics TechXPOT, Moscone Center South Hall		
Agenda		
10:30am – 10:45am	Welcome/Overview	Stacy Oresman, FlexTech Alliance, Director of Technology & Business Development
10:45am – 11:10 am	***A Future for Flexible and Printed Electronics***	Lawrence Gasman, NanoMarkets, Principal Analyst and Co-Founder
11:10am – 11:35am	***The Expanding Availability of Commercial Materials for Printed Electronics – Online Materials Registry***	Professor Erika Rebrosova, Ph.D., Western Michigan University, Assistant Professor in the Department of Paper Engineering, Chemical Engineering and Imaging
11:35am – 12:00pm	***Photonic Sintering Using Low Temperature Pulsed Light***	Saad Ahmed, Ph.D., Xenon Corporation, Engineering Manager
12:00pm – 12:25pm	***Advances in Materials and Processing for Printed Electronics and Photovoltaics***	Stan Farnsworth, NovaCentrix, Vice President of Marketing
12:25pm – 12:50pm	***High Volume Production of All-Printed Re-writable Memory Products for Consumer Applications***	Jennifer Ernst, Thin Film Electronics ASA, Vice President, North America
12:50pm – 1:15pm	***Printing Fabricated Micro-Semiconductors with Traditional Graphic Arts Presses***	William Johnstone Ray, Nth Degree Technologies Worldwide, Chief Scientist
1:15pm – 1:40pm	***Innovations in Solar: Driving Down the Cost of Flexible PV Panels***	Vishal Shrotriya, Ph.D., Solarmer Energy, Technical Director
1:40pm – 1:50pm	Questions and Closing Remarks	FlexTech Alliance

Learn more at http://www.semiconwest.org/SessionsEvents/ctr_043489

Save the Dates!

Workshops

Transparent Conductors

Aug. 17 & 18, 2011 San Jose, CA

Hybrid Nanocomposites & Interfaces for Printed Electronics

Sep. 13 & 14, 2011 Atlanta, GA

Flexible Electronics On & In the Body

Oct. 26 & 27, 2011 location tbd

New for 2011 - Webinars!

Transparent Conductors	June 16, 2011
OLED Lighting and Materials	August 2, 2011
Flexible Photovoltaics	December 6, 2011
Flexible Displays	October or November

11th Annual Flexible Electronics and Displays Conference and Exhibition

February 6-9, 2012

Location: Arizona Grand Resort, Phoenix, AZ

News and News Links from the FlexTech Alliance

excerpted from Veritas et Visus newsletters

FlexTech Alliance announces FLEXI Award winners: E Ink, Polyera, and the Imperial College of London

The FlexTech Alliance announced the recipients of the 2011 FLEXI Awards. The awards celebrate and recognize people, companies and organizations that are leading the development of this emerging industry with innovative and commercially viable technologies. E Ink, Polyera, and the Imperial College of London were recognized for significant contributions to innovation, R&D, and leadership in education. Awards were presented at the 10th Annual Flexible Electronics and Displays Conference held February 7- 10, in Phoenix. http://www.flextech.org

- E-Ink was the recipient of the FLEXI Innovation Award. Entries for this award were considered based on the most innovative flexible and/or printed electronics product launched in the last twelve months. Judging criteria included product design & ingenuity, overall market adoption, and successful revenue generation. E Ink won the award for its global innovation of electrophoretic displays in the flexible display industry. In July 2010 E Ink announced their next generation display technology, E Ink Pearl, which features the whitest reflective display in the industry with a contrast ratio approximately 50 percent greater than previous products. In November 2010, E Ink announced the launch of their first commercially available color product, E Ink Triton, which features 16 levels of grayscale, and is capable of displaying thousands of colors. The award was accepted by E Ink's Vice President of Research & Advanced Development, Dr. Michael McCreary.

- Polyera was the recipient of the FLEXI R&D Award. Entries for this award were considered based on world-class research, technologically outstanding and original product development, and new significant commercial potential for implementation into flexible or printed electronics. Judging was based on the vision of how entrants show their ability to identify and solve a real problem, and their determination to bring it to reality. Polyera, a supplier of functional materials for the printed and flexible electronics industry, has been a leading player in the development of these materials, in particular pioneering the development of high-performance, user-friendly n-type semiconductor materials. These materials not only represent a significant technical breakthrough by demonstrating the viability of high-performing n-type organic semiconductors, but also a commercial one by enabling the development of organic complementary circuitry (which require both n- and p-type materials). Polyera’s molecular materials have been used to fabricate the first inkjet-printed CMOS inverters, and their polymers have been used in the development of the first fully-printed complementary circuits operating in ambient conditions. The award was accepted by Polyera's Assistant General Manager, Brendan Florez.

- The Doctoral Training Centre (DTC) in Plastic Electronics, Imperial College London (ICL) was the recipient of the Technology Leadership in Education Award. This award recognizes and honors outstanding contributions to the flexible and printed electronics industry through education. Nominees are institutions or individuals that have created courses of education or training essential to building a successful flexible, printed electronics and displays industry. Judging was based on the quality of education, practical applicability, number of students completing the course, and degree of focus on flexible, printed electronics. One challenge in achieving the requisite training environment for Flexible Electronics education is the breadth of disciplines that this area involves and requires, including materials physics, optoelectronics, physical chemistry, device engineering/modeling, and design, synthesis and processing of molecular electronic materials. The Imperial College DTC meets this challenge by having aggressively invested in the broad field of Flexible Electronics that resulted in appointments in Physics, Chemistry, Materials, and the Institute of Biomedical Engineering. The award was accepted by Dr. Natalie Stingelin, Senior Lecturer in Functional Organic Materials, Imperial College Centre for Plastic Electronics.

Moser Baer and UDC announce technology and licensing agreement for energy-efficient OLED lighting

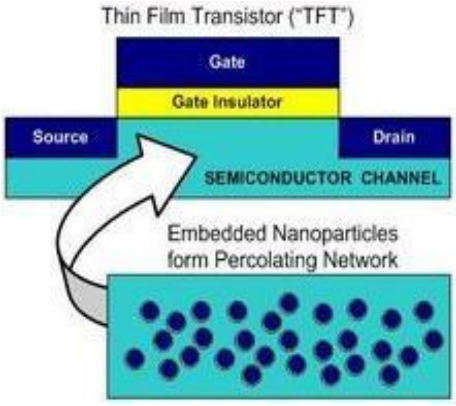
Moser Baer Technologies Inc., a US subsidiary of Moser Baer India Ltd., and Universal Display Corporation announced that the two companies have agreed to terms of a Memorandum of Agreement for technology licensing, material supply and technology assistance to support Moser Baer Technologies' initiatives in white OLED lighting. This agreement follows a program that the two companies announced last year in which the companies received $4,000,000 from the US Department of Energy to design and build the first white OLED lighting pilot manufacturing facility in the United States. Under the agreement, Moser Baer Technologies will license Universal Display's proprietary PHOLED and other OLED technologies and purchase Universal Display's highly energy-efficient UniversalPHOLED materials for white OLED panel manufacturing. Moser Baer Technologies and Universal Display will also work together in a five-year program to support Moser Baer's manufacture of white PHOLED lighting products. The establishment of Moser Baer Technologies' pilot manufacturing facility is a key next step in the development of a manufacturing base and market for white OLED lighting products in the US. The resulting panels will be made available to luminaire manufacturers to help seed the market for a range of new white OLED lighting products in the $90 billion lighting market. The Moser Baer Group brings several years of experience in light management and substrate manufacturing technologies that are suitable for OLED lighting devices. They plan to use Universal Display's superior PHOLED emitter materials and technology in combination with their substrate technology competencies and develop integrated, high-volume manufacturing concepts for OLED lighting products of the future. PHOLED technology is expected to play a critical role in the development and deployment of OLED solid state lighting technology, which offers increased energy efficiency, decreased power consumption, and an environmentally friendly alternative to traditional incandescent and compact fluorescent light bulbs. According to industry estimates, electric bills for lighting alone are over $200 billion per year on a worldwide basis. It has been estimated that by 2016, white OLEDs could generate well over $20 billion in worldwide savings of electricity costs and could save over 9 million metric tons of carbon emissions from the US alone. http://www.moserbaer.com/ http://www.universaldisplay.com

The US Department of Energy honors UDC for advances in efficient white OLED lighting

Universal Display Corporation announced that the company was honored by the US Department of Energy (DOE) in recognition of its significant achievements in solid-state lighting R&D during last year. Universal Display was honored for its advances in white OLED lighting performance using its high-efficiency PHOLED technology and materials. This is the fourth consecutive year that the company has been honored with this DOE award. The DOE award was specifically made in recognition of the advances achieved in several DOE-funded programs in 2010. Universal Display, along with project partners Armstrong World Industries, the University of Michigan and the University of Southern California, successfully demonstrated two phosphorescent OLED luminaire systems, the first of their kind in the US. This achievement marked a critical step in the development of practical OLED lighting in a complete luminaire system, including decorative housing, power supply, mounting, and maintenance provisions. With system efficacy of 51lm/W, the prototypical OLED lighting system can snap into Armstrong's TechZone ceiling system. In another DOE program, Universal Display demonstrated a key milestone of 66lm/W at a luminance of 1,000 cd/m^2, which is believed to be a world-record achievement, for a 15cm^2 phosphorescent white OLED lighting panel. http://www.universaldisplay.com

Versatilis shows dramatic improvement in semiconducting inks for printing electronics

Versatilis announced it has developed a method for significantly increasing the performance of the organic semiconducting inks used for printing electronic circuits. Working with research partner Lehigh University under a Small Business Technology Transfer (STTR) grant from the Office of Naval Research, Versatilis showed polymer transistors with 5-fold improvement over what could be otherwise achieved in such devices without incorporating its technology. Electronic devices made of organic or amorphous inorganic semiconductor materials, especially those made of "printable" semiconductor inks, have poor performance when compared to conventional silicon electronics. This is largely due to the very low intrinsic ability of such semiconductors to transport electrical charges, a problem that severely limits, for example, the appeal of printed electronics for higher end applications. Versatilis' technology involves mixing conductive nano or micro-particles into the semiconductor host material to form so-called percolating networks of dispersed particles. Such networks of embedded conductive particles enable electrical charges to take "shortcuts" effectively shortening their travel path, and dramatically improving device performance such as switching speed and other parameters. The effect had been previously demonstrated using carbon nanotubes to form percolating networks in a so-called "pick-up stick" transistor, but carbon nanotubes have presented a variety of challenges, all of which are circumvented by Versatilis' technique using



particles. Versatilis demonstrated a number of thin film transistors made with such embedded conductive particle based percolating networks and has been awarded the first broad patent (US 7,879,678) of several still pending. Existing printing technologies can be used, for example in a roll-to-roll manufacturing scheme since feature sizes can be larger for equivalent device performance. The technique can be used at high production rates in such a manner, as well as on wafers in batch mode. As a complement to this technology, Versatilis had also acquired in November last year the assets of Nanometrix, Inc., which included a novel technology for depositing ultra-thin, nano-scale coatings as well as monolayers of particles. http://www.versatls.com

Semiconductor device with embedded percolating network of nanoparticles

Plastic Logic announces $700M investment to make its plastic e-readers in Russia

Plastic electronics developer Plastic Logic is raising $700 million in funding. The investment will be used in part to build the world's largest commercial plastic electronics factory in Zelenograd, a Russian city often likened to Silicon Valley. The factory will be the second for Plastic Logic, a company known for its never-released Que e-reader for business professionals. The device was originally announced in the fall of 2008, and after several production delays, Plastic Logic reported plans in August to cancel the original product and move on to a second generation design. In contrast to other e-readers on the market today, the first generation Que, described as a paperless briefcase, featured an all-plastic design, making it thin, lightweight and able to withstand bending. Scheduled to open in 2013 or 2014, the new factory will employ more than 300 people and will be able to produce hundreds of thousands of plastic electronic displays per month. The company plans to manufacture its displays in both the new Zelenograd factory and in Dresden, Germany, where the company's first factory is located. The second generation displays, which Plastic Logic expects to release before the new factory opens, are currently being qualified in Dresden. The announcement includes an initial equity investment of $150 million from the Russian Corporation of Nanotechnologies (RUSNANO) and a $50 million equity investment from existing investor Oak Investment Partners. Plastic Logic is also in the process of closing $100 million in debt financing, for which RUSNANO will provide partial guarantees, and Archuleta said Plastic Logic expects to raise the remaining $400 million in funding before the factory opens. http://www.plasticlogic.com

Applied Materials introduces advanced technology for manufacturing high-performance mobile displays

Applied Materials announced its new Applied AKT-20K PX PECVD system for manufacturing high performance active matrix OLED and TFT-LCD displays used in the most advanced smart phone and tablet PC applications. Using critical LTPS technology, the system deposits highly-uniform films on 1.95m^2 glass sheets that are three times larger than the previous standard size. This capability enables manufacturers to significantly increase production and drive down cost – helping to accelerate the transition to larger, high resolution screen sizes for mobile consumer products. AKT-20K PX system enables ultra-high definition TFT-LCD screens with more closely-packed pixels, resulting in brighter, sharper, lower energy displays compared to previously available technology. Key to the AKT-20K PX system is its advanced LTPS technology which Applied has enhanced over the last 10 years. Applied has shipped nearly 100 systems worldwide for depositing LTPS films on smaller substrates. http://www.appliedmaterials.com/display

CDT and Singapore's NUS sign a five-year IP licensing pipeline agreement

Cambridge Display Technology (CDT) and the National University of Singapore (NUS) Organic Nano Device Laboratory (ONDL) signed a five-year intellectual property (IP) pipeline licensing agreement to commercialize the innovations arising from NUS's P-OLED research. Under the terms of this agreement, CDT will be able to access new innovations from ONDL research and take licenses in existing and new IPs in P-OLED displays and lighting, solar cells and thin film transistor circuits. CDT will pay royalties to the NUS if/when they commercialize these activities. http://www.cdtltd.co.uk

Cambrios and Toray Advanced Film to collaborate on line of transparent conductive PET films

Cambrios Technologies Corporation announced that it has reached an agreement to provide Cambrios ClearOhm coating materials to Toray Advanced Film Co., Ltd. of Japan, part of the Toray group, which provides innovative materials and components globally. Toray Advanced Film, the world's leading supplier of various base films and cutting edge processed film products, will use ClearOhm material to produce a line of transparent conductive PET films. Among other uses, transparent conductive films are a high value component of touch screens, including the projected capacitive type used in smart phones and tablet computers. Toray has also made a strategic investment in Cambrios. Toray Advanced Film will leverage its film and coating expertise using Cambrios ClearOhm conductive inks to produce transparent conductive films that have the highest transparency, best color, and most pliability of any other comparably conductive film. These films will replace ITO coated PET films in touch sensors for a wide array of consumer electronic devices. Cambrios ClearOhm material offers simpler patterning, less expensive deposition options and, because of its flexibility, can improve yield versus ITO. http://www.cambrios.com

FlexTech Alliance elects John Batey chairman of board

FlexTech Alliance, focused on developing the electronic display and flexible, printed electronics industry supply chains, announced that Dr. John Batey has been named chairman of the governing board. Dr. Batey has over 25 years experience developing and commercializing display technology and most recently served as president of Qualcomm MEMS Technologies. Dr. Batey will serve this term for two years, replacing Thomas T. Edman of Applied Materials, who served as FlexTech Alliance chairman since 2009. In his role as FlexTech Alliance chairman, Dr. Batey is charged with overseeing the organization's decisions on policy, program content and disposition of funds available to the consortium for sponsoring technology-related R&D projects. During his term, he will work with the governing board and all FlexTech Alliance stakeholders to further the organization's development in a manner that increases the consortium's value. "The electronic display and flexible, printed electronics industries have before them both immense opportunities as well as significant challenges," said Dr. Batey. "As an industry, we are all acutely aware of the role advanced supply chain development and management plays in both expanding and enabling new display technologies and associated infrastructure. The FlexTech Alliance plays an important role in that development. http://www.flextech.org

SDK and NovaCentrix to cooperate in printed electronics

Showa Denko K.K. (SDK) and NovaCentrix have agreed to cooperate in the promising area of printed electronics. SDK will manufacture and sell conductive inks developed by NovaCentrix through a licensing agreement, and jointly develop conductive inks to be used with NovaCentrix's photonic curing process technology. It was also agreed that Shoko Co., Ltd., SDK's consolidated subsidiary, will start serving as sales agent for NovaCentrix in Japan and part of Asia concerning NovaCentrix's PulseForge photonic curing tools and Metalon conductive inks.

NovaCentrix is a privately-held company in the United States with notable accomplishments in the area of wiring technology, which constitutes an essential part of the printed electronics technology. In printed electronics, conductive wiring is formed through printing with metallic-particles-containing inks (conductive inks), and sintering of those metallic particles with heat treatment. Because of the necessity of heat treatment, it is generally considered that application of printed electronics to plastic substrates is difficult. However, NovaCentrix's proprietary technology involves high-speed sintering with visible-light flash lamps, restricting the rise in temperature and enabling the use of plastic substrates. Furthermore, the system uses films as plastic substrates, enabling production with an efficient roll-to-roll process. SDK will fully utilize its metal, inorganic and organic material technologies in its joint development, aiming to develop conductive inks optimized for NovaCentrix's photonic curing system. SDK will aim to improve the performance of existing conductive inks, thereby achieving durability and conductivity equal to those of conventional copper foils and other bulk products. Conductive inks are now used in some of the components for smart phones and solar cells. While its market is estimated at JPY 30 billion at present, the market is expected to grow to JPY 100 billion by 2020. With the tie-up with NovaCentrix, SDK will accelerate R&D for the growing printed electronics market. http://www.sdk.co.jp

Plextronics announces OLED lighting distribution agreement with Sanyo Chemical Industries

Plextronics announced that the company has signed an OLED lighting distribution agreement with Sanyo Chemical Industries. Under the terms of the agreement, Sanyo will distribute select Plexcore OC inks developed specifically for use in OLED lighting applications in the Japanese market. Jim Dietz, Plextronics vice president of business development, indicated that the relationship with Sanyo has been a long-standing and important one for both companies. Plexcore OC includes two product lines with tunable hole injection designed for different device architectures - Plexcore OC AQ and Plexcore OC NQ. Plexcore OC AQ consists of water-based HIL inks designed to deliver stable, low operating voltage and extended lifetime in polymer OLED (P-OLED) displays as well as hybrid phosphorescent OLED lighting panels. Plexcore OC NQ includes solvent-based HIL inks for solution-processed phosphorescent OLED emitters. Combining new conductive polymer technology with solvent-based ink formulations, this HIL enables OLED display manufacturers to solution-process this layer without the concerns of potential device degradation due to the acidic nature of other HIL technologies. In devices, Plexcore OC NQ dramatically reduced operating voltage that is extending device lifetimes to be competitive with vapor-deposited OLED displays. http://www.plextronics.com

Universal Display exhibits next-generation OLED technology platforms

Universal Display Corporation unveiled a set of flexible OLED lighting design prototypes and technical advances to showcase the performance of its flexible FOLED, single-layer encapsulation and solution-processible UniversalP2OLED technologies. Universal Display, a pioneer of flexible OLED technologies, is responsible for a range of technology innovations that could accelerate the commercialization of flexible OLED display and lighting applications. The company and its partners have been working with the US Department of Defense, through the US Army Communication Electronics Research and Development Engineering Center (CERDEC) and US Army Research Laboratories, to develop flexible OLED displays for military applications. Recently, Universal Display and its partners delivered to the US Army eight wrist-mounted communication device prototypes designed and fabricated by L-3 Display Systems and based on a flexible OLED display using Universal Display's UniversalPHOLED technology and materials, as well as LG Display's backplanes applied to thin flexible metal foil substrates. Universal Display recently announced its proprietary, patented encapsulation technology for the packaging of flexible OLEDs and other thin-film devices, as well as for use as a barrier film for plastic substrates. Addressing a major roadblock to the successful commercialization of flexible OLEDs, the company's hybrid, single-layer approach provides barrier performance required for OLEDs using a potentially cost-effective process. The company reported advances in its printable UniversalP2OLED technology and materials, which could drive the commercialization of innovative, cost-effective manufacturing techniques for rigid and flexible OLED display and lighting panels. Universal Display's recent advances have included increased luminous efficiency and voltage reductions. In addition, recent technology development has rapidly improved operating lifetimes to put commercial viability in sight. http://www.universaldisplay.com

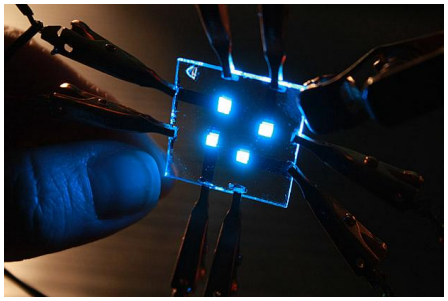
Universal Display's new flexible white OLED lighting concept, the OLED "Swirl", is built on flexible metal foil using the company's energy-efficient UniversalPHOLED technology and materials and proprietary encapsulation technology.

Universal Display unveils novel single-layer encapsulation technology for OLED and thin-film devices

Universal Display Corporation unveiled a novel, single-layer encapsulation technology for plastic substrate systems and thin-film devices, including rigid and flexible OLED displays and lighting panels. Details of the new thin-film encapsulation technology were delivered in a paper titled "Technical Gap Analysis of Vacuum Coated Materials for Flexible OLED Display and Lighting Applications." Developed in collaboration with research partner Princeton University, Universal Display's single, hybrid organic-inorganic layer approach has been demonstrated successfully as an encapsulant for flexible and rigid OLED devices. The encapsulation layer provides an effective permeation barrier to protect thin-film

devices from environmental conditions, such as moisture and oxygen, which is critical for the long-term performance of OLED display and lighting products. Using environmentally-benign and non-toxic materials in a potentially low-cost process, the barrier film technology may also be well suited for high-performance plastic substrate systems and other thin-film devices, such as photovoltaics and batteries. The approach relies on a single, hybrid organic-inorganic layer that is applied using a cost-effective process. This film creates a very strong permeation barrier to address the strict packaging requirements of these devices. In addition to providing benefit for OLED and other thin-film products in the market today, this approach may also accelerate the commercialization of emerging flexible OLED displays and lighting products, as well as the plastic substrate systems that are used to produce them. http://www.universaldisplay.com

University of Michigan researchers develop high-efficiency blue OLED

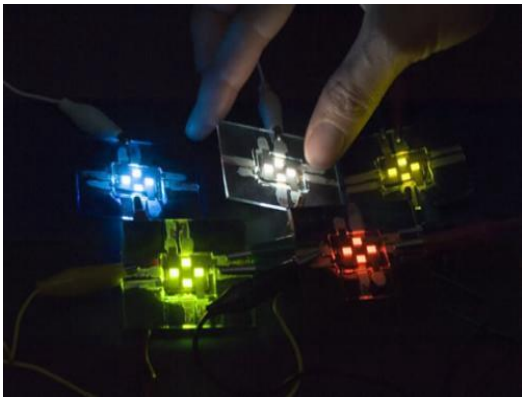


University of Michigan engineering researchers have designed what is said to be an exceptionally efficient fluorescent blue OLED. It doubles the known efficiency of fluorescent OLEDs. The ceiling for fluorescent OLED efficiency was thought to be 5%. Using redesigned materials and computer simulation, the researchers and their Singapore colleagues achieved 10%. With the material, they took the molecules and started to reconfigure them in a computer model, adding different functional groups in a systematic way. They identified the mechanisms that control the performance of OLEDs, and by applying the fundamental understanding so obtained they improved the material's characteristics. The research demonstrated the importance of simulation-based predictive design. http://www.umich.edu

Universal Display reports advances in its solution-processible phosphorescent OLED material systems

Universal Display Corporation announced advances in the performance of its UniversalP2OLED solution-processible, phosphorescent OLED material systems for use with solution-based manufacturing processes. OLED manufacturers are evaluating manufacturing techniques, like ink-jet printing, as additional paths for the cost-effective production of large-area OLED displays and lighting panels. Universal Display said that its P2OLED technology and materials have continued to progress over the past several years to the point where commercial viability is now in sight. Solution-based manufacturing techniques could become a cost-effective and attractive option for the production of OLED devices, especially at large sizes. The green P2OLED system, which offers a luminous efficiency of 68cd/A, has now achieved 175,000 hours of operating lifetime. This represents approximately a 1.3 times improvement in lifetime over results reported last fall. The red P2OLED system, with a luminous efficiency of 18cd/A, now offers an operating lifetime of 125,000 hours for a two-times improvement in lifetime. The light blue P2OLED system now offers a luminous efficiency of 29cd/A and 8,000 hours of operating lifetime for a 1.6 times improvement in luminous efficiency and lifetime. Small-area OLED displays, manufactured using conventional vacuum thermal evaporation, have already entered the mainstream consumer market in display applications for smart phones and multi-media players. Display and lighting manufacturers are evaluating other techniques for the manufacture of large-area OLEDs in an effort to further drive down costs for OLED TV panel and lighting panel production. Solution-processible techniques, such as ink jet printing, are candidates for the efficient and low-cost manufacturing of large-area OLEDs. http://www.universaldisplay.com

Plextronics OLED ink demonstrates boost in lifetime and lower operating voltage



Plextronics announced that its Plexcore OC NQ ink has been integrated into Universal Display Corporation's P2OLED solution-processed, phosphorescent OLED technology to assist in achieving lower operating voltage and longer lifetime in test devices. This is the second time in less than five months that UDC has announced breakthrough performance improvements in its P2OLED program that include the use of Plexcore OC NQ ink. Plexcore OC NQ was made available for limited sampling to key customers and partners last October. The non-aqueous-based hole injection layer (HIL) ink complements the company's existing aqueous-based HIL, and is geared specifically for solution processible phosphorescent OLED emitters.

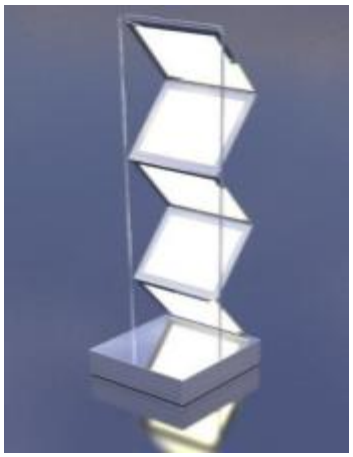
E Ink and Epson to build "retina" display for e-book readers

E Ink and Epson are to jointly develop an electronic paper panel with a "retina display" pixel density. Apple calls the iPhone 4 screen a retina display because its 326ppi density is so high that the human eye is unable to distinguish individual pixels. The E Ink/Epson screen will have a 300ppi, making the current Kindle's 167ppi look low resolution. It will be bigger at 9.7 inches compared to the Kindle's 6 inches. The new screen's resolution will be 2400x1650, and monochrome. E Ink will develop the display itself, Epson the chip that controls the screen. Neither firm said when the screen will appear in e-book readers. http://www.eink.com

Universal Display reports advances of UniversalPHOLED technology and materials for TV applications

Universal Display Corporation presented new findings on the use of energy-efficient, environmentally-friendly UniversalPHOLED technology and materials in OLED television applications. In an invited paper titled "High Efficiency Phosphorescent AMOLEDs: The Path to Long Lifetime TVs," Universal Display presents an analysis demonstrating that OLED TVs using phosphorescent OLEDs can be environmentally green and consume less power than comparable AMLCDs. In addition, the use of phosphorescent OLEDs reduces operating temperature rise to extend display lifetime and reduce cost. In a comparison of various display architectures, it highlights added power consumption and lifetime advantages through the use of the company's novel four sub-pixel architecture for OLED TVs. The new architecture adds a light blue sub-pixel to the conventional red-green-blue (RGB) configuration. The performance of this RGB1B2 architecture has recently been improved through use of the company's enhanced light blue materials system. Universal Display's enhanced light-blue materials system achieves a luminous efficiency of >47cd/A at 1,000cd/m^2. Under accelerated test conditions, this new emitter system demonstrates an operating lifetime of approximately 20,000 hours, to 50% of an initial luminance of 1,000cd/m^2 – for a two times improvement over results reported last year. http://www.universaldisplay.com

Novaled shows a new "Jumping Flash" transparent OLED lamp design



Novaled showed a new transparent OLED lamp design ("Jumping Flash"). Novaled is using five transparent white OLED panels (10x10cm each) and the whole lamp is expandable like a harmonica. When closed, it's a 10x10cm bright light square, and when you open it you get a vertical 50x10cm light strip. http://www.novaled.com

Novaled develops world's most power-efficient fluorescent white OLEDs

Novaled announced it has developed the world's most power-efficient fluorescent white OLED structures – achieving 36lm/W. Using its proprietary organic materials and a new flat light outcoupling method of extraction, Novaled increased OLED device light emission by more than 80%, with good color rendering, and also improved the angular dependence of the light emitted. Novaled's new power-efficient fluorescent white PIN OLEDs result in lower manufacturing costs and meet the standards for commercial lighting applications, making them ideal for OLED lamps and luminaires for general and design lighting. Novaled's novel methods boost outcoupling effectiveness, substantially increasing the 25-35% fraction of generated light that typically leaves the OLED device for lighting applications. They also increase power efficiency and quantum efficiency in both bottom and top-emission OLEDs. In bottom-emission OLEDs Novaled incorporates the material NET61 directly inside the electron transport layers. The combination of NET61 internal outcoupling and an external micro lens array (MLA) film boosts power efficiency by more than 70% and quantum efficiency by more than 80%. In top-emission OLEDs, Novaled uses scattering material NLE17 on top of the semi-transparent top electrode to help extract light and improve the quality of light emitted from top-emission white OLED devices.

Novaled's new outcoupling techniques use standard processes to produce the white PIN OLED device structures, thus reducing manufacturing costs for both bottom-emission and top-emission OLEDs. Unlike other outcoupling enhancement approaches in bottom-emission OLEDs – such as depositing complicated structured layers between substrate glass and the indium tin oxide (ITO) anode – Novaled uses simple internal outcoupling methods with vacuum evaporation processed organic materials to induce scattering of the light emitted by the OLED. In both bottom and top-emission OLEDs, the scattering does not negatively impact electrical properties. In addition, Novaled's new method improves the color rendering index (CRI) value for top-emission OLEDs on metal substrates. Although top-emission samples on metal substrates with a white light emission typically have stronger cavity effects than bottom-emission devices and show strong variations with the viewing angle, Novaled increases light extraction from top-emission white OLEDs and strongly reduces angular color dependence by using a scattering evaporation processed organic layer on top of the semi-transparent top electrode. Novaled's demonstrated CRI of 75 for top-emission OLEDs is ample for many commercial lighting applications. http://www.novaled.com

QD Vision achieves significant efficiency and performance improvements

QD Vision announced major advances in the efficiency and performance of its quantum dot LED (QLED) technology. QLEDs offer all of the functional benefits of emissive display technologies, with the added advantage of simplified manufacturing processes and the potential to consume half of the power of the most efficient OLEDs. QD Vision's red, green and blue QLEDs now meet or exceed the 1953 NSTC color standard without using color filters or secondary effects. The color performance of QLEDs translates into a fundamental 30-40% luminous efficiency advantage over the best known OLED technology. QD Vision's deep red QLEDs now offer greater efficacy at equivalent color than the best reported phosphorescent OLEDs, and its green and blue QLEDs match the performance of fluorescent OLEDs, but with superior color performance. For example, red QLEDs fabricated by QD Vision consistently achieve peak external quantum efficiencies (EQEs) of more than 18% and efficacies of more than 22 lm/W and 18 Cd/A, at 1931 CIE color coordinates of (0.68, 0.32). http://www.qdvision.com

QD Vision secures $22 million to fund expansion and ramp production

QD Vision announced it has closed a $22 million round of financing that will be used to expand volume production capacity, and to fund long term company growth. The latest round of financing includes existing investors, North Bridge Venture Partners, Highland Capital Partners, In-Q-Tel, and DTE Energy Ventures, as well as new investors, Passport Capital, Novus Energy Partners, and Capricorn Investment Group. http://www.qdvision.com

Thinfilm and PARC extend printed electronics commercialization engagement

Thin Film Electronics ASA ("Thinfilm") and PARC, a Xerox company, announced that they have entered the next phase of their co-innovation engagement. PARC and Thinfilm's collaboration on next-generation printed memory solutions kicked off last year with joint design of Thinfilm 128-bit Addressable Memory, which combines Thinfilm's unique non-volatile memory technology with PARC's printed CMOS transistor technology. Given the success of the initial design phase, this next phase extends the engagement to prototyping the product for manufacturing readiness. The engagement allows both companies to achieve together what neither could do alone. Thinfilm will use the PARC CMOS technology to expand the memory technology that it has previously commercialized in a roll-to-roll printed production process to an addressable version that is still fully printed. Products with Thinfilm addressable memory will be a key avenue for PARC to commercialize its technology. Such memory enables unique form factors, cost advantages, and integration with other printed components including sensors and simple displays that can be customized for multiple markets -- ranging from games and toys, to ID tags, disposable sensors, and price labels. http://www.parc.com

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Short Course – *Materials*
Printed Electronics – Materials & Deposition Techniques & the State of Current Requirements

The expressions "functional inks" or "electronic inks" are used to distinguish inks used in printed electronics applications from conventional inks used for graphics printing. Once printed, a functional ink can provide a variety of electrical, electro-optical and/or chemical properties. This course will provide a comprehensive overview of functional inks used in various printed electronics applications.

Short Course – *OLED Lighting*
SSL – A Bright Future for OLED Lighting

OLED technology is used in production today to fabricate small displays for cellular telephones and other mobile applications. Like compact fluorescent bulbs and LEDs, a natural evolution for OLED technology is general lighting. OLEDs are thin, lightweight and efficient, making them great options for lighting designers. They can also be formed on flexible substrates, opening new frontiers in design. This short course provides an overview of the technology and explores the possibilities and barriers OLEDs face in the general lighting market.

Short Courses Roll-to-Roll
Flexible Electronics – R2R Processes and Electronic Packaging

Flexible and deformable electronics are emerging as the next great leap in the electronics revolution. This short course focuses on the materials, processes and tooling by which these devices are fabricated. The manufacturing challenges facing industry will be outlined. Future trends in flexible and deformable technology will be emphasized throughout. Applications of flexible devices to biology, medicine and civil infrastructure are included.

IDTechEx

www.IDTechEx.com/pe

Printed, Organic & Flexible Electronics Forecasts, Players & Opportunities 2011-2021

authors: **Raghu Das and Dr Peter Harrop**

This report provides the most comprehensive view of the topic, giving detailed ten year forecasts by device type. The market is analyzed by territory, printed vs non printed, rigid vs flexible, inorganic vs organic, cost of materials vs process cost and much more, with over 200 tables and figures. Activities of over 1,000 leading companies are given.

The market for printed and potentially printed electronics, including organics, inorganics & composites, will rise from $2.2 billion in 2011 to $44.25 billion in 2021

Report Covers:

- Market forecasts by region and component type
- Realistic timescales
- Lessons, successes and opportunities
- Case studies

The report specifically addresses the big picture - including all thin film photovoltaics, relevant display technologies and much more. Importantly, it includes not only electronics which are printed, organic and/or flexible now, but it also covers those that will be. Realistic timescales, case studies, existing products and the emergence of new products are given, as are impediments and opportunities for the years to come.

Lessons, Successes and Opportunities

The report covers case studies of where printed electronics has been used, why and the results. It looks at new products that are imminently emerging and their prospects for success. The technical barriers and commercial barriers are listed and prioritized, as well as progress to overcome these. In particular, the following components are addressed, and for each one ten year forecasts are given, along with companies and their activities, case studies, impediments to commercialization and timescales:

- Logic and memory
- OLED displays
- OLED lighting
- Electrophoretic displays
- Electrochromic displays
- Electroluminescent displays
- Other displays
- Batteries
- Photovoltaics
- Sensors
- Conductors
- Other

If you are looking to understand the big picture, the opportunity, the problems you can address, or how you can start to use these technologies and the implications involved, this report is a must. **For more information please visit www.IDTechEx.com/pe or contact Raoul at Raoul@IDTechEx.com or phone +1 617 577 7890.**

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To schedule a membership overview meeting, call FlexTech Alliance today at 408.577.1300

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Opportunities for pre-competitive R&D Funding - FlexTech Alliance sponsors an industry-wide R&D funding program available exclusively to its members.

Gap Analysis and Roadmapping - Members receive complimentary admission to FlexTech Alliance workshops and tours of R&D and production facilities. Workshops are designed to identify and resolve key technical challenges.

Industry and Market Research Reports

FlexTech Alliance research reports provide valuable insights into the technological and economic trends of our member companies' primary markets. Free to members*, the data package consists of reports from:

-DisplaySearch -NanoMarkets - Veritas et Visus
-Insight Media - FlexTech Alliance

*with certain restrictions

Networking Events and Partnership Opportunities

The Flexible Electronics and Displays Conference and Exhibition - Members receive significant discounts to the annual Flex Conference. Attendees span the roles of technical, marketing, product development, manufacturing, and business planning functions.

Regional Workshops, Meetings and Business Conferences - Hosted at member locations, these one-day events provide a great venue for networking with industry experts throughout the supply chain.

Educational Events

Members receive discounts on FlexTech Alliance short courses. These courses provide valuable, up-to-date education and information on trends in technology and business. Webinars are planned for 2011

Member Marketing

Advocacy - FlexTech Alliance provides a strong and effective industry voice with the media, investement community, and federal and state governments.

On-line resources - Members are featured prominently on www.flextech.org, a popular resource for journalists, industry and financial analysts, and consultants.

Branding opportunities - Members receive an expanded and highlighted listing in the searchable on-line directory as well as posting rights and advertisement placement on FlexTech's homepage.

Product demos - FlexTech Alliance can help facilitate the development of product demonstrators.

FlexTech Alliance
for Displays & Flexible, Printed Electronics

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