FlexTech Alliance
for Displays & Flexible, Printed Electronics

FlexTech Trends

News from the world of displays and flexible, printed electronics

Q1 2011

FlexTech Trends

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Note from the President

by *Michael Ciesinski*

The FlexTech Alliance would like to wish you a healthy and prosperous 2011.

We kicked off this new year with our 10th annual Flexible Electronics and Displays Conference held February 7-10 in Phoenix, Arizona. Experts from more than 10 countries and 240 companies, research centers, universities and manufacturing centers converged at the Flex Conference. Research results, product demonstrations, commercial-lization panels, and supplier exhibits showcased industry advancements. To view highlights and photos from the event, see page 9 of this newsletter.

Numerous attendees remarked on the quality and depth of the 100+ presentations covering 25 different topics. If you are interested in purchasing Flex Conference proceedings, visit www.flextech.org for more details on how to order a copy.

In this edition of FlexTech Trends:

-Market update from Paul Semenza, Senior Vice President, DisplaySearch

-Summary of the FlexTech Alliance workshop “How Do We Get From Today’s Flexible Electronics Technology To Tomorrow’s High Performance Sensors?”

-Winners of the 2011 FLEXI awards. Congratulations to E Ink, Polyera and The Doctoral Training Centre (DTC) in Plastic Electronics, Imperial College London (ICL).

Congratulations are also in order to Kent Displays for being recognized by President Obama for technology and economic development. Click here to see and hear the president’s remarks.

http://www.kentdisplays.com/videos/obama-forum-kent-displays.html

FlexTech’s goal is to advance the growth, profitability and success of our member companies and organizations by sharing practical experience and developing solutions from R&D to commercialization.

To that end, we are planning some new and different events for 2011. Keep an eye out for emails and web site postings with details of upcoming events.

We look forward to a great year ahead.

LED Wave Driving New Interest in Inorganic Electroluminescent Materials

Paul Semenza
Senior Vice President, DisplaySearch

Over the past decade, the display industry has seen a shift away from devices based on phosphors or other inorganic electroluminescent materials. Electroluminescent displays lost to LCDs, electroluminescent backlights lost to LEDs, CRTs have become obsolete, emerging technologies such as FEDs never made it into volume production, and PDPs, while still growing, are losing share to LCDs. At the same time, organic electroluminescence, in the form of OLED displays and lighting sources, has created a great deal of excitement. It seemed like phosphor-based devices would be relegated to the museum. But the onslaught of LEDs in backlighting and general illumination is causing a resurgence of interest in inorganic electroluminescent materials.

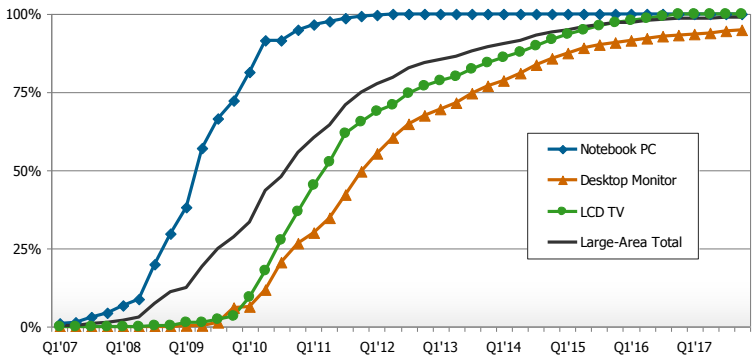


Figure 1: LED backlights are used in more than half of all large-area TFT LCD panels
Source: DisplaySearch Q3'10 Quarterly LED Backlight Report

Impact of LED Lighting

The large-area LCD market is being transformed by the switch from CCFL to LED backlighting, which allows for fast switching with wider color gamut and higher contrast, in thinner and lower-power packages. Led by notebook PC displays, LED backlights are taking over the key applications for large LCD panels (Figure 1). In particular, the conversion of LCD TVs, with their large sizes, to LED backlights is driving demand for LED chips; new applications in lighting are also contributing to growth (Figure 2).

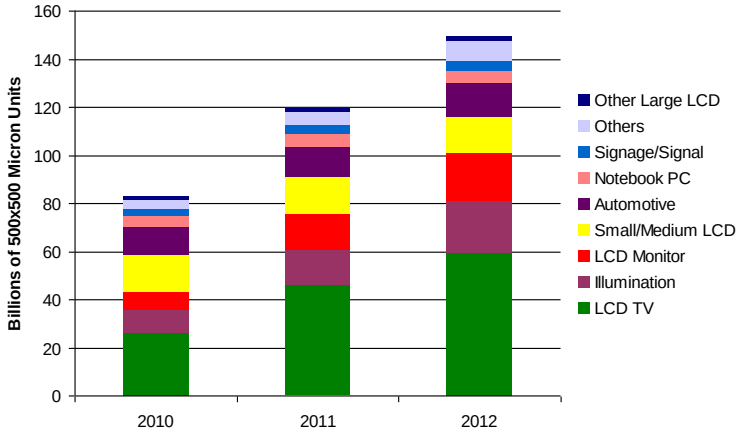


Figure 2: Total LED demand will pass 100 billion chips in 2011
Source: DisplaySearch Q3'10 Quarterly LED Backlight Report

The growing demand is driving advances throughout the LED supply chain, for example in epitaxial growth processes using MOCVD equipment. These processes enable higher manufacturing capacity and luminous efficiency. Chip packaging and driver ICs are also important aspects to high-volume LED manufacturing. But an aspect that is not so apparent – color conversion materials – is increasingly important to the performance of LEDs. This is because the most common type of LEDs used in LCD backlighting and general illumination – white LEDs – typically use phosphors or other color conversion materials to produce a broad light spectrum from a monochromatic source. The selection and use of these materials can have significant impacts on both device and system efficiencies.

White LEDs typically use GaInN chips that emit in the blue, along with a yellow phosphor that converts most of the blue into a broad band. Other approaches to producing white light include using red and green phosphors with a blue emitter, as well as a UV emitter with red, green, and blue phosphors. These approaches result in higher CRI (color rendering index, a measure of how "natural" the light appears, which is important in lighting), but lower luminous efficiencies. An alternate approach is to combine red, green, and blue emitters in a multi-chip package, which tends to have high cost.

Two of the most common yellow phosphors are YAG ($Y_3Al_5O_{12}$), originally developed by Nichia, and TAG ($Tb_3Al_5O_{12}$), developed by OSRAM; both are typically activated with trivalent cerium (Ce). An alternative class of materials uses silicate phosphors; intellectual property for these materials has been asserted by a group called the BOSE consortium (consisting of Tridonic, Toyoda Gosei, Leuchtstoffwerk Breitungen and Litec GbR) which has signed a cross-licensing agreement with Intematix. Recently, phosphors have been developed around SiAlON materials by Denka and nitrides by Mitsubishi Chemical.

These different types of phosphors can be complex to create, and are typically protected by patents, resulting in materials costs in the thousands of dollars per kilogram. These materials are also limited in efficiency and can suffer from thermal decay. This has led to continued development of inorganic phosphorescent and fluorescent materials, as well as new luminescent materials based on nano-scale semiconductors, called quantum dots.

Quantum Dots – The New Phosphors?

Quantum dots are nanometer-sized semiconductor crystals that use materials from periodic groups II-VI, III-V or IV-VI, typically synthesized in the liquid phase, and appear similar to colored inks. Quantum dots provide the stability and reliability of inorganic semiconductor materials, and since they can be "tuned" through selection of material and crystal size, and are processed in solution, they could enable efficient manufacture of electroluminescent displays, lighting, or phosphor replacements with broad color gamut, high efficiency, and environmental stability. Companies pursuing these technologies include QD Vision and Nanosys.

QD Vision's first commercial product was an LED lamp developed in partnership with Nexxus Lighting. Typically, white LEDs are bluish, which is not appealing for general lighting. To change the bluish white to warm white, yellow phosphor is typically used, but it reduces the luminous efficiency up to 50%. QD Vision's quantum dot-based optical element is used to convert the light at high efficiency. Depending on the material, the optic can convert an LED with 6500K color temperature to 4000K or 2700K.

In November, QD Vision and LG Display announced a joint development agreement to create displays based on electroluminescent quantum dot LED (QLED) nanotechnology. Like OLEDs, QLEDs have layered structures, but instead of using organic light emitters, QLEDs use quantum dots as the emitter layer. Of course, the HIL, HTL, and ETL need to be optimized for the quantum dot emitter. QD Vision believes that quantum dots make a better choice in planar lighting than the organic emissive material in OLEDs, with a richer color

gamut and simpler manufacturing process. QD Vision also formed a partnership with Solvay, a specialist in plastics and chemistry, to pursue printable quantum dots for display and general illumination applications.

Nanosys has developed a broad intellectual property portfolio around quantum dot materials and technologies. In 2010, the company announced agreements with LG Innotek, involving its Quantum Rail™ for use in displays, and with Samsung Electronics for commercial applications of nano-architected materials in thin film solar panels, flash memory products and displays. Quantum Rails are thin rectangular glass tubes filled with quantum dot material, and can be made in different sizes and lengths. The devices are attached to a light guide plate, where they convert the light from blue LEDs (typically used for backlights) to green and red, resulting in wider color gamut and lower power consumption.

Other Directions

There are other potential areas of developments for inorganic electroluminescent materials. One interesting approach has been developed by Prysm, which uses a UV laser diode array to scan a sheet with rows of printed red, green, and blue phosphors. This approach, related to CRTs and rear-projection, relies upon widely-available scanning technology as well as a new method for synthesizing and printing phosphors. For a technology that was looking to be obsolete, inorganic electroluminescent materials could play a key role in display and lighting technologies.

References

DisplaySearch, *LED Process and Technology Trend Report*, January 2011
DisplaySearch, Q3'10 *Quarterly LED Backlight Report*
DisplaySearch, *The Emitter: Emerging Display Technologies*, various issues

Highlights from FlexTech's Sensors Workshop
FlexTech Alliance Headquarters
San Jose, California
November 9 – 10, 2010

"How Do We Get From Today's Flexible Electronics Technology To Tomorrow's High Performance Sensors?"

As smart, networked sensors become widely used in smart buildings, civil infrastructures, aircraft and other military and commercial applications, circuitry such as logic, memory, and power management become essential performance requirements.

What are the next steps for the flexible electronics industry to deliver the required higher performance functionality? How fast will current techniques advance? Is a disruptive technology called for to solve the mobility, connectivity, and manufacturing challenges of these applications?

Morning General Session
At the FlexTech Alliance November 2010 workshop, these issues were addressed from various perspectives including system integrators and device engineers. Presenters and attendees explored the current state of the industry, where it needs to be, and how to get there.

Panel Discussion:
The afternoon session involved a spirited discussion with attendees and a panel of experts:
Moderator:

- Eric Forsythe, Army Research Lab

Panelists:

- Paul Semenza, Display Search
- David Allee, Flexible Display Center Arizona State University
- Yan Ye, Applied Materials AKT
- Brendan Florez, Polyera
- Ben Schlatka, MC10

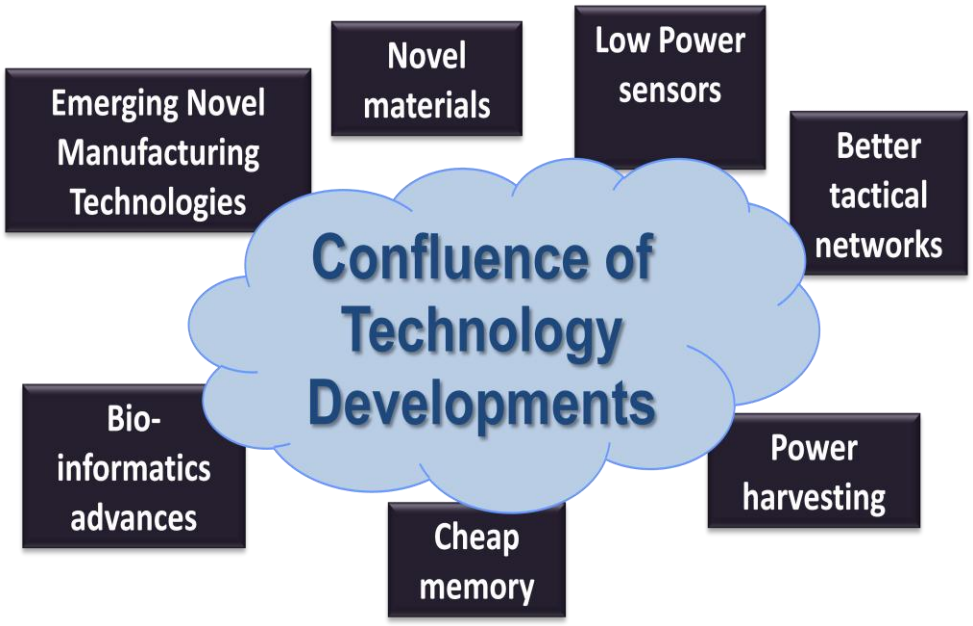
The discussion began with questions about where the sensor market is heading and which sectors have the technical pull for developing thin, flexible devices. These sectors were contrasted against the markets that are able to support development financially.

Prior to the workshop, attendees were able to take a tour of Applied Materials AKT facilities. The tour included PECVD processing equipment for large area TFT-LCD applications such as TFT-LCD television, displays and notebook computers. Tour participants were also able to see Gen 10 glass - which is larger than a single garage door and only 0.7mm thick.

Display made using AKT ZnON semiconductor
Courtesy of Applied Materials AKT

Presentation topics

Wednesday November 10, 2010	
Morning General Session	
Market Analysis	Paul Semenza, Display Search
Positioning the Current Condition of the Technology Base that is Trying to Meet the Needs of the Marketplace	Barry Ives, Lockheed Martin Advanced Technology Labs
Identifying the Gaps from a Designer's Perspective	David Allee, Flexible Display Center Arizona State University
Current Development and Manufacturing Scale-up Efforts for High Mobility Thin Film Transistors	Yan Ye, Applied Materials AKT
Disruptive Technologies to Achieve Stepwise Change in Performance	Brendan Florez Polyera
High Performance Conformal Electronics: Technology and Applications	Ben Schlatka, MC10
Afternoon Panel Discussion	
Overview of Flexible Electronics at PARC	Ross Bringans, PARC
Panel Discussion What If Higher Performance is Needed to Make Printed Electronics a Viable Industry?	



Supply Chain Development, Market Requirements and Core Technology of Flexible, Printed Electronics and Displays Explored at the FlexTech Alliance 10th Annual Flex Conference

Research Results, Product Demonstrations, Commercialization Panels, and Supplier Exhibits Showcase Industry Advancements

Experts from more than 10 countries and 240 companies, research centers, universities and manufacturing centers converged at the ***10th Annual Flexible Electronics and Displays Conference*** held February 7- 10, 2011 in Phoenix, Arizona. Attracting 460 registrants, the conference provided an effective forum to network and collaborate with partners in the flexible electronics supply chain. Twenty-five focused sessions covered a wide range of flexible, printed electronics and display topics including applications in e-tablets, energy, medical sensors and novel devices.

"From start-ups to Fortune 500 companies, the conference encourages members of this emerging field to participate in growing the industry," said Michael Ciesinski, CEO of the conference organizer, FlexTech Alliance. "FlexTech is very pleased that at this 10th anniversary event we were able to celebrate success stories, validate industry milestones, and have an open debate about future strategies."

Keynotes speakers highlighted the depth and breadth of the 2011 Flex Conference. Opening sessions featured a compelling mix of industry and government perspectives. Dr. David A. Honey, Director of Research, Office of the Director of Defense Research and Engineering, shared his perspective on enabling technologies needed to maintain national security capabilities in the decade ahead. Bernd Steinhilber, Senior Vice President of Bayer Material Science, offered a glimpse into the future of specialty films to reveal a world of undreamed-of technological possibilities. Mark Hartney, from the Advanced Research Projects Agency – Energy (ARPA-E), discussed the new ARPA-E and projects utilizing flexible electronics to demonstrate important technological and manufacturing breakthroughs in areas such as electrochromic windows and novel batteries.

Industry insights into consumer applications for flexible electronics followed these keynotes. Jeff Ashe, GE Global Research, addressed how physiological monitoring is undergoing a transformation to more portable and wearable devices and to care settings outside the conventional clinical hospital. Michael McCreary, E Ink, discussed e-readers and e-books, the growth of the market and the technology behind it all.

In addition to the stellar line-up of keynote presentations, the entire development cycle of R&D through to commercialization was emphasized in the program sessions, from device processing to printing techniques, inks and substrates to manufacturing processes and tools including roll-to-roll.

Exhibitors from 50 companies displayed new products and provided technology demonstrators in the exhibitor section of the conference. Market analysis presentations were provided by DisplaySearch, IDTechEx, Lux Research and NanoMarkets.

Exhibitors and attendees enjoyed our opening night exhibitor reception.

FlexTech Alliance Announces 2011 FLEXI Award Winners, Recognizes Flexible, Printed Electronics and Display Industry Achievements

E Ink, Polyera, and the Imperial College of London Receive Honors in Innovation, R&D, and Technology Leadership in Education

FlexTech Alliance announced the recipients of the 2011 FLEXI Awards. FLEXI nominations are open to all organizations involved with the flexible, printed electronics and displays industry. 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, 2011 in Phoenix, Arizona.

The FLEXI Innovation Award was accepted by E Ink's Vice President of Research & Advanced Development, Dr. Michael McCreary.

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.

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 FLEXI R&D 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 education program commenced in September 2009 with the goal to train no less than 80 young scientists and engineers over the period of the coming 8 years in "Plastic Electronics".

The FLEXI Technology in Leadership Award was accepted by Dr. Natalie Stingelin, Senior Lecturer in Functional Organic Materials, Imperial College Centre for Plastic Electronics.

News and News Links from the FlexTech Alliance

excerpted from Veritas et Visus newsletters

Armstrong World Industries and Universal Display demonstrate white OLED lighting ceiling system

Armstrong World Industries and Universal Display Corporation announced that the companies have demonstrated a novel white phosphorescent OLED lighting system to the US Department of Energy (DOE) in connection with the successful completion of their $1.9 million, two-year, Solid State Lighting Product Program titled "Development of High Efficacy, Low Cost Phosphorescent OLED Lighting Ceiling Luminaire System".

This demonstration is a critical step toward the commercialization of efficient, low-cost lighting systems for commercial applications. Universal Display's novel luminaire system is energy-efficient, has low-cost potential and is also aesthetically pleasing. Integrated into Armstrong's TechZone ceiling system, each luminaire, consisting of four 15x15cm PHOLED lamps, easily snaps into Armstrong's modular structure for highly utilitarian functionality, as shown in the photograph below.

The PHOLED luminaire used in the Armstrong TechZone System has overall dimensions of approximately 15x60cm. Each of the four lamps in the luminaire consists of a PHOLED lighting panel, an out coupling enhancement lens and a mounting frame. Using Universal Display's highly-efficient PHOLED technology and materials, each panel offers a record 58lm/W, which translates into a luminaire efficacy calculated to be 51lm/W. 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 nine million metric tons of carbon emissions from the US alone. Universal Display is working under several DOE-funded programs to advance energy-efficient white OLED lighting.

Universal Display PHOLED lighting luminaires mounted in an Armstrong World Industries TechZone ceiling system. Each luminaire is comprised of four 15x15 cm lighting panels mounted in outcoupling enhancement lenses

www.armstrong.com
www.universaldisplay.com

Plextronics announces availability of printable OLED material for ink-jets in 2011

Plextronics announced that its Plexcore OC NQ ink is now available for limited sampling, with more broad availability expected in 2011. The non-aqueous-based hole injection layer (HIL) ink augments the company's existing aqueous-based HIL, and is geared specifically for solution processable phosphorescent OLED emitters. The company also expects to introduce ink-jet (printable) inks for limited sampling early in 2011. This is a major step for large and cheap OLED television panels by end 2011. The ability to solution process OLEDs, especially displays, is a fundamental hurdle that the industry needs to overcome in order to more broadly commercialize OLED technology.

Early sampling of Plexcore OC NQ assisted UDC to achieve low voltage and long lifetime in recent performance testing of their "P2OLED" solution-processed, phosphorescent OLED technology. In October, UDC issued a press release announcing significant advances in the performance of its Universal P2OLED solution-processable, phosphorescent OLED material systems.

Plextronics was the HIL provider, and its Plexcore OC NQ ink helped UDC to achieve a lower operating voltage and a boost in lifetime over previously disclosed results. The company reported on a new green P2OLED system with 66cd/A and 130,000 hours of operating lifetime to 50% of an initial luminance of 1000 nits – representing approximately a two times improvement in luminous efficiency and lifetime over UDC's results reported a year ago.
http://www.plextronics.com

Cambrios Technologies and Plextronics collaborate on improvements to OLED-based solid-state lighting

Cambrios Technologies Corporation and Plextronics Inc. announced that they have entered into collaboration to develop a cost-effective, high performance material that could improve the manufacturing process and quality of lighting products based on OLEDs. The collaboration is funded, in part, through an assistance agreement with the Department of Energy (DOE) Solid State Lighting (SSL) program.

In the project, Plextronics' proprietary Plexcore OC material, which functions as a key component of OLEDs known as the hole injection layer (HIL), will be applied on top of Cambrios' proprietary ClearOhm material that creates a transparent electrode to form a transparent conducting hole injection (TCHI) electrode. Lighting accounts for a significant amount of energy consumption in today's world. In 2001, lighting amounted to more than 20% of the total electricity in the US. Solid-state lighting is widely expected to provide higher efficiency light sources, while eventually moving to a much lower cost. OLEDs could potentially be the lowest cost solution to high efficiency lighting.

Steady progress toward commercialization has been made in recent years. The use of traditional transparent conductors is expected to be a major impediment for broad adoption of OLED-based, solid-state lighting due to cost, and therefore, the industry is actively seeking alternatives that are based on high-throughput, low-temperature manufacturing processes.
http://www.plextronics.com

Corning expands line of slim LCD glass substrates

Corning Incorporated announced the commercial availability of EAGLE XG Slim glass substrates in larger generation sizes to support LCD panel manufacturing for larger applications like TV and large monitors. Initially intended to enable lighter-weight portable devices, the EAGLE XG Slim line debuted in June with glass sizes up to Generation 5 at 0.4mm thick.

The announcement adds 0.5mm glass in Generations 7 and 8 – the glass sizes that support television applications and large monitors. Until now, those generation sizes have traditionally been 0.7mm thick. At the standard glass thickness of 0.7mm, glass represents 10% to 25% of the module thickness for leading-edge slim TV designs. A migration to 0.5mm will provide a tangible benefit in efforts to reduce the thickness of televisions. Corning plans to further expand the EAGLE XG Slim product line by developing 0.3mm substrates for glass sizes that support portable electronic devices.
http://www.corning.com

SouthWest NanoTechnologies presents research paper on conductive carbon nanotube inks

SouthWest NanoTechnologies, a leader in high quality, single-wall and specialty multi-wall carbon nanotubes (CNT), presented performance data on its new conductive carbon nanotube inks. SWeNT's CNT inks, based on V2V ink technology developed by alliance partner Chasm Technologies can be printed using commercial, high-volume printing methods and equipment, including flexographic, gravure and screen printing.

This breakthrough ink technology, combined with SWeNT's unique ability to tailor the synthesis of CNT materials for applications (using its patented CoMoCAT process) will enable customers to print large area, low-cost devices for a wide range of applications including energy-efficient lighting, affordable photovoltaics, improved energy storage and printed electronics.
http://www.swentnano.com

GE Capital invests $10 million in nano fiber technology company Finetex EnE

Finetex EnE, a Korea-based manufacturer of electrospun nano fibers, disclosed that it has approved the terms of a private issue of convertible bonds to GE Capital valued at $10 million. Nano fiber is the next generation of filtration technology in a variety of industries, such as energy, water, transportation and healthcare.

Finetex has two business groups. The nano-fiber technology group develops and manufactures nano-fibers used in filtration media and technical textiles. The energy division focuses on energy efficient engineering for large HVAC buildings as well as solar energy engineering for energy systems and plants.
http://ftene.com

Thinfilm works with PARC to develop next-generation printed memory solutions

Thinfilm, a provider of advanced printed memory technology, and PARC (Palo Alto Research Center Incorporated) announced that they are working together to provide next-generation memory technology enabled through printed electronics. An essential element of most electronics devices, memory is required for identification, tracking status and history, information storage, and more.

Thinfilm is commercializing fully printed, rewritable memory for application in specific markets, including toys and games, and is developing contact-based memory arrays for higher-capacity applications. Combining Thinfilm's memory products with PARC's printed thin-film transistor tech-nology will allow the development of integrated systems as part of Thinfilm's product roadmap.

E Ink announces color e-paper

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IDTechEx expects the Printed Electronics market to grow to more than $50 billion over the next ten years, with logic (memory and transistors) representing the largest segment. Using printing to manufacture electronic memory minimizes the number of process steps, which in turn dramatically reduces manufacturing costs and lowers the environmental impact compared to traditional semiconductor processes. Target markets for Thinfilm memory products include RFID tags, sensor tags, and disposable price labels.
http://www.thinfilm.se

E Ink announces color e-paper

E Ink Holdings Inc. announced the release of its next generation display technology, E Ink Triton. Triton enables color e-paper solutions, enhancing the visual experience for e-publishing markets. For image-rich information applications showing charts, graphs, maps, photos, comics and advertising, color displays made with Triton imaging film enable ultra-low power and high mobility devices with a paper-like experience.

In addition to 16 levels of grayscale, Triton is capable of displaying thousands of colors. And just like E Ink's grayscale e-paper products, Triton's crisp text and detailed color graphics are fully viewable in direct sunlight. Displays made with Triton, as well as the recently launched Pearl, can perform up to 20% faster than those made with previous generations of E Ink imaging film.

The E Ink Triton design leverages the patented two pigment capsule platform found in millions of E Ink enabled eBooks. This technology offers unparalleled image stability; pictures and text can be maintained on the screen even when the power is turned off.
http://www.eink.com

New equation from University of Michigan could advance research in solar cells and OLEDs

An equation developed in part by researchers at the University of Michigan could do for organic semiconductors what the Shockley ideal diode equation did for inorganic semiconductors: help to enable their wider adoption. Without the Shockley equation, the computers of today would not be possible.

Developed in 1949 by William Shockley, the inventor of the transistor, the Shockley equation describes the relationship between electric current and voltage in inorganic semiconductors such as silicon. The new equation describes the relationship of current to voltage at the junctions of organic semiconductors – carbon-rich compounds that don't necessarily come from a biological source, but resemble them.

Organic semiconductors present special challenges for researchers because they are more disordered than their inorganic counterparts. But they could enable advanced solar cells, thin and intense OLED displays, and high-efficiency lighting.

About six years ago, researchers at University of Michigan realized that they could use Shockley's equation to describe the current/voltage relationship in their organic solar cells to a degree. Their findings were published, and from that time on, many physicists and engineers used the Shockley equation for organic semiconductors even though it didn't describe the physics perfectly.

The new equation does. It will allow researchers to better describe and predict the properties of the different organic semiconductors they are working with. And in that way, they will be able to more efficiently choose which material best suits the needs of the device they are working on.
http://www.umich.edu

3M invests in Printechnologics of Germany

3M has invested in Printechnologics, a German printed electronics specialist, aimed at joint efforts for providing innovative solutions for electronic circuitry on paper or foil. Terms of the transaction were not disclosed. Printechnologics has developed game changing technology enabling printed circuit structures on paper. We see various innovative application areas that provide significant growth opportunities and access to new markets for 3M, a spokesman said.

Printechnologics developed custom alterations to conventional printing methods with extremely high scalability and cost advantages to address mass markets. The technologies can facilitate a broad range of solutions across B2B and B2C channels. This opens significant global market potential. Possible applications are smart packaging to prevent counterfeiting or anti-fraud solutions in the gaming market in connection with multi-touch displays.
http://www.3m.com
http://www.printechnologics.com

Solar protection: this polymer film seals out water for better than other plastics – it can protect solar panels for decades.

3M unveils polymer film to protect flexible solar panels from water

3M unveiled a plastic film that it says can rival glass in its ability to protect the active materials in solar cells from the elements and save money for manufacturers and their customers. The protective film is a multilayer, fluoropolymer-based sheet that can replace glass as the protective front cover of solar panels. Manufacturers laminate the sheets onto the solar panels to seal them tight and shield them from moisture and other weather elements that can be deadly to the solar cells inside. The film is 3M's answer to demand by solar-panel makers – particularly manufacturers of certain thin-film solar cells – for an alternative to glass.

Glass has been the armor of choice because it's cheap, weather-resistant, and durable enough to last decades. The vast majority of the solar panels made today rely on glass as the top cover. But glass also adds weight and bulk to solar panels, and it must be packaged carefully to keep it from breaking, adding to shipping costs.

By replacing glass, the new film can do away with the need for supporting racks, which is particularly useful on roofs that can't bear a lot of weight. Blending solar panels into roofs also can overcome aesthetic objections by homeowners. The result is a plastic film that is 23 micrometers thick, much thinner than the 3,000-micrometer glass typically found on solar panels today.

The company uses fluoro-polymer because the material doesn't allow water to seep through easily, and it is resistant to high temperatures and ultraviolet radiation. 3M also engineered the film to prevent it from reflecting much sunlight. 3M says its film can achieve water vapor transmission rates of less than 0.0005 grams of water per square meter per day. Other front barrier films can let in hundreds of times more moisture. The film can be laminated in the same roll-to-roll process used to deposit thin-film semiconductors, and that can shave production costs.

Flexible solar panels also can be larger than glass panels because the flexible variety doesn't require the support of a racking system and can be easier to transport. The time and costs for assembling an array of large panels can be significantly less than putting together many small panels. 3M is making the film at a pilot production line and plans to mass-produce it next year.
http://www.3m.com

UDC delivers wrist-mounted flexible phosphorescent OLED display prototypes to US Army

Universal Display Corporation announced that the company has delivered eight novel wrist-mounted phosphorescent OLED displays built on thin flexible metal foil to the US Army Communication Electronics Research and Development Engineering Center's (CERDEC). The prototype wrist-mounted flexible OLED display devices were designed and built as part of a US Department of Defense (DOD) funded program to develop a thin, lightweight and ruggedized communications device.

During simulated exercises at the Fort Dix facility, the wrist-mounted devices were shown depicting a number of different sources of information, including a real-time unmanned air vehicle (UAV) video feed and various other images received through computers running different applications. These devices have the potential to provide soldiers with advantages in the field that could mitigate risk and improve operational performance.

The eight units each contain a 4.3-inch 320x240 full-color, full-motion AMOLED display using a-Si TFT backplanes designed and fabricated on thin metallic foil by LG Display. The front planes were then built on top by UDC using its high-efficiency, full-color PHOLED technology and materials. The use of Universal Display's PHOLED technology enables these displays to consume less power than comparable AMLCDs, an extremely important feature to lighten the load of electrical power requirements.

Designed and integrated by L-3 Display Systems, the units offer various advanced communications features, all integrated into a thin and rugged housing that comfortably fits around a wrist.
http://www.universaldisplay.com

A wrist mounted flexible OLED display and communications device built on thin metal foil, which uses Universal Display's highly efficient phosphorescent OLED technology and materials.

QD Vision and Solvay to develop a printable electroluminescent platform for Quantum Dot LEDs

QD Vision and Solvay announced an agreement under which the companies will develop a printable electroluminescent platform for quantum dot LEDs (QLEDs) that will lead to a new generation of solid state lighting products. Developed by QD Vision, QLEDs are a reliable, energy efficient, tunable color solution for display and lighting applications that reduce manufacturing costs, while employing ultra-thin, transparent or flexible materials.

QLEDs utilize printing technologies to enable the manufacture of electroluminescent lighting devices in a wide variety of form factors including thin, lightweight, and flexible substrates. These new solid state lighting devices can be produced efficiently in high volume and at low cost. Quantum dots provide the stability and reliability of inorganic semiconductor materials, and can be processed in solution. This unique capability enables the efficient manufacture of next generation electro-luminescent solid state light sources with extraordinary color quality, efficiency, and stability.
http://www.qdvision.com
http://www.solvay.com

Versatilis acquires the assets of Nanometrix

Versatilis of Vermont announced that it has acquired the technology assets of Nanometrix, Inc. of Montreal, Canada. The acquisition included all of the intellectual property and the associated inventory, production and laboratory equipment owned by Nanometrix. Versatilis intends to combine the acquired technology with several of its own developing technologies and to immediately re-launch the business, eventually spinning off a separate subsidiary under a new name.

The business will provide a novel engineered system solution for emerging nanotechnology applications that can enable next generation products based on so-called “macroelectronics” or large area, flexible electronics. These include novel solar cells and solid-state lighting panels in large area, flexible forms.

Nanometrix, Inc. was founded in 2001 by Dr. Gilles Picard and Juan Schneider to commercialize novel technology they had developed for depositing ultra-thin, micro and nano-coatings of important organic and inorganic materials, including single layers of arrayed particles. It is one of very few, if not the only known technology that can lay down such a dense monolayer of semiconductor particles at commercially viable rates, creating kind of a "sandpaper" effect. The technology has broad application in many emerging fields, and will help enable devices such as large area, flexible displays, solar cells and solid-state lighting panels.

Versatilis tool for depositing nanoscale coatings and single layers of particles

Early investors in Nanometrix included the venture capital arm of the Business Development Bank of Canada, Investment Quebec, and Innocentre. Versatilis is a research and development, intellectual property oriented venture focused on developing high growth businesses in the area of flexible electronics.

The company levers advanced materials and manufacturing process technology which it has developed or acquired for a unique competitive advantage in applications ranging from flexible displays to flexible solar cells, from flexible solid-state lighting panels to specialized applications in defense.
http://www.versatls.com

Cambridge Nanotech awarded grant from FlexTech Alliance to develop high-speed ALD system

The FlexTech Alliance announced that it has awarded a contract to Cambridge NanoTech to develop a high-speed atomic layer deposition (ALD) system. When completed, the system will enable the manufacture of large-area and flexible substrates for use in organic electronics, solar cells, biomedical devices, and displays.

The high-speed ALD system is targeted to operate at the high volumes necessary for commercial roll-to-roll practices. ALD is an ideal coating technology because of its perfect, conformal, ultra-thin films that are scalable to large-area substrates. ALD simultaneously offers excellent thickness uniformity, film density, step coverage, interface quality, and low temperature processing, making ALD beneficial for both roll-to-roll flexible substrates and rigid substrates.

To accelerate the ALD process, the engineering team at Cambridge NanoTech is focusing on cycle time reduction by means of a unique high speed precursor delivery and extraction mechanism. The beta system will be installed at the Flexible Display Center at Arizona State University in 2012. In addition to designing and building the high-speed ALD system, Cambridge NanoTech is developing film processes that are applicable to electronics and display manufacturers.
http://www.flextech.org
http://www.cambridgenanotech.com

PARC and Soligie to commercialize printed electronics technologies

PARC and Soligie Inc., a provider of design and manufacturing services for flexible and printed electronics, announced an agreement aimed at advancing the commercialization of printed electronics technologies and capabilities.

By working together, both companies will help their customers bring a range of novel and custom electronics solutions to market. Currently, consumer goods, electronics, healthcare, and materials companies who want to take advantage of emerging product opportunities in printed electronics do not have a clear or streamlined path from lab to market.

For example, while many universities and research centers contribute important early-stage concepts or even components, these entities are not set up to further integrate these components into full systems or to translate this research for production at high volumes.

PARC and Soligie aim to address this gap in the concept-to-market ecosystem for printed electronics. PARC, which already offers printed electronics services ranging from materials characterization and component device design to full system prototyping, specializes in driving printed electronics at the leading edge and early stages of research and development.

Soligie, which already offers capabilities in product development, quality systems, production scale up, and volume production, specializes in driving solutions for manufacturing readiness. By complementing each other's capabilities, PARC and Soligie together can now integrate services and provide a streamlined path from concept to product launch.

Companies and government agencies that want to take advantage of the new opportunities enabled by printed electronics can work with the two companies to deliver end solutions to the market. Example opportunities include sensors and sensor systems for medical device manufacturers, printed electronics for consumer packaged goods companies, and in-transit monitoring systems for companies with high-value shipments.
http://www.parc.com

Heraeus acquires H.C. Starck's Conductive Polymers Business Group

By acquiring H.C. Starck's Conductive Polymers Business Group, Heraeus is engaging in targeted expansion of its product portfolio as the world's leading provider of high-quality coating materials for important growth markets in the electronics industry. The range of products sold under the brand name Clevios will be expanded with new, innovative, and customer-specific applications for functional coatings, especially in the electronics, display, glass, and solar industries.

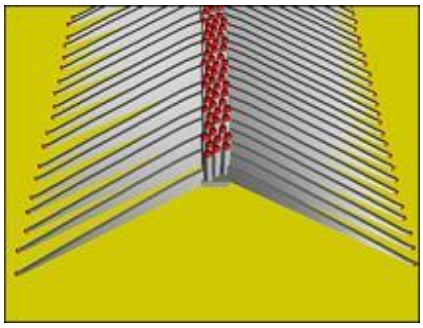
The Clevios product portfolio includes liquid polymer chemicals for antistatic and conductive coatings, screen coatings, plastics, and conductive polymer coatings, each tailored to specific applications (such as organic LEDs or as electrodes in capacitors). The transfer of Clevios to Heraeus, announced in early September, was completed on December 1, 2010. Both parties have agreed to keep the purchase price confidential.

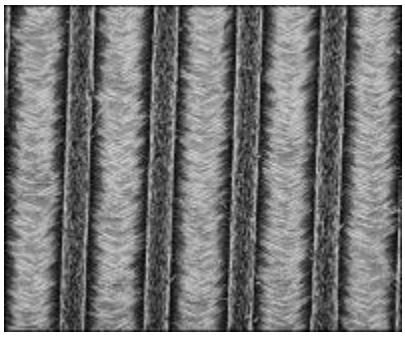
At Heraeus, Clevios is being integrated into the Heraeus Precious Metals Business Group as the Conductive Polymers Division. The advantages of the well-established international organization will provide tremendous benefit to customers, the majority of whom are located in China, Japan, and Korea.
http://www.clevios.com

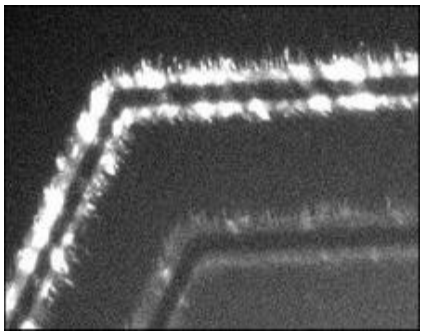
E Ink and Sollink set sights on flexible material technology

Both E Ink and Sollink, Taiwan`s top two makers of next-generation display substrates, are optimistic about the potential of flexible color e-paper technology which they are developing now with all-out efforts. At a flexible-electronics forum recently held in Taipei, Y.S. Chang, a technology executive at E Ink, estimated the paper technology will move in the direction of stressing flexibility and color features in three to five years. Addressing the emerging trend, Chang said E Ink will commercialize color e-paper by the end of this year and will also move to develop flexible type of the paper with its thin film transistor (TFT) making equipment.

Sollink Inc., a joint venture between Qualcomm MEMS Technology Inc. and contract electronics maker Cheng Uei Precision Industry Co., Ltd., will combine its Mirasol display technology with flexible e-paper in near future, according to the company`s VP for corporate operation, T.H. Chou. Mirasol technology boasts ultra low power consumption.
http://www.foxlink.com/_en/8_investment/01_detail.php?MID=12







Graphic illustrates a single row of nanowires (cylinders with red tops) with fin-shaped nanowalls extending outward; the transmission electron microscope image shows four rows of nanowires and their corresponding nanowalls, They are called "nanoLEDs" because they emit light when electrically charged. The distance across the micrograph is approximately the diameter of a human hair; Transmission electron microscope image of "nanoLEDs" emitting light

NIST horizontally grown nanowires yield "nanoLEDs"

(NIST) have developed a new way to create nanowires that produce light similar to that from LEDs. These "nanoLEDs" may serve miniature devices such as nanogenerators or lab-on-a-chip systems. Nanowires typically are "grown" by the controlled deposition of molecules — zinc oxide, for example — from a gas onto a base material by chemical vapor deposition (CVD). Most CVD techniques form nanowires that rise vertically from the surface.

Because the wire only contacts the substrate at one end, it tends not to share characteristics with the substrate material. Vertical growth also produces a dense forest of nanowires, making it difficult to find and re-position individual wires of superior quality. To remedy these shortcomings, NIST chemists developed a "surface-directed" method for growing nanowires horizontally across the substrate.

The NIST technique uses gold as a catalyst for crystal formation. The gold is heated to 900ºC, converting it to a nanoparticle that serves as a growth site and medium for the crystallization of zinc oxide molecules. As the zinc oxide nanocrystal grows, it pushes the gold nanoparticle along the surface of the gallium nitride substrate to form a nanowire that grows horizontally across the substrate and so exhibits properties strongly influenced by its base material.
http://www.nist.gov

Plastic Logic and Liquavista team to develop video display e-paper

Plastic Logic and alternative display developer Liquavista have collaborated on the creation of a hybrid e-paper that can display videos in color. The VideoFLICs project aims to create a second-generation display for the 'perfect e-reader,' says Liquavista project manager Chris Nice.

The project recently demonstrated a color display that can host videos, and has already demonstrated performance on a 1.5-2-inch screen. The project will now begin evaluating the reliability of its video-rate display and attempt to increase the screen size.

The £6.1 million (€7.2 million) initiative brought together Plastic Logic's organic electronic backplane with Liquavista's electrowetting-based frontplane.

Speaking at the UK Plastic Electronics Showcase, organized by the Electronics, Sensors and Photonics Knowledge Transfer Network, Nice commented: "We produced a combined display with some relatively small adaptations. This meant that Plastic Logic's organic backplane had to accommodate some increased processing temperatures, for instance." Trials for the compatibility of the two technologies have been done, but will be extended in the future. The project, which has been running since 2006, is being funded by the UK Technology Strategy Board.
http://www.innovateuk.org

NIST awards $7.4 million in funding to Polyera, Kent Displays, and Simmat

Three photonics-related development projects have won funding in the latest round of the US National Institute of Standards and Technology's (NIST) Technology Innovation Program (TIP). Those three projects will receive $7.4 million of the total $22 million that NIST has made available for nine projects, and the funding will be matched by the companies involved. The projects include:

- Polyera is developing processes to manufacture printable electronics and also the active layer in organic photovoltaic cells. Polyera is to receive $2 million from NIST, with the total value of the project estimated at $5 million. Under the NIST-funded project, Polyera will be working on a novel polymerization method that is hoped to provide better manufacturing control and higher yields of an organic photoactive layer that could form the basis of cheap, flexible solar cells. In September, Polyera said that it had raised $4 million in Series B funding from the Belgian chemicals company Solvay.
- Another company to receive NIST funding in the latest TIP round, which was heavily oversubscribed with more than 100 applicants and only nine awards, is Ohio-based Kent Displays. It will receive $3 million from NIST as part of a $6 million project aimed at developing a roll-to-roll process to make liquid crystal displays. Kent has previously developed optically addressable, flexible bistable cholesteric liquid crystals, based on photosensitive chiral dopants that enable high-resolution lightweight displays.
- The third company to win NIST funding for photonics-related work is Sinmat, which is receiving $2.4 million for the development of so-called “super-hard” substrate materials for producing next-generation electronic and photonic devices. Sinmat specializes in slurry materials that are used to polish silicon carbide wafers, upon which high-performance RF devices and high-brightness LEDs are manufactured.

The NIST program making the latest awards is a wide-ranging funding competition that is focused on small- or medium-sized enterprises, as well as joint ventures involving universities, national laboratories and non-profit research organizations. NIST says that the aim of the competition is to advance cutting-edge research in major growth sectors.
http://www.nist.gov/tip/tip_121510.cfm

FDC and AUO partner for flexible AMOLED development

The Flexible Display Center (FDC) announced that AU Optronics (AUO) is now an industry partner. The two will collaborate on the development of mixed-oxide thin-film transistors to accelerate the commercial availability of AMOLED flexible displays.

AMOLED displays have already begun gaining market traction in conventional glass displays for applications such as smart phones because of the crisp, vibrant and rich colors they deliver. The new partnership will focus on bringing the benefits of AMOLED displays, including full-color, full-motion video, to flexible substrates.

The companies will work in active partnership with dedicated engineering teams to advance mixed-oxide transistor technology and the handling capabilities of conventional flat panel display manufacturing processes to accommodate the thin, plastic substrates used for flexible displays. Mixed-oxide thin-film transistors offer a better ability to drive currents and improve the lifetime and stability of transistors used for OLED displays.
http://flexdisplay.asu.edu

US Army evaluating transportable solar-powered tents from PowerFilm Solar

The US Army is evaluating a host of flexible, portable, lightweight solar-powered shades and tent-like technologies. The products are designed to allow expeditionary units to deploy with transferrable, exportable electrical power that can charge batteries, computers and other essential gear without needing fuel or a generator. The solar-powered tent structures convert light energy into electricity, thus removing the need to haul generators and large amounts fuel. Technological advances in the area of photovoltaics have made it possible to build lightweight, portable materials which are flexible and can easily travel with dismounted units. Some of the Flexible PV products being evaluated are called: Power Shade, TEMPER Fly and QUADrant – military shelter items of various sizes and configurations which use flexible solar panels to harness light energy and convert it into transferable electricity. The TEMPER Fly is a roughly 16-by-20-foot tent structure able to generate 800 watts of electricity. A QUADrant is a smaller variant of the TEMPER Fly, able to generate 200 watts of power, and the Power Shades range in size and are capable of generating up to 3 kilowatts of exportable electrical power. The PV integrated military shelter items use a lamination process to combine the PV materials into the textile substrate.
http://www.powerfilmsolar.com

FUJIFILM Dimatix introduces DMP-5000 Series Materials Printer

FUJIFILM Dimatix introduced its new Dimatix Materials Printer (DMP). The new DMP-5000 is a large format, non-contact, fluid deposition system capable of jetting a wide range of functional fluids using multiple FUJIFILM Dimatix fluid deposition printheads interchangeably. The new DMP-5000 features a printable area of 500 x 500 mm and maintains a positional accuracy and repeatability of ± 5 µm and ± 1 µm respectively. The DMP-5000 uses a temperature controlled vacuum platen to accurately register, maintain, and thermally manage substrates during printing. These substrates include plastic, glass, ceramics, and silicon, as well as flexible substrates ranging from membranes, gels, and thin films to paper products. The printer includes an integrated drop visualization system that captures droplet formation images dynamically as droplet ejection parameters are adjusted to produce a tuned printhead and fluid combination. Also, sophisticated electronics allow the printhead to be calibrated on a per nozzle basis to compensate for any channel-to-channel variability. A second camera system allows substrate measurements and alignment, observations of fluid drying behavior, with droplet measurement and placement calculations.
http://www.dimatix.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.

FlexTech Alliance
for Displays & Flexible, Printed Electronics

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-DisplaySearch -NanoMarkets - Veritas et Visus
-Insight Media - FlexTech Alliance *with certain restrictions

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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

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

FlexTech Alliance
for Displays & Flexible, Printed Electronics

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