

FlexTech Trends

News from the world of displays and
flexible, printed electronics

Volume 5 – Fall 2009

FlexTech Trends

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Note from the President

by Michael Ciesinski

FlexTech's quarterly technology and market workshops are gaining in popularity. Designed to expose our member companies to the nascent field of flexible, printed electronics, this activity delivers valuable information for business development and R&D managers. From an initial group of 40, we are now approaching 100 industry participants at the workshops. Each session is focused on a specific application or part of the supply chain. The workshops begin with a current market assessment from a respected market analyst firm, followed by presentations from experts in the field, with an emphasis on customers. With this format, you can be assured of walking away with topical information and insights.



Our most recent workshop, held on August 20, 2009 in Endicott, New York was focused on medical devices and featured Rahgu Das, CEO of ID Tech Ex. He described the level of business investment in printed electronics, noting that 2250 developers are now working in the field, up 50% from 2 years ago. Many of these companies are in the materials industry. Das reported that governments are taking a more active role in promoting flexible, printed electronics with German authorities willing to cover 40% of start-up costs of new facilities. With respect to end user, the smart card industry is struggling to adopt printed electronics, but cosmetic firms like Estee Lauder have products in the market, according to ID Tech Ex.

Other presenters came from Palo Alto research Corporation (PARC), Johns Hopkins University, Endicott Interconnect Technologies, and Binghamton University. These workshops are open to all, with no membership requirement. Visit <http://www.flextech.org> for information on upcoming workshops.

The FlexTech Alliance is very pleased to welcome Robert W. Tulis, Ph.D as our new Director of Technology and Business Development. Bob's professional career spans positions at Science Applications International Corp (SAIC), the Defense Advanced Research Projects Agency (DARPA), and Polaroid Corp., where he held senior management and R&D assignments. At FlexTech, Bob will be responsible for management of the Technical Program and all working groups, technical conferences and workshops. He will be the primary interface between and among FlexTech, our members, and our federal funding partners, seeking opportunities to deploy the consortium's assets in support of emerging technology development. You can contact Bob directly at robert.tulis@flextech.org.



Lastly, this issue of FlexTech Trends features an interview with the chairman of the 3D@Home Consortium, Rick Dean of THX. A spinout of LucasFilms, THX develops technologies and certification programs that help deliver the true vision of filmmakers, game developers and musicians, from their studios to audiences around the world. Consequently, Rick works with some of the biggest names in the entertainment industry. FlexTech manages the 3D@Home Consortium, providing business and marketing services to the 40+ industry group. In the interview, Rick shares his thoughts on the current status of the 3D display industry and the progress being achieved by the consortium. For more information, please visit <http://www.3DatHome.org>

Cordially,

Michael Ciesinski, President



Market Update: The future of OLED lighting in the general lighting market



by Lawrence Gasman

Lawrence Gasman is principal analyst and founder of NanoMarkets LC, in Glen Allen, Virginia. He has over 25 years of experience as a high-tech consultant for companies including Analog Devices, Cisco, Hewlett-Packard, IBM, Intel, Fujitsu, NEC, Nortel and NTT, and is also the author of three books on telecommunications topics. He is also on the editorial board of the Foresight Nanotech Institute and is a regular speaker at various nanotechnology and display related conferences. <http://www.nanomarkets.net>

This year saw the first OLED lighting products aimed at the general illumination market, along with announcements of clear intent by several important lighting and OLED firms that they plan to get into the OLED lighting business in the next few years. In Exhibit I we provide a listing of firms that seem likely to generate revenues from the general illumination market with OLED-based products in the near future.

Today most OLED lighting consists of “concept products”; they are not expected to generate profits in themselves. Rather they are here to win friends among buyers at the wholesale and retail level as well as influence lighting designers. NanoMarkets believes that revenues from OLED-based general illumination will be negligible this year; perhaps a few million dollars, at best. And even this level of revenues has more to do with the very high prices of the first OLED lighting rather than being an indication of substantial volume sales.

Nonetheless, there can be little doubt that OLED makers now have their eyes firmly set on the prize of the general-purpose illumination market. And prize it is. By the middle of the next decade, according to NanoMarkets’ latest forecasts the revenues from OLED-based general illumination will be well over \$3.0 billion. It is important to note, however, that such revenues could never be achieved within this timeframe without a big help from the regulators, who in both Europe and the U.S. are on the verge of banning inefficient incandescent bulbs. At one time it looked as if a new generation of highly efficient incandescent lighting was going to appear, but this seems far less likely today. GE is one firm that has dropped its work on “next-generation incandescent”. When one of the big three lighting makers pull the plug on incandescent technology it surely has the look and feel of incandescent’s death knell. In the immediate future, all this bad news for incandescent lights looks like good news for fluorescent lighting, especially those compact fluorescent lights (CFLs) that can be screwed in to existing fixtures. For a few years CFLs seem set to fill the market gap that incandescents will leave behind them, but, ultimately CFL technology is doomed too. In a market that prides itself for its eco-friendliness, can a lighting technology that uses considerable amount of mercury survive for long?

OLED and HB-LEDs: Friends or Foes? The other problem with CFLs is that many judge the quality of the light provided by these lamps to be poor. Frankly, this is also currently true of the of solid-state, light-emitting-diode (LED) technology. Many consumers say the lighting of today’s high-brightness LEDs (HB-LEDs) to be harsh and unattractive; good enough for headlights and traffic lights, but not exactly what you’d want in your front room. However, while fluorescent lighting is very mature, LED lighting is at the early phases of its technology development and there are therefore plenty of opportunities for improvements in almost every dimension of LED lighting performance including the quality of the lighting experience. In fact, after becoming well established in a number of niche markets, HB-LEDs – which are inorganic semiconductor chips, not the organic lighting sheets that are the main topic of this article -- are now on the verge of making a serious bid for the general illumination market based on their low power

consumption and other factors. Over the long-term – as CFLs begin to go away – it will be HB-LEDs that provide the first big surge of solid-state lighting into the general illumination market.

HB-LEDs will most likely be the biggest competition for OLED lighting in the future, and OLED lighting will be somewhat late to the general illumination market compared with HB-LEDs. Nonetheless, OLED lighting also has some advantages that HB-LEDs would be hard pressed to match. OLED lighting will take the form of large, lightweight and flexible lighting panels that could create a whole new aesthetics for general illumination. It is not impossible that HB-LEDs could emulate such panels – using transfer printing techniques, for example – but thinness and flexibility is not an intrinsic property of HB-LEDs as it is with OLEDs.

In fact, the relation between HB-LEDs and OLEDs in the general illumination market is likely to prove quite nuanced. For starters, HB-LEDs are going to pave the way for OLED lighting, in the sense that they will build consumer understanding of and credibility for solid state lighting. Secondly, and more important in the long-term, HB-LEDs and OLEDs are – in a sense – complements. OLED lighting panels provide a wide-area light, like flood lights, while HB-LEDs have the point-like character of spotlights. NanoMarkets' analysis suggests that the market has always – and will probably always – need both OLEDs and HB-LEDs. Indeed, some of the concept lighting that has appeared at trade shows has actually been a hybrid product that uses a combination of OLEDs and HB-LEDs.

Cost Matters, So Does Design and Marketing: Obviously, the future role of OLEDs in the general illumination market represents a complex situation involving judgments about aesthetic appeal. But it is also a matter of cost and once again, this is an issue that is rather nuanced. At this stage in the game, no one really knows how much a mass-market OLED light will cost, but the consensus is that it will be a lot more than a regular light bulb. There are two reasons why this may not matter much. First, as I have already mentioned, regulators in important markets, seem determined to put the incandescent bulb out of business. Incandescent bulbs may be inexpensive, but if you can't buy them this is not a market advantage. More importantly, simple bulb-for-bulb comparisons may not be entirely appropriate. A better guide may be total cost of ownership, which takes, lifetime and cost of electricity over that lifetime into consideration. The idea here is that while an OLED light might be a lot more expensive than an incandescent bulb or a CFL, when you add up all the costs, you spend less with an OLED than with some other kind of bulb.

This sounds good, especially when one considers that OLED lifetimes and efficiencies have improved dramatically. They could get a lot better as the economies of scale and experience curve effects that are standard in the semiconductor industry – of which the solid-state lighting business is surely a part – begin to make themselves felt. But today and for some time to come most people still think OLEDs would not necessarily prove cost effective when compared on a total cost of ownership basis to more conventional type of lighting. In any case, while the total-cost-of-ownership concept may well be a useful measure for the owners and managers and large buildings, our guess is that most residential consumers are going to go for the cheapest bulb in the store and this is unlikely to be the OLED bulb for many years to come.

As a result, NanoMarkets believes the early entrants will have to think about marketing OLED lighting as a complete package, including the fixture. One reason for this is related to total cost of ownership again, but not in a bulb-to-bulb comparison sense. Rather, OLEDs can probably make do with less expensive fixtures than are used for other types of lighting. This is because, aesthetics aside, the main functional purpose of fixtures is reduced glare and OLEDs as area emitters don't really have a glare problem.

There are other reasons for OLED lighting firms to focus not just on the OLEDs themselves (as many of them now do), but on the entire fixture. One is that it may give the OLED lighting company a larger share of the value added. Another is that it gives the lighting firm more insight into the luminaire-dependent performance of OLEDs – the all-important measure from the perspective of the consumer.

Starting Simple: The Future of OLED Lighting: The strategic leap from being a company entirely focused on designing an organic chip, as it were, to one that is supposed to know about lighting design is considerable. From the limited amount of information we have available to us, it seems likely that the first commercial OLED lights – commercial in the sense that you will be able to buy them easily in a store or online – will simply consist of multiple small panels, nicely arranged, rather than the majestic large panels that OLED lighting makers have discussed. However, some prospective OLED lighting manufacturers are already thinking well beyond this kind of thing and are imagining OLED window/light hybrids; walls that let in light during the day and shine at night; even lighting that changes in intensity and color when we gesture at it; this would be the ultimate in mood lighting.

(The analysis in this article is based on the analysis in NanoMarkets' recent report, AN OPPORTUNITY ANALYSIS FOR OLED LIGHTING: 2009 TO 2016. This report covers the use of OLEDs for backlighting, signage, architectural lighting, vehicular lighting, and industrial lighting. For more information on this report, see http://www.nanomarkets.net/products/prod_detail.cfm?prod=10&id=305)

Exhibit I	
Selected Firms That Will Shape the OLED-based General Lighting Market	
Organization	Product/Demo
General Electric	GE says it will have commercial OLED lighting products on the market by 2010 and that its manufacturing process enables it to make a 2 x 2-ft OLED light panel with a 4 x 4-array of OLEDs.
Kodak	Demonstrated 6-inch OLED panels at the 2009 SID display show.
Konica Minolta	Says that it plans to release commercial OLED lighting products in 2010.
Koizumi Lighting Technology	This firm has designed some OLED lighting demonstrators which it has shown at lighting trade shows.
Lumiotec	Lumiotec has demonstrated its OLED lighting equipment dubbed "Fenalene" at Rohm's booth at various trade shows.
NEC	NEC Lighting has exhibited an OLED light at trade shows.
Novald	In 2009 unveiled a 15x15 cm white OLED device
Osram/Siemens	Developed an OLED-based table lamp with Ingo Maurer. It has also demonstrated a 100 cm ² lighting tile that it had developed with several partners under the German OPAL research project.
Panasonic	Panasonic has exhibited prototype OLED lighting panels. These are said to be one of the thinnest available.
Philips	Philips is selling its Lumiblade OLED material to designers in a do-it-yourself kit and has shown a variety of concept lights at various trade shows
Rohm	Rohm has also developed OLED lighting demonstrators. Among its concept products are an OLED based "shadowless lamp" and an "OLED flash."
UDC	Developed a 6 x 6-inch panel for the U.S. Department of Energy in 2007. In 2008 UDC received DOE funding to develop integrated lighted ceiling tiles with Armstrong World Industries by 2010.
WAC Lighting	W2 Architectural Lighting division unveiled OLED-based lighting products at the 2009 Lightfair International. Products included an OLED mini chandelier and an OLED "wall sconce."

A Toolmakers Perspective

Enabling Printed Electronics Progress

by Stan Farnsworth



Stan Farnsworth is VP of Marketing at NovaCentrix and has been with the company since its inception in 1999. He is responsible for strategic and tactical marketing for all NovaCentrix products, including the company's PulseForge tools and Metalon inks. While at NovaCentrix Stan has led commercialization and business development for nanomaterials and nano-material-enabled products for markets including optical coatings, life sciences, defense, printed electronics. Previously, Stan held engineering, operations, and management positions at Intecorr International, a small Houston-based consulting company, and Applied Materials in both Austin and Santa Clara. He has an undergraduate degree in mechanical engineering from Rice University and a master's degree in heat transfer and fluid mechanics from the University of Texas Austin.

It's a challenge to design and build tools before the intended users know they need them, especially tools for building products that don't yet exist. The complication is that new product technologies can require new processing and manufacturing methods, but the new manufacturing methods can't be developed without the products that will need them, creating a classic "chicken and egg" problem. Nowhere is this truer than in Printed Electronics, the moniker used to loosely group printed technology verticals including displays, RFID, PV, logic, battery materials processing, and flexible circuits. These technology verticals in turn enable applications in energy generation and storage, smart packaging, inventory control, and many other applications yet-to-be developed by creative product marketers and engineers.

In spite of the seemingly disparate applications of these technology verticals, they have at least one trait in common. High temperature materials such as silver, copper, silicon, and graphene need to be processed on low temperature substrates like plastics and paper. Without a robust means of heating the functional materials to their required process temperatures, the performance of the applications will be significantly limited, the product unit costs will be too high versus the performance of the devices for broad adoption, and the potential value of the sector will remain unrealized. NovaCentrix is working to help solve this conundrum by developing and offering the PulseForge processing tools for printed electronics, and is specifically offering tools with the recognition that not all users will immediately be ready for the full capabilities of the tools. Yet, it is precisely the availability of the advanced process and production capabilities that NovaCentrix hopes will contribute towards successful technology and product launches, and ultimately in meeting the market potential of Printed Electronics.

The PulseForge 3300 is the latest tool from NovaCentrix specifically addressing Printed Electronics development and manufacturing, and builds on the technology and process experiences gained with the other PulseForge tools. The common trait to all of the PulseForge tools of course is the patented use of proprietary lamps used to heat the target materials and not the substrates. Beyond that basic shared characteristic, each tool in the PulseForge family is designed for a specific set of users.

- The PulseForge 1100 is ideal for very early-stage material and product concept developers, who require very flexible energy delivery conditions, but do not require volume production.
- The PulseForge 3100 is optimal for development, scale-up, and manufacturing of metallic ink-based systems or high-speed drying processes on low temperature flexible substrates.
- The new PulseForge 3300 is purpose-built for processing silicon inks and thin-films, photovoltaic materials, and battery materials including ceramics, as well as very-high-volume processing of metallic systems, at speeds up to 300 meters/minute.

The PulseForge tools have also recently shown to be capable of directly processing thin polymers that historically might have required dedicated UV processing, but can now be processed much more quickly and without collateral heating damage.

To satisfy the requirements of silicon processing on low temperature substrates, and for very-high-speed processing of metallic inks on low temperature substrates, the new PulseForge 3300 has several key features. Foremost, the tool delivers power in the extreme ranges required to process silicon in several forms, delivering pulse lengths as short as 30 microseconds, and with exposures surpassing 40 kW/cm² per pulse. Given the process area per pulse with a 150mm-width system, this equates to a shocking 5 megawatts (MW) of delivered energy per pulse. The combination of short pulse lengths and high delivery rates is essential for creating the required thermal state of the target material systems. By controlling factors such as pulse length and pulse power, the user can tailor the tool to achieve the desired material response.

In recognition that different users of the PulseForge 3300 will be at different points in their development processes, the tool is able to operate in three modes.

- **Static Mode:** Delivery of pulses to a single placed sample without conveyor motion, useful for early material development.
- **Samples Mode:** Delivery of pulses with a conveyor programmed to run the samples under the lamp housing and then return the samples to the start. This is useful for early material development, and for processing pre-production samples.
- **Production Mode:** Running the tool in a full-forward configuration, as for pilot production or full volume production. In this mode, the full benefit of the ~1 kHz maximum pulse rate can be realized, resulting in very high material through-put. For this mode, the PulseForge 3300 is integrated directly with the customer's material handling system, be it roll-to-roll or conveyor-based.



The versatility of the PulseForge 3300 also means that the same tool can be used for progressive phases of a product development effort, from concept and feasibility all the way through pilot production and ultimately volume manufacturing. In designing the tool with this capability, NovaCentrix is minimizing the customer's uncertainty and risk that comes from scaling prototype products into full production- the same processing tool can be used.

From a toolmakers perspective, the continuing technology and product developments in Printed Electronics are truly compelling. What technologist doesn't get excited about the vision of printed solar cells charging printed batteries powering printed displays, placed on packages, clothing, or buildings, or used in transportation? We support many groups working in many different areas, and the innovation and creativity that we encounter on a daily basis is inspiring. Our challenge as a toolmaker is not just to support those efforts, but also to stay ahead of those efforts with the tool and process capabilities needed for our customers to be successful. That's how we'll solve this chicken-egg dilemma in Printed Electronics.

The new PulseForge 3000 from NovaCentrix enables deposition of high-temperature materials on low-temperature substrates.

Teonex Q65 – A high performance film for flexible electronics

Bill MacDonald, Keith Rollins, and Bob Rustin

After graduating B.Sc and Ph.D in chemistry from the University of St Andrew, Bill Macdonald joined ICI Plastics Division in 1980. He was initially involved in research into advanced materials, primarily liquid crystal polymers, and moved into the Polyester Films Business in the early 1990's. The Films Business was sold to DuPont and Bill MacDonald is currently a Business Research Associate at DuPont Teijin Films (DTF), a 50:50 joint venture between DuPont and Teijin. He is currently actively involved in developing substrates for flexible electronic and PV applications and in understanding the material requirements required for these emerging industries. He has coauthored some 40 papers, several book chapters and regularly presents on the flexible electronic conference "circuit". He is a Visiting Professor in the Department of Pure and Applied Chemistry, University of Strathclyde.



Dr Keith Rollins has roles as both Global Plastic Electronics Marketing Manager with DuPont Teijin Films and is Business Exploitation Manager with the PETEC Centre in the UK. Dr Rollins has spent the last 30 years in the Advanced Materials and Specialty Chemicals industries, the majority of this time with the ICI, DuPont and DuPont Teijin Films' Polyester films businesses.



DuPont Teijin Films (DTF) is the world's leading supplier of polyethylene terephthalate – PET (Melinex, Mylar and Teijin Tetoron) and the leading supplier of polyethylene naphthalate – PEN (Teonex) polyester films specializing in film products and related services for the specialty, industrial, packaging and advanced magnetic media and photo systems, electrical and electronics markets. The company has reported sales of \$1.1 billion and employs about 3,000 people with dedicated marketing, technical and manufacturing operations in every region of the world. To maintain its leadership in polyester film technology DuPont Teijin Films seeks to continually identify new markets where the benefits of these materials and the business's track record in innovation can be exploited. A good example of this is the category is Printed and Plastic Electronics, an area in which DuPont Teijin Films has been active now for a number of years. In the early years of working with technology developers in this space, it was often assumed by device developers that the "plastic" at the heart of the device could be purchased almost as a commodity item with their focus typically being more strongly on the downstream processing issues. Over a period of time however, it became clear that the specification and functionality of the base flexible substrate had an extraordinarily important role to play in developing both functional devices and, as scale-up occurs, in delivering economically acceptable manufacturing yields. Over this same period, DuPont Teijin Films became very closely involved with the companies pioneering these new technology areas and it became apparent that the "Holy Grail" of a flexible substrate i.e., a film that was flexible, dimensionally stable at processing temperatures, solvent resistant, had defect free surfaces over display scale areas and had the barrier properties of glass was an extreme challenge for any plastic material. DuPont Teijin Films invested a significant amount of time working with the technology developers to define the required property set to understand how they might meet this challenge by exploiting the DuPont Teijin Film skill base and tool box of effects. What was apparent was that the technical requirements were much more demanding than the requirements in the traditional markets for plastic films -a new approach was required.

Over this period, DuPont Teijin Films has emerged as the market leader in this area and Teonex Q65FA PEN has emerged as the film of choice for high performance flexible electronic applications. One of the main reasons for this is that Teonex Q65FA product design and manufacturing process produces a film which is both oriented and crystalline and this imparts unique features to the film compared with the high performance non crystalline films such as polycarbonate and polyethersulphone. One of the obvious benefits of orientation

and crystallinity is that Teonex Q65FA has excellent resistance compared to the amorphous films, to a wide variety of solvents, especially the harsh chemicals used in printed electronics manufacture. The films also have very low moisture pickup which means that the films do not swell significantly as they re-equilibrate after processing at elevated temperatures.

The upper processing limit of plastic materials is usually limited by the glass transition temperature (T_g) which is the temperature at which the plastic material changes from the glassy state to the rubber state i.e., non crystalline plastic materials will “flow” above this temperature and the T_g defines the upper temperature for processing. A further but less obvious benefit of the biaxial orientation and crystallinity is that because of the crystalline component of the Teonex Q65FA, the film retains mechanical integrity above the T_g and can be put through an additional stabilization process whereby the strain introduced through the initial filming process is relaxed out. This means that the upper processing temperature of the Teonex Q65 FA is not defined by the T_g , but by the temperature at which the film has undergone this offline stabilization process. The film also exhibits very low shrinkage up to these temperatures and by judicious control of film and processing conditions, shrinkages of 100ppm and lower at 150C have been reported. This is exceptional behavior for a plastic film. Furthermore because of this combination of biaxial orientation and crystallinity the coefficient of thermal expansion (CTE) of Teonex Q65 FA is <20ppm/C and does not alter significantly at the T_g . This low CTE (CTE of most amorphous polymer is of the order of 50ppm/C) is a good match with inorganic materials which results in less stress being introduced into multilayer films involving inorganic layers on Teonex Q65 FA.

Any defects on the surface of the film can give rise to pinhole defects in barrier films or to lineouts or pixel outs in complex TFT arrays. This is a major challenge to plastic film producers as films are typically not manufactured and slit to size in a clean room environment and the soft surface is easy to scratch. It is impossible to eliminate dust and debris from the surface and the approach taken by DuPont Teijin Films is to take the Teonex Q65 FA into a clean room environment and to apply a planarizing coating of several microns thickness which basically paints over any dust or scratches on the surface and also provides a scratch resistant coating for further processing. A typical white light interferometry image is shown in Figure 1. However to translate this level of smoothness measured over microns to a display sized area of film takes considerable attention to detail and can only really be achieved at the commercial scale DuPont Teijin Films are now operating at. This does not make for especially exciting scientific reporting, but this commitment to commercialization is essential to support display manufacturers as they move from prototype developments to market entry products.

Figure 1: White light interferometry image of the surface of planarized Teonex Q65 FA



The exciting progress being reported by the Flexible Display Center at ASU illustrates how advances in processing technology coupled with the superior property set of planarized Teonex® Q65 FA can be combined to create ground breaking displays, and a-Si TFT performance matching the performance that which can be achieved on glass at similar processing temperatures has been demonstrated. Figure2 shows a 3.8-inch QVGA E Ink display on Teonex Q65FA. The high surface smoothness and dimensional reproducibility of the Teonex Q65FA is essential to achieving this.

2010 looks like being a landmark year in flexible display development as the first e-reader displays fabricated on plastic are introduced into the market. Initial products will be based on black and white electrophoretic displays but full color displays will not be long behind and this coupled with the requirement of pushing TFT performance will ensure that the higher temperature property set and surface smoothness that the planarized Teonex Q65FA provides will be essential to continued developments in this exciting embryonic technology area. DuPont Teijin Films continues to innovate to meet the ever demanding increases in film properties and looks forward to working with the electronics industry as flexible displays become a commercial reality.

Figure 2: 3.8-inch QVGA E Ink display on Teonex Q65FA (Image courtesy of Flexible Display Center at ASU)



Flexible Displays and Electronics Report

Are flexible displays finally ready for mass adoption?

The 300+-page *Flexible Displays and Electronics Report* contains detailed data and unparalleled analysis on the readiness of various flexible display technologies and their commercial opportunities.

In this new report, DisplaySearch and the FlexTech Alliance forecasts that flexible display revenue will increase from \$85M in 2008 at a compounded annual growth rate of 58% to \$8.2B in 2018. In addition to market forecasts by technology and application, this comprehensive report covers:

- Market readiness of core technologies, suppliers, and manufacturers
- Market drivers impacting the growth of flexible displays and electronics
- Analysis of electrophoretic, electrochromic, OLED, RFID, flexible substrates, active matrix backplanes and more
- Product roadmaps and capacity by technologies and applications

Contact us today for more information on the *Flexible Displays and Electronics Report* and how you can get a complimentary copy of the 85-page Flex Tech Alliance (with assistance from cintelliq) report *“Flexible Electronics: Government Investment and R&D Programs in the U.S. and European Union”*.



An Inside Look at 3D

Interview with Rick Dean from THX

Rick Dean is the Chief Technical Officer for THX. He oversees a wide variety of services and mastering projects and represented THX in worldwide press and technical reviews of Digital Cinema and Home Video. Rick chairs the 3D@Home Consortium which represents consumer electronics manufactures, studios, games developers, and 3D technology providers to help drive standards for enabling the 3D market in the consumers home and commercial applications. He also serves as Governor of the SMPTE, active in the Hollywood section and has served in multiple standards groups.



Tell us about THX and its role in the entertainment and 3D industry. THX develops technologies and certification programs that help deliver the true vision of filmmakers, game developers and musicians, from their studios to audiences around the world. THX technologies and certification programs are implemented throughout the production chain—from the set and studio to movie theaters and playback devices. We help manufacturers produce better audio/visual products, and cinema owners and studio designers create world-class venues. Most importantly, audiences get to experience the true sights and sounds of films and other media exactly like it was created. Where THX differs from so many other stand alone quality oriented programs, is that we leverage all our experience from years of active participation in the content creation environments for both picture and sound. This sets the bar for the performance of content and technology working together. A spinout of LucasFilm, THX was originally chartered with leveraging technology to maximize artistry in sounds and pictures in the theater, then later in the home. The creation of quality experiences continues to be our key goal. Our company has a new initiative underway, the THX Media Director, a technology that aims to turn digital media into smart content that communicates directly with AV components to enable automatic configuration including 3D for the best playback experience for any level of consumer.

Why the buzz about 3D? First, it's a new, very exciting visual experience for the consumer. Second, for content providers, it's a new medium for the creative community to create immersive experiences and market their products, which now includes movies and games and will include other entertainment. Finally, it can be financially rewarding, for example, as theater owners can charge slightly higher prices for 3D movies, and in the home it is an added point of sale.

In March '09, you were elected chairman of the 3D@Home Consortium (<http://www.3dathome.org>). **What's the charter and purpose of the consortium?** The 3D@Home Consortium will speed the commercialization of 3D technology and content to the home, providing an exciting viewing experience for the consumer including motion pictures, gaming and other forms of entertainment. We can accomplish this by bringing together leading CE companies such as Intel, LG and Samsung, along with content providers such as Disney, and with the 3D technology supply chain. Together, they are addressing issues such as development and distribution of content, display interfaces and hardware, and consumer education. The members obviously want to see adoption of 3D technology by consumers for their home theatres, and there are many challenges to getting it there.

How does the consortium structure and manage its work product and gain acceptance for its output? **With 3D gaining in popularity, aren't there many companies and organizations to be brought together?** 3D@Home Consortium has almost 40 member companies and is growing. At its inception in April 2008, the consortium established four steering teams (STs) to address content creation; storage, transmission and distribution; promotion; and displays and metrology. Chaired by industry technical and thought leaders, the STs drive 3D@Home Consortium's agenda and work product. We built a dedicated website where committee members exchange ideas, make proposals, and can ballot on a 24/7 basis. This allows all member companies to participate regardless of whether they are located in Asia, Europe or North America. Additionally, the consortium now has liaisons established with the Society of Motion Picture and Television Engineers (SMPTE), the Consumer Electronics Association (CEA), the Society for Information Display (SID) and the European

Broadcasting Union (EBU), among other relationships. Recently, I signed a Memorandum of Understanding with the 3D – Fusion Industry Consortium of So. Korea. All of these organizations are working on segments of the 3D infrastructure, but 3D@Home is the place where members can keep their eye on the big picture.

Can you point to technical and market development progress that the consortium has achieved? Sure. I am especially excited about developments in ST1, where the team is recruiting advisors who are leaders in 3D content creation. With 100+ years of experience between them, these advisors can offer expertise in identifying a high-quality stereoscopic 3D experience. We anticipate numerous columns, articles, and videos emanating from these advisors and hosted at <http://www.3dathome.org>. From a practical perspective, ST2 is working on display interface requirements and is now balloting its initial specification. This will be shared with CEA and SMPTE and could lead to adoption of an industry standard. ST4, which has responsibility for displays and metrology, has produced a 3D glossary of terms, a 3D “family tree” that describes how the various 3D solutions operate, and is working on actual display specifications, test patterns, and images.

Earlier this year, Jeffrey Katzenberg of DreamWorks Animation said that sports and gaming will be a catalyst for driving 3D into the living room. According to a news story, he went to say that “monitors are shipping now and will be in stores by early next year.” Can you comment on this? I am certainly in agreement with Mr. Katzenberg that Hollywood Movies alone will not be “the” driving force. I believe that the consumer wishing to purchase 3D products for their home will look at Sports and Games in addition to movies, and that a 3D offering in all forms of entertainment will drive success.



Board Level Members



Leadership Level Member



Basic Level Members



A FlexTech Alliance Special Report

Flexible Solid State Lighting: Technology, Manufacturing and Market Assessment

Summary:

This report is a complete overview of the technologies and market opportunities for print-based, flexible, solid state lighting (SSL). With new SSL technologies, novel form factors can extend and expand lighting applications. It is in this space that print-based, flexible, SSL technologies are poised to enter and change the market place.

Experts agree that new lighting technologies are needed to promote energy efficiency and help reduce the emission of green house gases. Introduction of light emitting diode (LED) and organic LED (OLED) light sources can contribute to accomplishing these goals because of their high conversion efficiency of electricity to visible light.

The 329 page report contains charts, graphs, cost of ownership analyses and many other means to visually depict the flexible SSL market's characteristics and dynamics. Interested in the market for OLED lamps? Device architectures? Materials? Manufacturing, and conversion processes? Then this is the report for you.

Member Price: \$1995

Non-Member Price: \$2,495

Visit www.flextech.org to download the executive summary and table of contents.

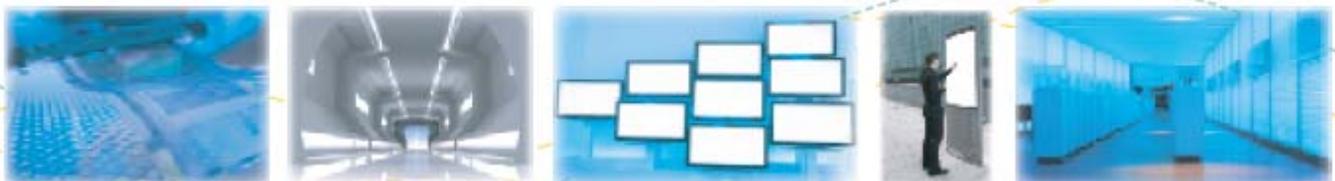
Report Features:

- The market opportunities for print-based lighting systems.
- How OLED devices manufactured for display applications need to be adapted for lighting applications.
- Identification and assessments of specific materials that meet the requirements for fabricating white OLEDs with high efficiency and long lifetimes.
- The manufacturing issues associated with producing cost effective light-emitting printed devices.
- Conversion operations required to turn a printed light-emitting structure into a product that can be sold to a consumer.

Produced and Distributed by:

FlexTech Alliance™
for Displays & Flexible, Printed Electronics

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Funding Opportunity Released 2010 SBIR Phase I Projects



The US Department of Energy has released the 2010 Small Business Innovation Research (SBIR) Phase I funding opportunity, which includes topics related to solid-state lighting (SSL). The SBIR program seeks to increase the participation of small businesses in federal research and development. Phase I projects evaluate the scientific or technical merit and feasibility of ideas with commercial potential.

The 2010 SBIR topic area related to SSL has three main areas of interest – two focusing on transitional technology and one on supporting technology:

- Transitional Technology for Light Emitting Diodes (LEDs)
- Transitional Technology for Organic Light Emitting Diodes (OLEDs)
- Supporting Technologies for Off-Grid SSL Applications

Proposals are due November 20, 2009, and grants will be made in FY10. For more information on this funding opportunity, visit the SBIR website at <http://www.science.doe.gov/sbir>.



Quarterly Flexible, Printed Electronics Workshop *"Flexible Substrate Requirements for the Market"*

October 22, 2009



FlexTech Alliance is pleased to announce its Fall Quarterly Flexible, Printed Electronics Workshop, scheduled for Thursday, October 22nd, hosted by SEMI in San Jose, California. Please join leading technologists from producers, materials and tool manufacturers, as well as prominent universities and laboratories for a great networking event, a chance to collaborate with other experts in your field, and the opportunity to make a significant contribution towards moving the emerging printed electronics industry closer to commercialization.

Please also note that on October 21st, there will be facility tours available - and an optional Networking Dinner (\$40).

To register or for more details and directions, please visit the following link:

<http://quest.cvent.com/i.aspx?5S,M3,5b6397fa-5ab8-445e-9faf-171cbdf8463a>

Summary of FlexTech's Quarterly Workshop on Flexible, Printed Electronics

Binghamton University

August 20, 2009

The FlexTech Alliance held a quarterly Printed Electronics Workshop, hosted by Binghamton University. The Workshop focused on providing end-user markets and technology updates in the area of flexible electronics in medical applications. Workshop goals and objectives included:

- End-User Markets and Technology Updates
 - Flexible electronic medical applications
- Medical Applications: Approaches and Challenges
- Breakout Groups: Opportunities and Challenges for Successful Commercialization
 - Sensors and health monitors
 - Power requirements
 - Soldier systems

With regard to flexible medical applications, Raghu Das from IDTechEX identified several medical applications. There are increasingly affordable yet information-rich solution on labels (e-labels). There are also solutions such as blood pressure monitors, glucose test strips, body area networks (BAN), and smart skin patches.

A recent NSF/ONR study was conducted to determine how the US might improve its position in the field of flexible hybrid electronics. The EU already has a strong emphasis on innovation centers that foster the development of flexible electronics systems and manufacturing methods. These efforts are innovation-driven, interdisciplinary and synergistic, and committed to graduate education.

Solutions for the warfighters were discussed – identifying the key technology consideration as weight. Military uses must support different types of users with different needs. There are regulatory considerations, (HIPAA and FDA). Other considerations include concerns about wireless on the battlefield and interoperability.

Printed sensor tapes integrate electronics, memory, and sensors and require new processing technologies to fabricate TFT backplanes for prototype displays and image sensors. Areas in which printed low cost disposable sensors are desired include medical sensors (which need to be disposable), sensors in packages (because the package is disposed of), and chemical/ biological sensors (where the sensor substance is used up).

Another application is related to Intravascular Ultrasound (IVUS) Systems. IVUS systems use a tiny ultrasound transducer mounted on the tip of a catheter to image the interior of blood vessels, providing advantages over traditional angiography, but there are key technical challenges to be addressed

Sensors and Health Monitors: In the area of materials, this segment requires improved surface roughness control, flexible substrates that can withstand higher processing temperatures, higher mechanical stability, improved stretchable substrates – materials other than PDMS, highly elastic conductors, and substrates resistant to degradation or improved barrier layers. In the area of manufacturing, challenges include system integration, improved sensor sensitivity and specificity; interconnects for flexible circuits including flexible to hard; wire-cutting operations, chemical sensors with improved sensitivity and specificity, processes and characterization of large linear dimension circuits; drying of printed circuits, and cleanliness of web and rollers.

Power Generation: This segment includes areas related to photovoltaic devices, fuel cells, and energy harvesting (e.g., nano antennas, body motion, wind, thermal, and organic materials decay, etc.). Power distribution can be on the grid, on the body, or in the home. Opportunities for using flexible electronics for power management exist in power storage, thin film batteries, and capacitors

Partner update from the FDC

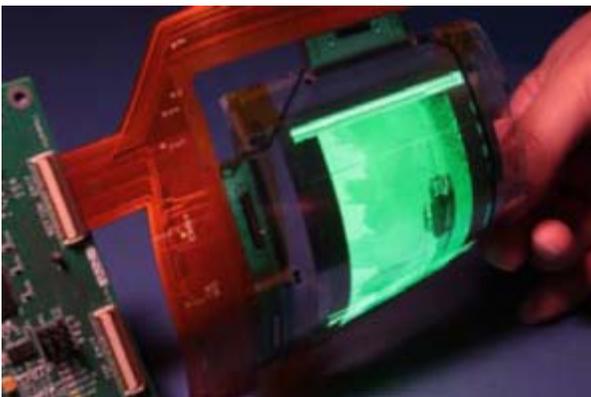
by Nicholas Colaneri, Center Director, Flexible Display Center

As an early adopter of advanced technologies, the Army recognized the importance of developing revolutionary information displays and had the foresight to commit to fostering a sustainable ecosystem that could successfully develop and commercialize flexible electronic displays. The Army's long-term commitment to this flexible display initiative not only recognizes the important role that the Center plays within this developing market but, more critically, allows us to accelerate the application development and commercialization process. Some early successes have been our role in development and commercialization of DuPont Teijin's planarized PEN substrate system for flexible electronics, EVG150XL large area spray coater development with EV Group, and low temperature PTS planarization material with Honeywell, as well as, an ASU proprietary temporary bond process, ripe for spin out.



SID 2009: The FDC exhibited its various electrophoretic flexible display technology and applications demonstrators, as well as its 4-inch diagonal PHOLED display on PEN that was integrated under collaboration with UDC. The Center also presented on two topics: Flexible CMOS and Electrophoretic Displays, (as presented by D. Allee in collaboration with UT-Dallas, B. Gnade and AM PHOLED Displays on Temporary Bonded Polyethylene Naphthalate Substrates with 180°C a-Si:H TFTs, as presented by Doug Loy.

Just before the show, the Center and the University of Texas at Dallas announced our successful production of CMOS circuitry on a flexible plastic substrate, with the goal of advancing flexible electronics. The new circuits offer high power efficiency with one-third of the consumption of traditional thin film transistor circuitry, making them ideal for applications such as smart medical bandages or triage patches. Bruce Gnade of UT Dallas explained that "this represents the first step towards creating higher-level flexible electronics circuitry, such as logic and memory."



At the show, the Center and Universal Display Corporation introduced the first a-Si:H active matrix flexible OLED display to be manufactured directly on DuPont Teijin's PEN substrate. Implementing Universal Display Corporation's PHOLED technology and materials and the FDC's proprietary bond/debond manufacturing technology, the 4.1-inch monochrome QVGA display represents a significant milestone towards achieving a manufacturable solution for flexible OLEDs. The flexible OLEDs achieve the same brightness as traditional displays with extremely low power consumption and target military and commercial applications that require more rugged displays.

The FDC is a government – industry – academia partnership that's advancing full-color flexible display technology and fostering development of a manufacturing ecosystem to support the rapidly growing market for flexible electronic displays. FDC

partners include many of the world's leading providers of advanced display technology, materials and process equipment. The FDC is unique among the U.S. Army's University centers, having been formed through a 10-year cooperative agreement with Arizona State University in 2004. This adaptable agreement has enabled the FDC to create and implement a proven collaborative partnership model with over 20 engaged industry members, and to successfully deploy world class wafer-scale R&D and GEN-II display-scale pilot production lines for rapid flexible display technology development and manufacturing supply chain commercialization.

<http://www.flexdisplay.asu.edu>



Technical Presentations

Welcome Reception

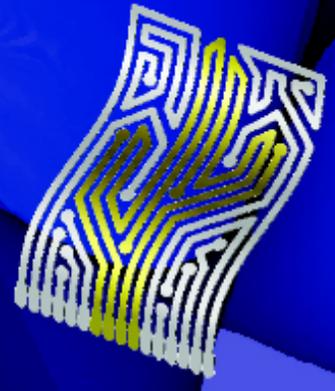
Short Courses

Exhibitor Reception

Market Presentations Industry Awards Dinner

Poster Sessions

Exhibits



2010 Flexible Electronics & Displays Conference & Exhibits

Phoenix, Arizona, USA

February 1-4, 2010

www.flexconference.org

3 Full Days of Events, Networking & Marketing Opportunities

Speaking Opportunities

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www.flextech.org:

- Flexible Displays
- Materials Advancements for Flexible Electronics
- Manufacturing on Flexible Substrates
- Strategic Market & Business Overviews
- Worldwide FPE Programs & Progress
- Flexible Solar/Photovoltaics
- Solid State Lighting
- OLEDs
- Printed Electronics Processes and Technologies
- Equipment for High-Throughput Electronics Manufacturing
- Smart Sensors
- Touch Products
- Medical Devices
- Energy Storage & Batteries
- RFID
- Sensor Technology & Applications
- Testing & Reliability
- Electronics Integration-Hybrid Solutions
- X-Ray Detection (Organic)
- Roll-to-Roll Systems
- Substrates & Barriers
- Inks
- Inspection Techniques
- OTFT & Organic Semiconducting Materials

Sponsoring & Exhibiting

Sponsors and exhibitors at the 2009 Flexible Electronics and Displays Conference and Exhibition ensure their company is seen as a recognized player in the industry. FlexTech staff, Brede, and the Pointe Hilton offer you a full range of services from shipping and storage to signage and booth set-up. Our goal is to ensure your exhibit is easy, affordable, and delivers a significant return on your investment.

Premier Sponsor - \$ 8,000

- Three tickets to Technical Conference & short courses
- Premier logo placement on conference signage
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- 10x8 booth package (includes 6' table + electrical service)
- 1/2 page company description in Conference Guide
- Placement of literature in conference bag
- Placement of full-page B/W ad in Conference Guide

Sponsor - \$ 4,000

- Two admissions to Technical Conference
- Logo placement on conference signage
- Choice of name placement on a break or luncheon service
- 10x8 booth package (includes 6' table + electrical service)
- Placement of literature in conference bag
- 1/2 page company description in Conference Guide

Exhibitor - \$ 2,800

- One admission to Technical Conference
- 10x8 booth package (includes 6' table + electrical service)
- 1/2 page company description in Conference Guide

News and news links from the FlexTech Alliance

excerpted from Veritas et Visus newsletters

Plextronics and Novaled to collaborate on development of organic lighting technology

Novaled and Plextronics announced that they have agreed to jointly develop doped and solution processed organic materials for OLED applications. The collaboration agreement specifies that the companies will combine their respective technologies to develop an advanced solution processable Hole Injection Layer (HIL) technology for OLEDs. <http://www.plextronics.com> <http://www.novaled.com>

Novaled announces a large area OLED device fulfilling international lighting specifications

The Novaled 15x15cm OLED device reaches a power efficiency of 30lm/W at an initial brightness of 1,000cd/m². It shows a high quality white light with CIE color coordinates at illuminant A being in line with DoE ENERGY STAR specifications. By using Novaled's proprietary "litternity" technology a lifetime of 20,000h can be reached. Novaled developed the 15x15cm white OLED device with a thickness of less than 2mm. The Novaled OLED stack allows for a natural and warm white light performing a very high color-rendering index (CRI) of 90. The perception of this light is similar to sunlight or what is delivered by incandescent bulbs. With this large area flat light element OLEDs will enable a pleasant illumination of the room together with revolutionary design. By reaching 30lm/W on a 15x15cm area Novaled achieved an intermediate step in line with the European project OLED100. <http://www.novaled.com>



FlexTech Alliance awards Uni-Pixel Displays contract for R2R conductor patterning process

Uni-Pixel and the FlexTech Alliance announced that Uni-Pixel has been awarded a contract by the FlexTech Alliance for further advancement of its roll-to-roll conductor patterning capabilities that it has developed for its Opacity active layer films. During the course of development of the unique polymer films used in the company's TMOS displays, Uni-Pixel has pioneered a method to use an inkjet printing system to pattern conductors on films at significantly thinner trace widths than previously achieved. This discovery provides the potential to enhance roll-to-roll printed electronics manufacturing by dramatically improving flexible printed circuitry, while at the same time reducing the cost of production. <http://www.flextech.org> <http://www.unipixel.com>

Universal Display awarded US DOE contract to demonstrate thin, efficient OLED lighting

Universal Display Corporation announced that the company has been awarded a \$1.65 million, two-year contract from the US Department of Energy (DOE) to demonstrate a thin, highly-efficient, white OLED lighting concept for under-cabinet applications. Under terms of the contract, UDC will deliver a set of under-cabinet lighting units to the DOE. Each unit will consist of five 6x6-inch white PHOLED lighting panels that are based on the company's phosphorescent OLED technology and materials. <http://www.universaldisplay.com>

UDC awarded SBIR Phase II contract from US Air Force for flexible OLED displays

UDC announced that the company has been awarded a \$750,000 Small Business Innovation Research (SBIR) Phase II contract from the United States Air Force Research Laboratory. Work under the program, titled "Low-Power, Direct-View Flexible Displays", will focus on the development of a non-glass, ejection-safe, flexible OLED display prototype for prospective use by pilots in tactical cockpit settings. Developed in collaboration with L-3 Communications Display Systems and LG Display, the flexible phosphorescent OLED display prototype will be energy efficient, offer full-color video rate and have wireless communications capabilities. In addition, it will have the capability to be wrapped around a cylinder for easy storage during flight. The design goal is to provide Air Force pilots with a replacement for printed maps and checklists typically held on their knees in tactical cockpits. Under terms of the Phase II program, the team will deliver four breadboard subsystems based on a bright 6-inch diagonal, full-color, low power consumption PHOLED display on flexible metal foil. <http://www.universaldisplay.com>

FlexTech Alliance awards OPV contract to Solarmer Energy

The FlexTech Alliance announced the award of a \$450,000 contract to Solarmer Energy, Inc. to design and synthesize high efficiency donor polymer materials for use in organic photovoltaics (OPVs). Potential applications for Solarmer's new photovoltaic technology are in portable electronics, building integrated photovoltaics (BIPV), and smart fabrics. OPVs have many advantages over most other solar cell technologies, including broader color range and tunability, better performance in low intensity and indirect light, low raw material costs and consumption, high materials utilization, light weight, ease of manufacturing through high-throughput printing and coating processes, non-toxic materials used in manufacturing, easy scalability, and very low initial capital investment. <http://www.flextech.org>

FlexTech Alliance awards contract to Etched in Time for linear plasma etch module

The FlexTech Alliance announced the award of a contract to Etched in Time, Inc., totaling \$324,000. Under the contract, Etched in Time (EITI) will develop a linear plasma etch module using high density downstream processing in conjunction with reactive ion etch (RIE) for etching of dielectric films. At the end of the six-month contract, EITI's module will be incorporated into the roll-to-roll system at Binghamton University's Center for Advanced Microelectronics Manufacturing (CAMP) facility in upstate New York. The system is designed to be compatible with a range of roll-to-roll tools, offering a variety of companies in the industry the advantages obtainable through this new technology development. <http://www.flextech.org> <http://www.etchedintimeinc.com>

Vitex Systems announces license agreement with major thin-film supplier

Vitex Systems announced that it has executed a license agreement with a global supplier of specialty materials and related thin-film services, granting them the rights to develop and manufacture Vitex's proprietary Barix barrier film. Licensed fields of use include, but are not limited to, photovoltaic and other large-area thin-film technology based applications. Financial terms were not disclosed. <http://www.vitexsys.com>

NovaCentrix wins Award for PulseForge 3100

NovaCentrix announced that the PulseForge 3100 with Pulse Thermal Processing has been selected by R&D Magazine as a recipient of the 2009 R&D 100 Award in the Process Sciences category. This award recognizes the 100 most technologically significant products introduced in 2008. The PulseForge 3100 uses rapid pulses of high-intensity light for high-speed drying, curing, sintering or annealing of high temperature materials on low temperature substrates such as plastic and paper, enabling inexpensive and flexible electronics. The award was a joint submission of NovaCentrix and Oak Ridge National Laboratories. <http://www.novacentrix.com>

**Corning and Soitec to work together on advanced substrates for OLED mobile displays**

Corning and the Soitec Group announced an agreement to work together on the development of high-performance silicon-on-glass (SiOG) substrates for the flat panel mobile display market. The two companies will focus their efforts on top-performance backplane substrate technology for OLED mobile displays. The first applications are anticipated to be small- to medium-sized mobile display devices. Soitec's proprietary Smart Cut technology is used to transfer ultra-thin single crystal layers of wafer substrate material (such as silicon) onto another surface. This proven technique is used to fabricate more than 90% of SOI production wafers in the semiconductor industry. <http://www.corning.com> <http://www.soitec.com>

NanoGram Corporation announces first ambient, inkjet nanoparticle silicon ink

NanoGram Corporation announced the successful fabrication of the first thin film transistor produced by ambient printed nano-silicon to reach a carrier mobility of 2.0 cm²/Vs. The TFT is based on a non-pyrophoric material and was produced by Sharp Laboratories of America. NanoGram's printable silicon material is based on nano-scale crystalline silicon particles formulated into inks, which can be ink-jetted or spin coated onto a substrate and then fabricated into a TFT. The proprietary ink technology was developed as part of NanoGram's technology development agreement (TDA) with Teijin Limited. NanoGram's <http://www.nanogram.com>

UT Austin licenses method that speeds electronics manufacturing to Versatilis

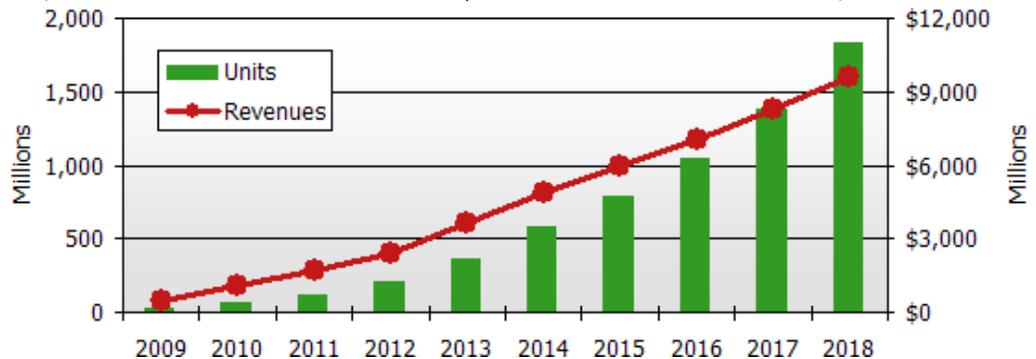
The University of Texas at Austin has licensed a time-saving technology for electronics manufacturing to Versatilis. The technology, a dual-tone photo-resist that saves steps in the manufacturing process, provides a unique method of photolithography used in electronics. Versatilis originally developed the novel photolithography method under a Defense Advanced Research Projects Agency (DARPA) contract. It uses multiple wavelengths of light to capture multiple patterns in photo-resist layers simultaneously rather than through a repetitive, sequential process as is conventionally done. <http://www.utexas.edu>

Raytheon delivers first Ground Soldier System Prototypes

Raytheon delivered 10 Ground Soldier System (GSS) Increment 1 prototypes Sept. 16, 2009, supporting a significant program milestone in the rapid development of a wearable computer that links the dismounted warfighter to the netted battlefield. The Raytheon GSS Inc 1 team, which includes key partners Black Diamond Advanced Technologies and CHI System, Inc., will next support Army limited testing prior to incorporating refinements for final prototype delivery in March 2010. Raytheon GSS Inc 1 links the dismounted leader to the battlefield network for real-time tactical situational awareness. The soldier system incorporates human factors engineering and analysis for a comfortable fit made to endure harsh environments and long warfighter missions. <http://www.raytheon.com>

E-paper display revenues forecast to reach \$9.6B by 2018, DisplaySearch reports

In its recently released E-Paper Displays Report, DisplaySearch forecasts that the total e-paper display market will grow to 1.8 billion units and \$9.6 billion in revenues in 2018, from 22 million units and \$431 million in revenues in 2009, for a CAGR of 41% for revenues and 64% for units. The market for e-paper displays, which are found in e-books, e-textbooks, e-newspapers, e-magazines, mobile phones, electronic shelf labels, point-of-purchase and public signage displays, displays in smart and credit cards, clothes and other wearable items, and other applications, has taken off this past year, becoming one of the few shining stars in the economic downturn. <http://www.displaysearch.com>



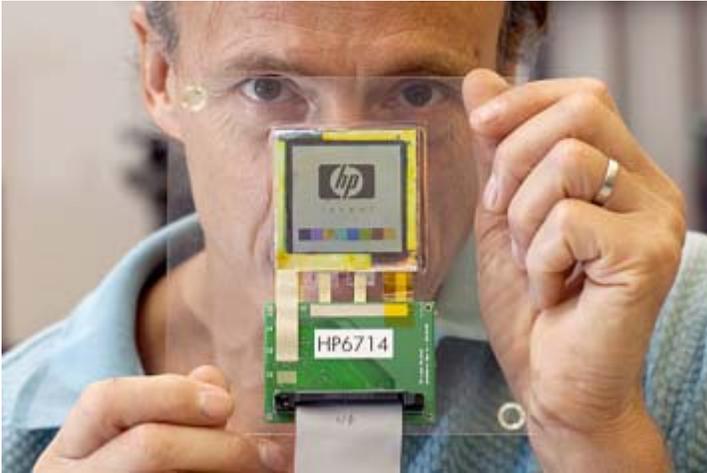
Plastic Logic partners with Olive Software on e-reader

Plastic Logic announced that Olive Software will be a key service provider and partner for the Plastic Logic Publishers Program. Together, Olive Software and Plastic Logic are developing content publishing solutions that enable major newspapers, magazines, web content and other publishers to simply and efficiently optimize and distribute their content for the company's forthcoming e-reader. The Plastic Logic Reader, designed especially for mobile business professionals, is due in the marketplace in early 2010. Olive is a pioneer in the digital publishing industry with over a decade of experience in the development of innovative, multi-channel publishing, content management and distribution solutions. Olive currently produces hundreds of newspapers, magazine titles for industry leading publishers across multiple platforms – including electronic reading devices, smart phones, browsers, IPTV and more. <http://www.plasticlogic.com>

Prime View and E Ink revise merger agreement

Prime View International announced in late September that it has amended its merger agreement with E Ink Corporation. In addition to the \$215 million cash consideration unveiled on June 1, 2009, the revised agreement includes consideration for E Ink shareholders based on the combined company's stock performance over a three-year period. The consideration will be granted in the form of 120 million convertible preferred shares that can be converted into common shares as the stock climbs from NT\$50 to NT\$80. At the end of the three-year period, any unconverted preferred shares will be cancelled. <http://www.eink.com>

HP Labs develops paper-thin plastic displays



HP is using inorganic amorphous silicon to develop plastic electrophoretic displays. The displays can be as thin as 50 microns, or about half the thickness of a human hair, and are thus better for environmental sustainability. The circuitry that drives these displays can be printed on plastic in a way that's similar to laying down ink on paper. In the next 18 months, HP plans to start delivering displays as part of wearable watches it is creating for US Army infantry soldiers. Commercial applications are also planned in part through an HP spinoff, Phicot. <http://www.hpl.hp.com>

Carl Taussig, director of HP Labs' information surfaces lab, shows off a flexible display prototype.

Photo: David Paul Morris / The Chronicle

Philips develops high-quality color e-paper

A new approach developed by Philips now offers fresh hope for color e-paper displays that are so bright and clear that even traditional LCDs will pale in comparison. Philips Research's approach involves turning the traditional electronic-paper pixel quite literally on its side, in order to tune it to different shades of the spectrum. Philips' technique, which is called in-plane electrophoretics, differs from other electrophoretic solutions in that it involves suspending colored particles in a clear liquid and moving them horizontally instead of vertically. Each pixel is made up of two microcapsule chambers: one containing yellow and cyan particles, the other, below, containing magenta and black particles. Within each microcapsule, one set of colored particles is charged positively while the other is charged negatively. <http://www.research.philips.com>



A prototype in-plane electrophoretic display consisting of 1,000 pixels

Tred Products launches first commercial products



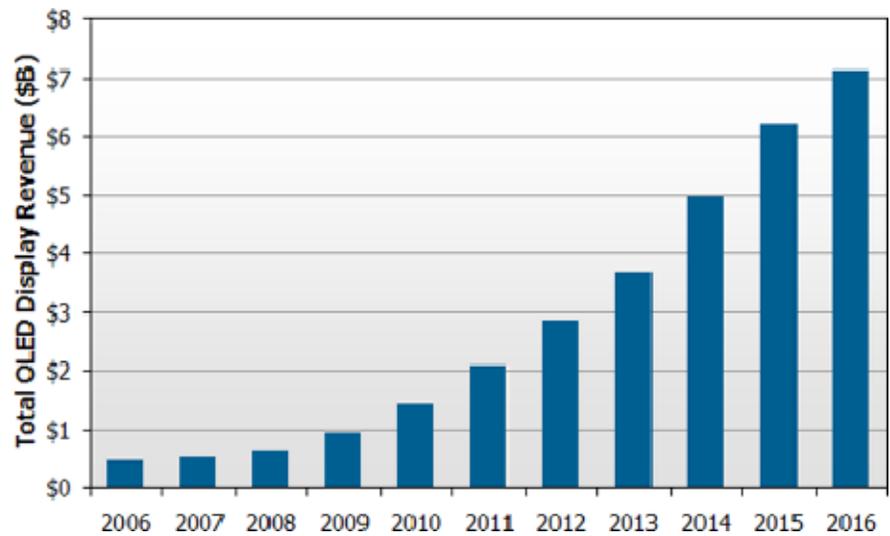
Tred Displays recently completed a series of beta sites. Following the success of these sites, Tred began shipment of their tredPANEL and tredLINK products for revenue to select channel partners. tredPANELS are battery powered, wireless displays that offer a unique solution as a replacement for printed price signs. Ralph's Thriftway (Olympia, WA) used Tred's products in their produce department, combining Tred's digital pricing content with graphics from WP Sign Systems. In another installation, Charter Bank used Tred products at multiple locations, showing interest rates for mortgage and checking accounts. Tred's iN-Series tredPANELS are designed for POS/POP as well as various signage applications. <http://www.TredDisplays.com>

Uni-Pixel receives first orders for Opacity film products

Uni-Pixel announced that it has received its first purchase orders for film products and has reached agreements with two high volume film production companies to rapidly advance the production process for its Opacity films to meet growing demand opportunities. The announcement further signals the company's success in achieving a number of significant milestones as it transitions from a development stage company to a commercial manufacturing business. By working closely with its production partners, Uni-Pixel has proven the processing capability in both ultra-violet (UV) micro-replication, as well as thermally embossed micro-replication. <http://www.unipixel.com>

DisplaySearch forecasts worldwide OLED revenues to grow to \$7.1 billion by 2016

In its latest Quarterly OLED Shipment and Forecast Report, DisplaySearch forecasts the total OLED display market will grow to \$7.1 billion by 2016, from \$0.6 billion in 2008, with a CAGR of 36%. DisplaySearch also reported that in Q1'09 worldwide active matrix (AM) OLED revenue surpassed passive matrix (PM) OLED for the first time. AMOLED revenue is increasing strongly due to strong mobile phone main display shipments, as Nokia, Samsung Electronics, and Sony Ericsson heavily promoted AMOLED mobile phones in first half of 2009. More than 10 mobile phone models with AMOLED main displays have been released in 2009. PMOLED has been the revenue leader in the OLED display market, driven by high unit shipments. However, in Q1'09, PMOLED shipments were down significantly due to weakness in MP3 and mobile phone sub-display applications.



OLED display revenue forecast

<http://www.displaysearch.com>

NanoMarkets sees repositioning of printed electronics toward printed solar panels

According to a new research report from NanoMarkets, while other areas of printed electronics (PE) have languished, printed photovoltaics (PV) has continued to establish itself as both a real business and one of the few hopes for printed electronics. NanoMarkets' latest forecast of printed PV sees the market growing to \$1.9 billion by 2014 with two-thirds of that coming from printing the core cell structure itself. NanoMarkets believes that substantial opportunities will emerge for manufacturers of novel inks. For example, solar cells using CIGS ink should be worth almost \$340 million by 2014. NanoMarkets also predicts that printed organic PV cells will surpass \$300 million in the same time frame. <http://www.nanomarkets.net>

DuPont and Applied Materials collaborate to boost solar cell efficiency

DuPont and Applied Materials announced a collaboration to advance multiple printing technology that is expected to increase the absolute efficiency of crystalline silicon (c-Si) photovoltaic (PV) solar cells. Photovoltaic metallization pastes are screen printed onto the surface of solar cells in a pattern of grid lines which serve to collect electricity produced by the cell and transport it out. To maximize efficiency in the solar cell, the multiple printing technology will reduce the shadowing effect of wide grid lines on solar cells and improve electrical conductivity. <http://photovoltaics.dupont.com>.

Energy Conversion Devices completes merger with Solar Integrated Technologies

Energy Conversion Devices, Inc. (ECD) announced it has completed its merger with Solar Integrated Technologies, Inc. (SIT). SIT is now a wholly owned subsidiary of ECD. "This merger strengthens and diversifies our business," said Mark Morelli, president and CEO of ECD. "This merger is an important element of our future growth plans as ECD transitions from manufacturing and selling a product to a company that provides complete solar solutions and value-added services." <http://www.energyconversiondevices.com>

Honeywell launches new material to improve efficiency, power output of solar panels

Honeywell Electronic Materials announced a new material that improves the efficiency and power output of photovoltaic (PV) panels. The new product, called Honeywell SOLARC, is a transparent coating material that improves the light transmittance through the glass that covers PV panels, thus increasing the PV module efficiency and power output. This coating also significantly reduces glare from the glass, allowing the PV panels to better blend with its surroundings. SOLARC is a liquid-based coating and can be used by all common types of PV modules. The coating is compatible with many coating processes, including spray, roller, curtain, slot-die and spin-on coating. <http://www.honeywell.com/eupvsec>

Lockheed Martin installs Barco's simulation mini-domes for PC-21 flight training

Barco announced the successful installation of two nine-projector SEER mini-domes for Lockheed Martin Simulation, Training & Support in the Asia-Pacific region. The Barco SEER (Small Environment-Enhancing Reality) system is being used for basic flight training in the Pilatus PC-21 Basic Wing Course trainer. The mini-dome is driven by nine of Barco's liquid crystal on silicon (LCoS) projectors, which are designed specifically for flight simulation purposes. Barco's two SEER mini-domes each consist of nine LCoS SIM 7 projectors, standardized mechanical structures, and specialized Barco auto-alignment tools. While eight of the projectors generate the simulated imagery, one projector is used for the HUD (Head Up Display) overlay. Barco's SIM 7 projector is designed specifically to meet the stringent FAA and JAA requirements for flight training. It offers a contrast ratio exceeding 2,000,000:1, and a smearing reduction option that accurately handles fast-moving images. These features result in a geometrically accurate composite image on the SEER dome's spherical surface, completely free of color, brightness and overlap disturbances. <http://www.barco.com>



FUJIFILM Dimatix Launches Spectra Polaris Printhead

FUJIFILM Dimatix launched the new Spectra Polaris PQ-512/15 printhead which utilizes the binary operating capability of Dimatix' VersaDrop jetting technology and Q-Class hybrid construction to deliver ink drop sizes from 15 to 30 picoliters from 512 individually addressable inkjet nozzles at continuous frequencies up to 45 kHz fired at 8 meters/second velocity with exceptional straightness. The new Spectra Polaris printhead is equipped with a flexible, fluid interface allowing single or two-color operation with a broad range of inks, including UV-curable inks and aggressive organic solvents, making it suitable for a broad range of commercial and industrial printing applications such as wide-format, label and package printing at resolutions to 1000 dpi. <http://www.dimatix.com>



RAHN launches printed electronics initiative

To support new developments in the emerging field of printed electronics, RAHN has developed a program to support companies considering Energy Curing as an option for fabricating printed electronics products. By way of its Energy Curable technologies, RAHN intends to enable printing of functional inks on common substrates such as paper, plastic, and textile using standard printing processes. <http://www.rahn-group.com>

Cambridge NanoTech launches plasma ALD system

Cambridge NanoTech announced the launch of its first line of plasma ALD systems, the Fiji Series. Built on the success of the Savannah, the Fiji delivers unparalleled flexibility and ease of experimental use for plasma ALD research. Cambridge NanoTech grew directly out of Gordon Lab at Harvard University, one of the foremost ALD research groups in the world. <http://www.cambridgenanotech.com>

Rockwell Collins launches Integrated Crew Display System

Rockwell Collins introduced the Integrated Crew Display System (ICDS) for military vehicles. The system provides enhanced situational awareness resulting in increased crew safety and mission effectiveness. ICDS provides video feeds via a helmet mounted display (HMD) from multiple sensors and systems in the vehicle, which can be simultaneously viewed by all crew members. <http://www.rockwellcollins.com>





Industry Research – FlexTech research reports provide valuable insights into economic and technology trends of the electronic displays and flexible electronics industries and its primary markets. Providers include DisplaySearch, Fuji Chimera, Insight Media, Toray Research Council, and Veritas et Visus. Collectively, the reports are a \$27,000 value!



R&D Program – FlexTech's R&D Program has two elements for members:

- Gap analysis and technical roadmapping that identifies and resolves key technical challenges
- Pre-competitive R&D funding to provide funds for projects defined by member interests.



Networking & Partnering

- Technical Conferences & Workshops – led by our flagship event, the *Flex Conference*
- Regional Meetings – great networking events at member locations
- Business Conference – connection with potential investor and partners



Member Marketing

- On-line Resources – www.flextech.org is a portal for members' corporate information
- Advocacy – industry voice with the media and federal and state governments
- Demo Creation – FlexTech facilitates the development of product demonstrators

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