



Knowledge Transfer Networks Accelerating business innovation; a Technology Strategy Board programme

UKDL Newsletter

Issue 1 **September 2007**

Contents

*The **UKDL Newsletter** is focused on bringing news and commentary about plastic electronics, displays, and lighting-related happenings in the UK. The **UKDL Newsletter** is published quarterly for the UKDL by Veritas et Visus.*

Introducing the UKDL…

by Chris Williams

Welcome to this first edition of the UK Displays & Lighting (UKDL) Newsletter! The newsletter will be a regular publication that is targeted at all engineers, scientists, managers who work in and around displays and lighting technologies, and users of display and lighting products who are looking for advice and guidance about future technology trends.

This newsletter is focused on the activities and developments in flat panel displays, plastic electronics and solid state lighting. We hope to inform and educate you in an entertaining way, and each issue will contain a wide-ranging summary of activities that are taking place around the UK in the displays and lighting communities at our companies and universities, as well as presenting detailed interviews with leading figures in the UK displays & lighting communities.

- UKDL is one of 22 Knowledge Transfer Networks funded by the UK government to help facilitate Knowledge Transfer between companies and universities around the UK and beyond in a wide range of disciplines and activities. Full information about the role of the KTN network can be seen on the web at http://www.ktnetworks.co.uk
- UKDL is an inclusive Knowledge Transfer Network – anyone involved with displays or lighting technologies as a researcher, developer, manufacturer or major user is welcome to join us, both from within the UK and from overseas. Full details and a membership application form can be found on our website http://www.ukdisplaylighting.net.

MISSION STATEMENT OF THE UK DISPLAYS & LIGHTING KTN

The UK Displays & Lighting KTN is committed to support the displays and lighting communities (SMEs, OEMs, academics) in the UK:

- From the science base, through the manufacturing sector to the end user
- From the point of scientific invention, through "fit for purpose" use in its operating lifetime to the implementation of recycling and waste management at "end of product life".

These support activities are implemented with a clear focus on increasing UK manufacturing, employment and wealth creation opportunities.

All change at the top! These are turbulent times: recent stock market fluctuations around the world have been a rude reminder of the global impact of adverse activities in any of the major developed countries. With the backdrop of financial unease, and the implementation of major change in political structure here in the UK, we have also experienced a major change in the implementation of government strategy to support Innovation in Industry.

In July, the UK Government's Department of Trade & Industry underwent a major transition, splitting to form two new departments: Business, Enterprise and Regulatory Reform (BERR) and Department of Innovation, Universities and Skills (DIUS). In addition the responsibility for developing the content of, and delivering, Innovation has been transferred by DIUS to a new Non-Departmental Public Body called the Technology Strategy Board. The Technology Strategy Board is located in Swindon, adjacent to the Science Councils.

The Technology Strategy Board has assumed full responsibility for running the Technology Programme, which is the vehicle established by the former DTI to support Collaborative Research and Development and Knowledge Transfer within all sectors of UK Industry. As a result, all of the Knowledge Transfer Networks (KTNs) and Knowledge Transfer Partnerships (KTPs) will be managed by the Technology Strategy Board. The Technology Strategy Board is a completely "new" body, and is recruiting staff to be able to deliver its

commitments. Fortunately, the recruitment of staff within "our" sector has been completed, and I am pleased to confirm that Michael Biddle has been appointed by the Technology Strategy Board to be our "Connector", and will assume responsibility for liaising between UKDL, our members, and the management team of the Technology Strategy Board. Michael will be a regular visitor, and speaker, at our events around the UK, so there will be plenty of opportunity for members to network with him. The Lead Technologist within the Technology Strategy Board for our sector is Nick Appleyard, and he will also be a regular visitor to and participant in our events.

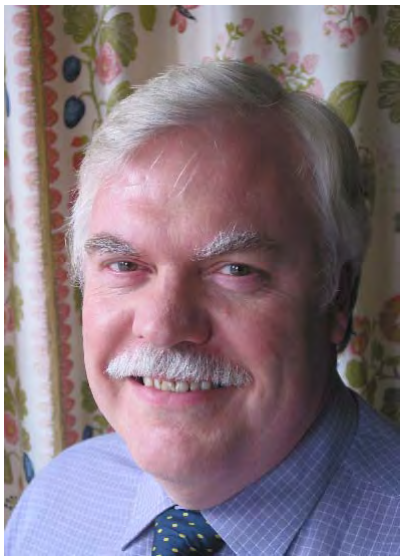
Plastic electronics – the revolution advancing over the horizon: Those of us who have been fortunate to work in the electronics industry in the last 30 years have seen tremendous change – from the first commercially available discrete transistors to the present highly complex integrated circuit designs. Display and lighting technologies have also been transformed – and have transformed the world in the process. The very existence of personal computing and communication products was made possible by the availability of small, low power, electronic displays. Today, the liquid crystal display built on a glass substrate is ubiquitous, and whilst there are many different types of display technology that compete with LCD in the market, LCD is definitely the king!

But all of this may be changing. As the "king" of LCD increases in complexity and size, so the cost to establish a manufacturing facility soars. As with silicon-based semiconductors, the manufacturing base for displays built on glass is increasingly being restricted to companies with very deep pockets and huge financial and technical resources.

If we look into the labs at the universities, and on the development benches at companies around the UK, a new technology platform is emerging. Plastic electronics, using organic carbon-based materials as semiconductors, offer a promise for "very low-cost" manufacturing in the future. Manufacturing plants are predicted to cost much less than those for conventional semiconductor and display manufacturing, and the materials cost of "like for like" devices is predicted to be lower. The manufacturing processes will be low-temperature, allowing the functional materials to be deposited and patterned on plastic and even paper substrates.

We aren't there yet – the current "state of play" is comparable to the state of the silicon semiconductor industry back in the 50's and 60's, but progress is rapid and we can expect to see the first "real world" products emerging onto the streets in the next year or so. The activity level in and around the UK is extremely high – of UKDL's 600+ membership, more than 500 are registered as having an active interest in the field of plastic electronics.

Plastic electronics has the opportunity to disruptively change our world – for the better. We are at the ground floor of this revolutionary technology platform, and the prospects look great! We will use the UKDL newsletter as one of the key ways to tell you about the activities and progress here in the UK.



To receive more information about displays, lighting and plastic electronics activities in the UK, please look at our website www.ukdisplaylighting.net, or e-mail us directly at info@ukdisplaylighting.net

I hope you enjoy reading this issue of the UKDL Newsletter. If you do – tell your friends. If you don't – tell us! We welcome all feedback about the information we present, and will be pleased to receive your comments.

With best regards,

Chris Williams
Director
UK Displays & Lighting KTN

Display and lighting news from around the UK

excerpted from Veritas et Visus newsletters

Max Lyons shows off high-resolution images from England

Photographer Max Lyons newly added several high-resolution images from a recent trip to England using PTAssembler and Panorama Tools. Lyons' site carries a wealth of examples of large files comprised of photos that have been stitched together. The website also offers some instructions on how to stitch together multiple images so as to create super-high-resolution image files. http://www.tawbaware.com/maxlyons

The upper left image is of the interior of the Ely Cathedral. Shot with a Canon 20D with a combined field of view of 85 degrees. The image measures 14661x9677 pixels (135.3 megapixels) and is comprised of 3x8 images. The upper right image is of an ultra-wide (180 degree) view of the Great Court at the British Museum. Lyons advised that "the people wandering around made this image a real challenge to blend correctly. Some people ended up getting captured in two different locations". The image measures 14330x8756 pixels (119.7 megapixels). The lower image is at the British Museum. Lyons advises, "Because no tripods are allowed inside the reading room, I had to prop the camera up on a desk to shoot the eight images in this panorama." The image is 12703x4182 pixels (50.7 megapixels).

DTI releases WEEE guidance notes

As guidance notes go it's a pretty long document, but on February 28th the UK's Department of Trade and Industry launched its document on compliance with the WEEE directive. Manufacturers of electrical and electronic equipment in England and Wales had until March 15th to join and approved compliance scheme, with the directive coming into law on July 1st. http://www.dti.gov.uk/files/file37923.pdf

Promethean Activboards used in BBC's "Waterloo Road"

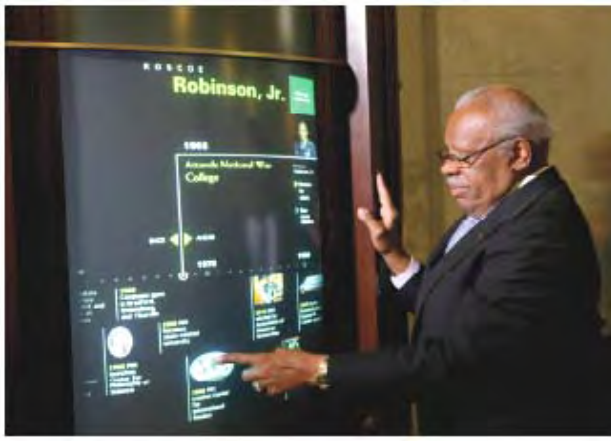
Art has imitated life in the current series of BBC drama, "Waterloo Road", after its failing comprehensive school introduced Promethean Activboards. Drawing inspiration from the interactive teaching revolution that is taking place in the UK, Waterloo Road implemented Promethean Activboards, with Activstudio software, to ensure storylines stayed true to real life. Producers called on Promethean to deliver a series of training sessions to the cast and crew. http://www.prometheanworld.com

Promethean integrates Activboard+2 with Sanyo projector

Promethean announced a new addition to its Activboard+2 family. Building on its long-standing relationship with Sanyo, the company can now offer the Activboard+2 with an integrated Sanyo XL40 projector. Attached by a strong steel arm, the Sanyo XL40 short-throw projector is positioned just one meter away from the board. Activboard+2, the first interactive whiteboard anywhere in the world to incorporate projector and whiteboard as one product, has new features. The integrated projector reduces the "shadow effect" meaning presenters and trainees can interact with the board with no obstructions. The board is height-adjustable for maximum presenter/learner comfort. The system comes with Promethean's Px interactive software, a set of speakers and an amplifier. http://www.prometheanworld.com

Zytronic helps undergraduates get in touch with university's heritage

Zytronic has combined its ZYTOUCH projected capacitive technology (PCT) with rear projection film, as the only solution capable of meeting all the requirements for a large, walk-around, permanent interactive exhibition at the University of Pittsburgh, Pennsylvania. The Legacy Gallery exhibition has been created by Pittsburgh-based design solutions innovator ThoughtForm and comprises large electronic displays as kiosks, 10 feet tall and 8 feet in diameter. Each of the two islands feature six outward-facing, curved, interactive displays that tell the story of the university's 220-year history, its people, and its present-day activities, illustrated through text, still images and video. One smaller, interactive touch screen also forms part of the display, and enables look-up of hundreds more alumni, faculty, and students of distinction. Zytronic's laminated-glass touch screens with bonded rear projection film combine with classical cabinetry and brass metalwork to complete the effect. ZYTOUCH provided ThoughtForm designers the freedom to design large touch-sensitive graphical displays, curved to match the radius of the islands, and capable of showing bright, clear images using rear projection technology. In combination with this design flexibility for the displays, Zytronic's PCT was the only sufficiently robust touch technology compatible with the screen sizes and curvature visualised by ThoughtForm designers in the original concept. Zytronic's PCT sensing uses micro-fine capacitors embedded within the front panel of the display to detect when a user touches the screen and locate the position. Each capacitor is in the form of a human hair-size wire that is connected to an integrated electronic controller board, which generates a signal at a particular frequency for each wire. When a conducting stylus touches the glass surface of the sensor, a change in capacitance occurs. This results in a measurable frequency change in the capacitors surrounding the contact point and the integrated controller then calculates the X-Y coordinate position and communicates this to the host controller. http://www.zytronic.co.uk

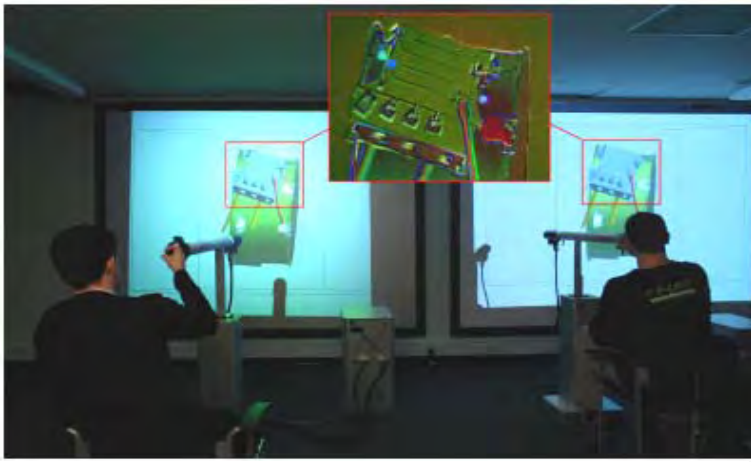


Countdown clock switched on for UK digital TV switchover

A countdown clock has been switched on in Whitehaven harbor to mark the countdown towards the UK's first switchover to digital TV. Digital UK has installed the clock to inform people how many days, hours, and minutes are remaining before analog TV signals start being turned off on October 17. An online version of the clock has also gone live at http://www.digitaluk.co.uk.

University of Manchester shows haptic interaction without time-lag across the Atlantic

Researchers at the University of Manchester, working with a team from the University of North Carolina at Chapel Hill in the US, have developed a system that employs a "time-travelling" technique to make interaction tasks more seamless. At the IEEE Virtual Reality conference in March 2007, they presented a system that enables, for the first time, effective transatlantic cooperative haptic manipulation of objects whose motion is computed using a physically-based model. They propose a technique for maintaining synchrony between simulations in a peer-to-peer system. A CAD assembly task, using physically-based motion simulation and haptic feedback, was carried out between the US and the UK with network latencies of the order of 120 ms. They compared the effects of latency on synchrony between peers over the Internet with a low latency (0.5 ms) local area network. Both quantitatively and qualitatively, when using the new technique, the performance achieved over the Internet is comparable to that on a LAN. As such, this technique constitutes a significant step forward for distributed haptic collaboration, the researchers say. Three major factors make haptic cooperation over the Internet challenging. Firstly, maintaining both local responsiveness and consistent simulation state for distributed participants is difficult. Client/server approaches suffer round-trip communication delays, whereas peer-to-peer systems are difficult to synchronise. Secondly, latency, especially over large distances, is unavoidable. Network latency adversely affects the stability of haptic rendering, as an object can be penetrated before its correct position is received, resulting in disconcerting rebounds. Thirdly, haptic rendering must be performed at a 1kHz update rate (or better) for correct perception of solid contact. The system adopts a peer-to-peer architecture to maintain local responsiveness; over the Internet conditions tested, it reduces positional and rotational divergence between objects at each peer to 0.02 mm and 0.03–0.04 degrees respectively. This is achieved through the separation of objects simulated at each peer into globally correct and locally perceived representations. Synchrony between globally correct representations is maintained through event ordering using a consistent global time co-ordinate frame, while local responsiveness is achieved through an optimistic simulation and rollback mechanism. The system decouples haptic display, simulation, and graphical rendering into asynchronous components so that each can run at appropriate rates. Although there are avenues for future research, the technique in its current form enables very effective haptic cooperation over the Internet, the researchers say.



Two users performing the task with simulated latency equivalent to the WAN condition (120ms) and synchronization/prediction

Touch4 selects Zytronic for 17-inch touch-screen technology for kiosks

Zytronic's ZYTOUCH touch sensors are behind a new generation of interactive kiosks that use durable, high-visibility 17-inch touch screens. Suitable for a wide range of retail, hospitality and commercial applications, the new GP2 range from kiosk specialist Touch4 includes products for indoor and outdoor use and very harsh operating environments. Kiosks in the Touch4 GP2 family incorporate a 17-inch high visibility screen with maximum resolutions to 1280x1024. Touch accuracy is better than 1 mm, while the ZYTOUCH-based design ensures resistance to contamination and allows Touch4 to provide safety glass over the screen as standard. Zytronic's ZYTOUCH, incorporating projected capacitive technology (PCT), also ensures that Touch4 kiosks can be used with gloved and ungloved fingers – a key feature for outdoor kiosks that will enable them to be used year-round. ZYTOUCH, which works by projecting the sensing field forward, in front of the sensor array, enables designs that can detect contact when the sensor is located behind a glass or polycarbonate panel up to 20 mm thick. This allows the touch sensor array and control circuitry to be positioned entirely inside the enclosure. http://www.touch4.com

Eleksen fabric touch panels selected by Intel for UMPCs and MIDs

Eleksen Group, the inventor and manufacturer of ElekTex smart fabric touch pads for consumer electronics, has been selected as an UMPC ecosystem partner by Intel to deliver a range of ElekTex-based solutions for Intel based Ultra-Mobile PC (UMPC) and MIDs (Mobile Internet Devices). Eleksen will have an array of working reference designs, prototypes and concept designs based on a variety of ElekTex sensor designs and control electronics that can be easily integrated into an OEM mobile computing accessories product. Fabric-based ElekTex data entry sensors can be integrated into device bags and protective cases for UMPCs and MIDs, enhancing the usability of the device without sacrificing its portability. http://www.eleksen.com

Photosynth used in *Britain in Pictures: BBC Collection*

Since the beginning of the year, Microsoft Live Labs have been working with the BBC on a time limited technical trial of the Photosynth technology in support of the "How We Built Britain" television series. Viewers will be able to explore synths of Ely Cathedral, Burghley House, the Royal Crescent, Bath, the Scottish Parliament Buildings, and Blackpool Tower Ballroom. The BBC will also have units on location at each of the historic sites to collect images from tourists visiting the sites that Microsoft will add to the synths. The Trafalgar Square effort also features some historical photography to provide a unique contrast to the locations past. http://labs.live.com/photosynth/bbc

De Montfort University paves the way to 3D television

Three-dimensional television in the home could become a reality thanks to a multi-million pound project to develop a new system led by researchers at De Montfort University, Leicester, UK (DMU). The Multi-User 3D Television Display (MUTED) project aims to develop a practical 3D television system, which has not been achieved before. The project is worth Euro 4.5 million (roughly £3 million) and is supported by Euro 3 million (about £2 million) of funding from the European Commission's Framework 6 program. Researchers at DMU's Imaging and Displays Research Group (IDRG) are leading the work to create a 3D viewing experience without the need for special glasses. Several viewers will be able to watch the screen at the same time and will also be able to move around the viewing room and still see 3D wherever they sit. The project will also investigate ways in which 3D technology can enhance medical scans, allowing doctors and scientists to explore the resulting images in greater detail using 3D displays. There are six other participants in the consortium: Fraunhofer HHI, Germany; the Eindhoven University of Technology, the Netherlands; University of West Bohemia, Czech Republic; Sharp Laboratories of Europe; Biotronics3D; and Light Blue Optics. The MUTED display will be the first system to use colour lasers, holographic projection technology and a new optical system design. http://www.dmu.ac.uk

FUJIFILM Dimatix supplies UK's Xennia with advanced ink jet technology

FUJIFILM Dimatix announced that it has extended its relationship with UK-based Xennia Technology Limited in supplying Spectra printhead technology for the high-precision XenJet 4000 and XenJet 5000 materials deposition systems. The XenJet 4000 is a high precision, 3-axis development system for accurate functional materials' dispensing that is now available from Xennia with FUJIFILM Dimatix Spectra SE-128 printheads. The XenJet 4000 uses a fully programmable XYZ motion stage with sub-micron resolution and repeatability of +/-5um over an A4 print area. The Spectra SE-128 is a high-performance jetting assembly designed for a broad range of high precision jetting and micro-dispensing applications. The Spectra SE-128 includes a nominal 30-picoliter calibrated drop size, excellent jetting straightness and channel-to-channel uniformity. Constructed of materials compatible with a wide range of aliphatic and aromatic hydrocarbon solvents as well as acidic aqueous solutions, Spectra SE-128 printheads can handle a broad range of functional fluids including organic solvents and UV-curable fluids. http://www.xennia.com.

Less than 20% of UK companies signed up for WEEE compliance schemes

According to representatives of the UK's Environment Agency and Environ, less than 20% of those UK companies required to comply with the WEEE directive had signed up to compliance schemes by the deadline of March 15th. Much of the blame is being put on the Department of Trade and Industry's failure to release the guidelines on schedule. The Environment Agency's position is that they're still encouraging businesses to join compliance schemes and will not be prosecuting immediately. Sadly this is a classic example of one branch of government having its hands tied by the failure of another, however the directive itself has been well publicised and it is reasonable to expect that after a period of grace due to the delay of the guidelines the Environment Agency will be keen to implement the directive. http://www.environment-agency.gov.uk

Glasgow University researchers test out tactile feedback on underground trains

At the CHI 2007 conference, April 28–May 3, San Jose, California, researchers from Glasgow University in the UK presented a paper entitled "Tactile Feedback for Mobile Interactions". They investigated the use of vibro-tactile feedback for touch-screen keyboards on PDAs. Such keyboards are hard to use when mobile as keys are very small. They conducted a laboratory study comparing standard buttons to ones with tactile feedback added. Results showed that with tactile feedback users entered significantly more text, made fewer errors and corrected more of the errors they did make. They ran the study again with users seated on an underground train to see if the positive effects transferred to realistic use. There were fewer beneficial effects, with only the number of errors corrected significantly improved by the tactile feedback. However, they found strong subjective feedback in favour of the tactile display, suggesting that tactile feedback has a key role to play in improving interactions with touch screens. The paper presents a study into the use of tactile feedback for an on-screen PDA keyboard where a stylus (or finger) is used to press the keys. Entering text on such keyboards is problematic as the keys are small (less than 1 cm^2 on a PDA). Trying to do this whilst mobile makes interaction even harder as the PDA and stylus are both moving. Particularly difficult situations are on buses or trains, which can be very bumpy, yet these are situations where people often want to read/send e-mail, browse websites, etc. on their way to work. The aim of the work was to look at the effects of tactile feedback from key presses with a stylus to see if performance could be improved. The iPAQ the researchers used for the study did not include a vibro-tactile actuator so they added an external EAI C2 tactor. This was connected via the headphone jack. It was placed at the top right corner of the iPAQ so that the index finger of a right-handed user would rest on it. They used simple tactons (tactile icons) to represent different aspects of the button interaction. They used two stimuli: one to indicate a successful button press and one to indicate an error. They ran the same experiment again but this time users were seated on a train on the Glasgow city underground. The studies showed that tactile feedback provides significant benefits for keyboard interactions on touch-screen devices, both in static situations and more dynamic, mobile ones. Such feedback is likely to help all button interactions on touch-screens, not just text entry, which would be a considerable benefit as buttons are very common. Giving tactile feedback via the device rather than the stylus also means that users would get the benefits even if using a finger to press the buttons. A key recommendation from this work is for PDA and smart phone designers to use tactile feedback in more of the interactions with their devices as an easy way to improve usability. http://www.dcs.gla.ac.uk/gist/

The vibro-tactile actuator on the back of an iPAQ

Cenamps and CPI host PETeC groundbreaking in North East England

On July 27, Cenamps, in partnership with the Centre for Process Innovation (CPI), hosted a groundbreaking ceremony for the Plastic Electronics Technology Centre (PETeC), which is set to establish North East England as a global leader in the application of plastic electronics. The first spade was inserted into the ground, formally starting construction of the £10m project at NETPark, County Durham, where the new facility is to be based and operational facilities will come on stream during 2008. PETeC is a new resource for prototyping and small volume manufacturing of plastic electronics. http://www.cenamps.com

BGS and Virtalis collaborate to create geological modelling system

The British Geological Survey (BGS) and Virtalis collaborated to showcase geological modelling at the European Association of Geoscientists and Engineers' (EAGE) Conference in mid-June in London. Their GeoVisionary development enables the visualization of underlying geological modelling in 3D and allows other related geo-science data, such as geo-technical, environmental and geo-chemical information to be overlaid onto it. The two teams first collaborated two years ago, when the British Geological Survey (BGS) installed two identical Virtalis StereoWorks visualization systems. Andrew Connell, technical director at Virtalis, commented:

> "What marks GeoVisionary out is the quality and detail of the images we have achieved and its speed. It is possible to "fly" to any part of the UK in seconds. Nor do you need a powerful workstation to operate GeoVisionary. We designed the System for geologists in the field using laptops. Even so, there are 70 billion triangles in the data set and 15 trillion pixels in the images which is understandable when you consider there are height measurements every five meters and photographs of the terrain give a pixel for every 25 cm. We have built in seamless streaming, merging detailed pictures, geological notes, historical maps and subsurface data from boreholes in real time. GeoVisionary is infinitely scalable because the system only remembers where it is looking at any given moment. Each field of view comprises 2 million triangles which are updated 100 times a second. The novel data formats give the ability to visualise as you fly, continuously streaming both geometry and photography to imperceptibly update the world around you, giving a landscape that rapidly morphs before your eyes. It is visually stunning and highly useable."

GeoVisionary was designed in such an open way that it is not limited to the British shores or BGS data. BGS has already used the application to validate and plan projects internationally. BGS has also gathered planetary data and investigated how best to view such data. http://www.bgs.ac.uk

Aerial photography UKP/Getmapping based on NEXTMap Britain elevation data from Intermap Technologies

Sumitomo Chemical to acquire CDT

On July 31, Sumitomo Chemical and CDT jointly announced that they have entered into a definitive merger agreement whereby Sumitomo Chemical will acquire CDT. Under the merger agreement, Sumitomo Chemical will acquire all outstanding shares of CDT common stock at a price of $12 per share in cash, for an aggregate purchase price of approximately $285 million. The merger consideration represents a 107 percent premium over CDT's 90-day average closing share price and a 95 percent premium over CDT's closing share price of $6.15 on July 30. Completion of the merger is subject to CDT stockholder approval and other customary closing conditions. The acquisition is expected to close during the third or fourth quarter of 2007. http://www.cdtltd.co.uk

CDT, Thorn Lighting and Durham University collaborate on white lighting

CDT announced that in collaboration with Thorn Lighting and the University of Durham, the company has been awarded a £1.6 million grant by the UK Department of Trade and Industry-led Technology Programme. The grant will part fund a three-year project to develop solution processable organic materials and device architectures suitable for large area white lighting applications. The total project cost is £3.3million. Under terms of the grant, CDT through its Sumation joint venture will provide materials, device architecture and testing, modelling, and technical input. The project is aimed at developing materials and devices for solid-state, high efficiency lighting applications based on CDT's patented polymer OLED technology. Successful completion of this project will offer novel lighting products with environmental benefits.
http://www.dti.gov.uk/innovation/technologystrategy

CDT showcases 160 ppi 3-inch OLED

CDT showcased a high-resolution 320x240 OLED at the SID 2007 Conference in Long Beach, California. The 160-ppi three-inch full colour display incorporates CDT's polymer OLED technology and was produced by CDT using a Litrex Gen 2 inkjet printer on amorphous Si TFT substrates provided by Casio. The company stated that since starting the project in fall of 2006, CDT has been able to demonstrate that it can achieve the accuracy required to produce the displays over 14-inch substrates. The achievement of printing 160 ppi high resolution is the combination of Casio backplane design, Litrex printer droplet accuracy, CDT's know-how on ink formulation, and optimised print strategy. "With materials development progressing rapidly via our Sumation joint venture and inks and printers becoming more robust, the opportunity for companies like Casio to adopt a P-OLED based commercial solution for displays continues to grow," said Dr. David Fyfe, chairman and CEO of CDT. http://www.cdtltd.co.uk

CDT wins grant to develop organic TFTs

Cambridge Display Technology (CDT) announced that it has been successful in its application for a 2006 Fast Track grant to develop electronic design automation software (EDA) for use in organic TFT-based (OTFT) electronic applications. This not only marks the entry of CDT into the OTFT space but will also be important in the development of displays using OTFTs, in particular flexible displays based on plastic substrates. The project will extend the use of EDA software to organic semiconductor (OSC) materials, and accelerate the development of low-cost fabrication techniques for organic displays on both flexible and rigid substrates. The grant, for approximately $500,000, has been awarded by the UK Department of Trade and Industry's Technology Programme to a small consortium led by CDT and including Silvaco International, one of the leading providers EDA simulation software. http://www.cdtltd.co.uk

CDT and Sumation announce improved lifetimes for polymer OLEDs

Cambridge Display Technology (CDT) and Sumation announced new and improved results for green and blue polymer OLED materials. Data from spin coated devices using a common cathode and a recently developed solution processable green polymer OLED material demonstrate lifetimes of 50,000 hours from an initial luminance of 1000 cd/m^2. This is equivalent to over 285,000 hours from an operating brightness of 400 cd/m^2 for this material and represents a 40% increase in lifetime compared to results announced in March 2007. Blue materials have now been developed with a demonstrated lifetime of 10,000 hours from an initial luminance of 1000 cd/m^2 (or 62,000 hours from an operating brightness of 400 cd/m^2) and a deeper colour. CIE chromaticity coordinates for previously reported blues were x=0.14, y=0.21, whereas the latest materials are much deeper (x=0.14, y=0.19). Developing red, green and blue materials with the right colour point is particularly important for full colour display applications from which richness of colour is increasingly being expected and demanded by consumers. http://www.sumation.co.uk

CDT wins grant for fluid dynamic simulation research

CDT has been awarded another grant by the UK Department of Trade and Industry (DTI). This grant will part fund a project, which will be important in the field of low cost organic electronic devices, and especially in the development of low cost flexible displays. The total value of project is around $500k. The project will aim to develop commercially viable computational fluid dynamic (CFD) simulation techniques to model the drying behaviour of organic semiconductors. Until now, the production of working display prototypes has required the use of empirical data, which is both expensive and slow to obtain. Using the new models, the development cycle time should be significantly reduced. Working with lead partner CDT on this project is ANSYS Europe which has many years experience of multiphase free-flow modelling. ANSYS Europe will implement the models for organic semiconductor drying behaviour in order to provide predictive tools within its ANSYS CFX software, which should lead to further understanding of the complex drying process. When completed, the materials process model will itself be made available commercially by the partners to display makers wishing to accelerate their own polymer OLED display developments, as well as helping CDT to improve the performance and time to market of its own range of inkjet inks. http://www.cdtltd.co.uk

Screen Technology offers scalable modular iTrans display solution

England's, Screen Technology, along with their Italian manufacturing partner, Hantarex, created a scalable modular display based on Screen Technology's iTrans optical design. The display pictured is configured at 125 inches but because it is completely scaleable, users can achieve almost any desired shape or size. At a 1.7 mm pixel pitch and sunlight readability at wide viewing angles, Screen Technology is targeting the large-area signage market that is currently dominated by LED-based solutions. iTrans displays are made from tiles which can be assembled to make essentially any rectilinear shape or size. Each iTrans module measures 17 inches at the diagonal, at a resolution of 204x152 pixels. The iTrans optical design eliminates sub-pixellation and the image break-up associated with LEDs and Plasma displays when viewed too close. This ensures that text is readable from all distances. iTrans displays have a typical luminance of 2000 cd/m^2.

Pictured with a 12-5-inch display is Tom Jarman (left), CEO of Screen Technology and Giacomo Taffelli, president of Hantarex.

Meanwhile, Screen Technology recently reported a net loss for the year of £4.7 million, compared to a loss of £2 million last year. The company expressed disappointment at the delays it had experienced in bringing its high-speed tile assembly machinery into full production, but expects it to be fully operational in the second half of the year. http://www.screentechnology.com

Electronics Yorkshire launches e-learning courses

Electronics Yorkshire, based in Leeds, UK, launched the first in a series of online courses aimed at the professionals in the electronics industry. Courses currently available include Lead-Free Soldering and Electrostatic Discharge (ESD) Awareness. The soldering course introduces production staff to the key issues associated with the RoHS and WEEE Directives. More courses, including Advanced Surface Mount Techniques, should be online soon. See www.electronicsyorkshire.org.uk

Pufferfish sphere puts the emphasis on 3D inflatables

While virtual reality systems are getting better at immersing us in a simulated experience of reality, one UK business has developed a visually arresting yet surprisingly simple solution. Born out of the collaboration between Will Cavendish, an architecture student at Edinburgh University, and Oliver Collier, studying music technology, the PufferSphere, and soon to be released Puffer Immersive Mobile Sphere (PIMS), provides a 360-degree viewing window. The PufferSphere system includes projection, specific lens technology and computer equipment fitted in to a base unit pod from which the screen inflates to an imposing three meters tall. Cavendish says, "It's like a balloon. All of our products at this stage involve inflatables. We can use the screen in any way that we can use a flat screen. Cavendish describes the PIMS as the natural next step. "There's a huge growth in 3D modelling software but little development of how we can view it. Our latest product allows us to take the immersive experience of virtual reality and take it to the client. The PIMS can be set up on site and allows a group of people to be fully visually immersed within an environment at a human scale." http://www.pufferfishdisplays.co.uk

OLED-T host boosts OLED lifetime and efficiency

OLED-T announced a new patented host material for OLED displays that delivers significant performance benefits compared with existing materials. The host layer is a crucial layer in the make-up of an OLED display as it impacts its performance including efficiency and lifetime. The new OLED-T material, called E746, is targeted as a direct replacement and upgrade path for aluminium quinolate (Alq3), the host material most commonly used throughout the OLED industry. OLED-T has developed E746 for OLED displays in the mobile market such as mobile phones and digital cameras where its power consumption and lifetime performance benefits are expected to deliver improved product performance. In fluorescent red and fluorescent green customer OLED display devices, OLED-T's E746 material outperforms Alq3 in terms of energy efficiency, colour co-ordinates, lifetimes and voltage drift. E746 enables OLED displays to be manufactured with a current efficiency increase of between 30% and 50%, a power efficiency improvement of as much as 45 to 80% and a lifetime increase of 100% for fluorescent red and 200% for fluorescent green. The new E746 material is manufacturing process compatible with Alq3. It has a lower toxicity than aluminium based materials and is thermally stable up to 350ºC. Available in kilogram quantities for customer testing, E746 is provided in a powder form that can be deposited onto a substrate by vacuum evaporation coating methods. OLED-T is currently developing a variant for blue OLED displays. http://www.oled-t.com

Pelikon and Supertex expand collaborative efforts on segment drivers

Pelikon, the UK-based manufacturer of printed segmented electroluminescent (pSEL) displays, and Supertex, a manufacturer of high voltage analog and mixed signal integrated circuits (ICs), have announced the extension of their collaboration to sell their jointly developed Pelikon Segment Drivers (PSDs) under the Supertex brand. As a result, Pelikon will be able to leverage Supertex's sales network to expand the market for PSDs as well as Pelikon Display Controllers (PDCs). http://www.pelikon.com

Xaar launches new printhead for display manufacturing

Xaar recently demonstrated its piezoelectric inkjet technology and applications for the electronic-display sector. The new Xaar 1001 GS6 offers makers of display manufacturing equipment considerable commercial advantage through outstanding precision, productivity, and reliability. Designed for high-speed, high-repeatability applications, the Xaar 1001 GS6 printhead is based on Xaar's patented Hybrid Side-Shooter, TF Technology. With dynamically variable drop sizes, this new printhead architecture offers non-contact materials deposition for new manufacturing techniques within the display industry. http://www.xaar.co.uk

US footwear retailer takes up QinetiQ 3D gauges

Stride Rite, the US children's footwear retailer and manufacturer, has purchased 30 QinetiQ FootSee 3D foot gauges, a system designed to produce highly accurate foot measurements. Foot gauges have been successfully trialed in three Stride Rite stores in the Boston area since November last year. FootSee is already in widespread use in the UK, with hundreds of foot gauges installed with a leading British footwear retailer. The device uses six 3D camera systems and measures customers' feet quickly and accurately, providing highly detailed length, girth and shape data and helping to ensure the best fit possible. The recorded 3D data can also enable trend analysis, assisting future footwear design and improving stock control and the efficiency of in-store service. Stride Rite and other US footwear retailers currently use manual methods to measure customers' feet. The foot gauge is based on innovative 3D optical ranging technology developed and patented by QinetiQ. The origins of the technology can be traced back to work done for the UK Ministry of Defense on the detection of unexploded ordnance. The foot gauge captures data very rapidly and both feet can be scanned simultaneously, allowing store staff to decide quickly on the best fit. http://www.qinetiq.com

Plasma Quest deposits ITO onto glass and flexible substrates at ambient temperatures

Plasma Quest announced in June that it had deposited indium tin oxide (ITO) onto glass and flexible substrates at ambient temperatures using PQL's "High Target Utilization Sputtering" (HiTUS) technology. Thin film coatings with a resistivity of $3.9x10^{4}$ Ωcm and an average transparency of approximately 90% in the 400 to 750 nm wavelength range have been deposited at 900Å/min. The company demonstrated that films deposited with a low partial pressure of oxygen exhibit poor transmission and low electrical conductivity. Increasing the oxygen flow rate produces films that are both transparent and conducting. The stability of the HITUS system enables run-to-run repeatability of these high quality coatings. In collaboration with Nottingham Trent University the ITO coatings deposited here at Plasma Quest are to undergo laser patterning trials to assess their suitability as electrode contacts for flexible, electroluminescent display technology. http://www.plasmaquest.co.uk

MicroEmissive Displays opens its new German manufacturing site

In early May, MicroEmissive Displays (MED) formally opened its new volume manufacturing facility in Dresden, Germany. The facility consists of a 396 square meter state-of-the-art cleanroom, with 16 manufacturing and technical staff, representing a total investment to date of more than $10 million. MED's eyescreen products are the world's only polymer organic light emitting diode microdisplays. For purposes of this newsletter, the most interesting part about MED's announcement was the image included in their promotional material. Claiming that "the innovative design of the eyescreen, with its integrated driver ICs and its digital interface, offers product design engineers a fast, robust design-in solution for smaller, lighter-weight, stylish products of the future, all for a size comparable with the pupil of the human eye", the image effectively superimposes a microdisplay over a human eye. http://www.microemissive.com

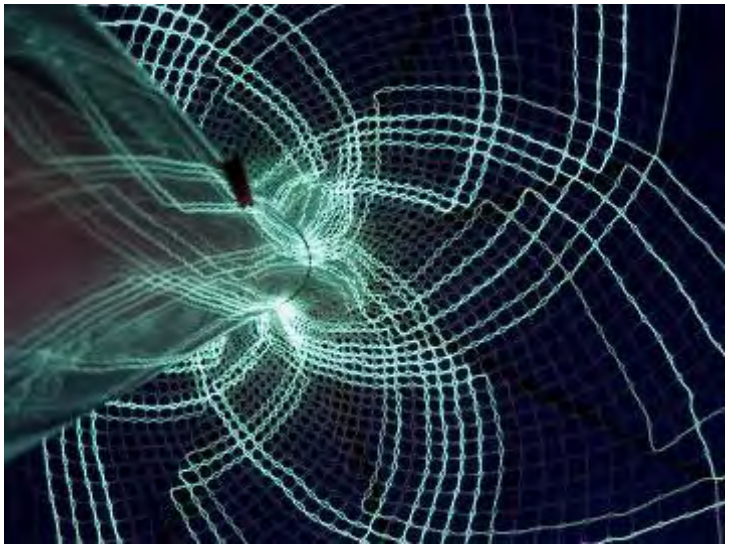
MED's microdisplay superimposed over the surgeon's right eye creates an effective visual image. Interestingly, despite the high-technology image, it also showcases the ubiquity of the very low-technology barcode label…

MED starts shipments from new Dresden production facility

On July 24, MicroEmissive Displays commenced shipments of microdisplays from its new Dresden manufacturing site, on schedule. The Dresden facility was officially opened in May of this year and has significantly enhanced MED's ability to manufacture its next generation eyescreen microdisplay product. Production volumes will ramp up in the second half of 2007 and the first half of 2008 in order to meet the growing demand which is reflected in additional "design in" projects and the signing of exclusive distribution agreements, to date covering Hong Kong, China, Taiwan, Singapore, Malaysia, India, Korea, Israel and much of Europe. http://www.microemissive.com

Loop.pH develops eco-friendly "Sonumbra" textile-based light source

Loop.pH recently showed off an initial version of its Sonumbra project in a responsive play space in Mowbray Park, Sunderland, England. It is designed to respond to the interplay and activity of the people orbiting the umbrella by casting a "sonic shade of light". The atmosphere of musical rhythms, harmonies and luminous patterns are composed by the visitors' movement - either active or passive. The light-emitting fabric of the umbrella is crafted into a lacework of many electroluminescent fibbers. This latticed pattern is animated in concert with the generated surround sound and visually illustrates the visitors' position within the constellation. For the long-term, the Sonumbra project is envisioned to provide an eco-friendly source of both shade and light for those parts of the world without consistent sources of electricity. "Imagine an outsize parasol planted in an African village. By day, it offers shelter from the sun: by night, it sheds light for the local community using the energy collected in solar cells embedded in its canopy. It explores a new role for textiles, and shows concern for the planet". The work was commissioned by Newcastle Gateshead Initiative and Sunderland City Council. http://www.visitsunderland.com

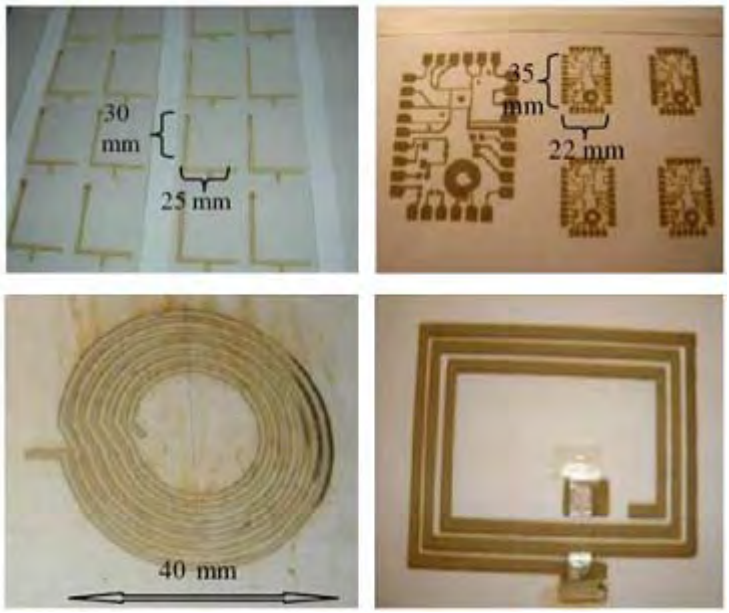


Acrongenomics, Molecular Vision, and Pearson Matthews to develop medical diagnostic device

Acrongenomics, Molecular Vision, and Pearson Matthews announced recently that they have joined forces to design a fully-manufacturable, prototype, point-of-care medical diagnostic device suitable for detecting kidney and cardiac biomarkers. The basis for the device will be the proprietary Molecular Vision technology, which uses organic light emitters and photo-detectors, coupled with microfluidics for the detection of biomarkers in bodily fluids. The diagnosis relies on the optical characterization of labelled biomarker molecules and can use fluorescence, absorption, chemiluminesence or any of the other usual optical detection methods. Molecular Vision recently signed a major development contract with Acrongenomics to jointly exploit and commercialise the technology. Pearson Matthews is a specialist design development company.
http://www.molecularvision.co.uk

Leeds University uses consumer inkjet printer to print electronic circuits

Researchers at Leeds University recently demonstrated a "standard Hewlett Packard inkjet printer with a solution of metal salts and water" could print out an actual electronic circuit. The mysterious "silver salt solution" and vitamin C mixture could be used to "pave the way for safer and cheaper electronics manufacturing". The researchers loaded two separate chambers in the printer's cartridge, which normally contain different ink, with the metal solution and the reducing agent. Using silver nitrate solution as the "metal ink" and ascorbic acid (vitamin C) as the reducing agent proved the most successful combination. They then programmed the printer to produce a variety of circuits and radio antennas on different surfaces including paper, cotton and acetate, all of which were placed in the printer like a normal sheet of paper. One test involved patterning an antenna like that used in a mobile phone on transparent film where it was reportedly possible to bend it almost in half without any loss of conductivity. After a circuit is printed using silver nitrate, vitamin C is overlaid a few minutes later. Water can then be used to wash away other products, leaving the silver behind. http://www.leeds.ac.uk



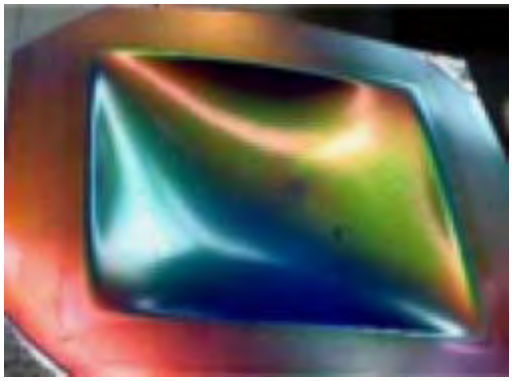
A standard office printer loaded with silver nitrate and vitamin C can produce (clockwise from top-left) mobile phone antennas, circuits, RFID chips and inductive coils on a range of surfaces.

UK Research Councils bear the cost of WEEE

The UK's Department of Trade and Industry (DTI) announced where it will find the money to pay for the cost of implementing the WEEE Directive. In the UK, public funding for science is allocated by a network of Research Councils who determine who and what is worth investing in. Until now the councils have been riding high on new investment in science, but the DTI will now take a £60 million chunk of the Science Budget to meet financial demands elsewhere, including implementing WEEE. The DTI estimates that the cost to the science budget of WEEE was £27 million for the period spring 2006 to 2007, which ironically is almost the same amount that will be deducted from the budget for the Engineering and Physical Sciences Research Council (EPSRC) – the very same body that funds research into recycling electronics. http://www.dti.gov.uk

Southampton and DKI scientists develop self-assembling polymer opal film

Scientists at the University of Southampton's Quantum Opto-electronics Lab in the United Kingdom and the Deutsches Kunststoff-Institut (DKI) in Darmstadt, Germany have developed a new type of self-assembling polymer opal film, which can be used to make objects that change colour when stretched. These polymer films are photonic crystals, made up of trillions of tiny spheres with holes between them similar to certain wavelengths of light. These holes preferentially reflect certain frequencies based on their precise size. Applications for the technology are still being considered, but for example, they could easily help see if some kinds of perishable food items are not good anymore because the packaging would change colour. They also could be used to detect fake money or in other defense and aerospace applications. http://quantopt.phys.soton.ac.uk/



Example of a polymer opal film

University of Bath leads Modecom OLED development consortium

An international research project, called Modecom, (Modelling Electroactive Conjugated Materials at the Multiscale) has begun that could help bring OLEDs to the mass-market. The project's goal is to help enable devices that are thin and flexible, such that lighting and electronic display screens could for the first time be created on almost any material, so that clothes and packaging can display electronic information. The devices' uses could vary from lighting that is many times more efficient than current bulbs to clothes whose colour can be changed at will and beer cans that display the latest football results.

Because these polymers are thin and flexible, they could be used in a multiplicity of ways:

- As a transparent window. This is like a conventional window during the day, but when it gets dark a switch is turned on and the entire window area emits light in a more efficient way than conventional or energy saving bulbs, promising huge savings.
- In garments which could change colour at the press of a button.
- In clothing, which displays strips of the polymer, which run off solar power, allowing electronic messages to be displayed which can be updated. This could be useful for the emergency services,
- In packaging for common goods that could be made to display electronic messages such as health warnings and recipes, or could emit light.
- As a source of solar power to top up mobile phones batteries.
- As lightweight, solar power sources that could be rolled up and stored and which would also be ideal for people requiring electricity in remote locations, such as field researchers, mountaineers, sailors and military personnel.

The consortium is led by the University of Bath in the UK, and has started with £850,000 pound for the 3-year project. The consortium consists of 13 groups from nine universities and two companies. Three groups are from the UK, six from the US, and one each from China, Belgium, Italy and Denmark. The European Union is funding the European and Chinese partners. The collaborators will work at the molecular level and also look at the workings of the device as a whole. This research will also aid the understanding of the polymer materials used in plastic electronics in applications such as electronic paper and intelligent labels on groceries. http://www.modecom-euproject.org

On the left is an impression of a policeman wearing an OLED jacket, and on the right is an impression of a yoghurt pot with an OLED-based warning. These are examples of the sort of solutions planned for development by the Modecom project.

Elumin8 and ABSEL cooperate to popularise EL

Elumin8 recently refreshed their website, revealing numerous additional works where they have helped create customised solutions using their innovative EL lamp technology. The French company ABSEL recently aligned with Elumin8 regarding architectural, design, and targeted projects on the European continent. Elumin8's lamps are arguably the most powerful on the market, with a nominal brightness of 208 cd/m² at 120V/400Hz for white phosphors. The chromatic value of the phosphors can be set to reach a warm white value ~X=0,36 ~Y=0,39. Elumin8 develops its own drivers to power the EL lamps, enabling optimised control of the lamp that results in extra-smooth gradations of light. Elumin8 has recently been highly involved into the inner lighting of the current new Jaguar concept car called C-XF. Supplying EL for the clusters, the dashboard, light into doors and around the car, under seats, the under face of the roof and around the engine. Elumin8 also recently developed a touch sensitive EL poster for an outdoor commercial advertising campaign. The animation turns on when a pedestrian applies his hand to the poster. Numerous other products are showcased on the websites of both companies. Elumin8 manufactures the products in Dorset, England. http://www.elumin8.com http://www.absel.fr

On the left is a collaboration with designer Matteo Messervy where Elumin8 produced an animated ceiling for the Alcatel Paris headquarters. On the right is a collaboration with designers Olivier Ferracci and Ginco in which Elumin8 produced and installed a wall and a floor display for Cite de l'Espace in Toulouse.

On the left is a project designed by Gentleman Jim entitled Eluminarium commissioned for the London International Architecture Biennale. On the right, Elumin8 collaborated with the Jaguar design team to produce internal lighting for the new CXF car. The car was launched this past spring.

Ceravision launches microwave powered light bulb

Ceravision announced that units of its new Continuum 2.4 lighting technology are available for evaluation by lamp and electronics manufacturers. Continuum 2.4 is a compact electrode-less lamp system, the first commercially viable bulb to be powered by microwaves. Patented internationally, it provides: a long stable lamp life, high brightness, brilliant colours, fast turn-on and extraordinary energy efficiency. Unlike competing environmentally friendly bulbs, Continuum 2.4 contains no mercury and is also inexpensive to manufacture using widely available components. Continuum 2.4 could make a major contribution to the development of environmentally friendly lighting. Lighting accounts for more than 20% of all energy usage and carbon emissions, and of this commercial and industrial lighting generates a massive 80%. Continuum 2.4 lamps are easily integrated into mass-market electronics, such as projection displays.

http://www.ceravision.com

The Blackstone Group acquires Klöckner Pentaplast Group

The Klöckner Pentaplast Group (Luxembourg) announced that an affiliate of The Blackstone Group (London, UK) has signed a contract to acquire the company and all its holdings from Cinven (London, UK) and JPMorganPartners. The Blackstone Group is one of the world's leading private-equity firms. The purchase price is 1.3 billion Euros ($1.8 billion). The management of the Klöckner Pentaplast Group will remain in place. http://www.kpfilms.com

Eleksen selected by Intel for UMPCs and MIDs

Eleksen Group, the inventor and manufacturer of ElekTex smart fabric touch pads for consumer electronics, has been selected as an UMPC ecosystem partner by Intel to deliver a range of ElekTex-based solutions for Intel based Ultra-Mobile PC (UMPC) and Mobile Internet Devices (MID). Eleksen will have an array of working reference designs, prototypes and concept designs based on a variety of ElekTex sensor designs and control electronics that can be integrated into a mobile computing accessories product. Fabric-based ElekTex data sensors can be integrated into device bags and protective cases for UMPCs and MIDs, enhancing the usability of the device without sacrificing its portability. http://www.eleksen.com

Glen Spectra updates PR-650 spectroradiometer

For nearly 15 years, the PR-650 SpectraScan from Glen Spectra has been the most widely used spectroradiometer in the world - the workhorse of the industry. The new PR-655 replaces the PR-650 with a plethora of enhancements. This makes spectrally based photometric and colourimetric measurements even easier. This portable battery powered instrument utilises a fast-scanning multi-element detector spectrometer with a spectral resolution of 3.12 nm per pixel. The system is controlled by a full 56 x 75 mm colour touch screen. Following a measurement, the PR-655 displays data and colour spectral and CIE graphs on the system display. The PR-655 design provides stand-alone operation - no PC required, even to see the spectrum. The PR-655 can be also controlled via the SpectraWin software over the USB or Bluetooth interface or using text based commands (Remote Mode). Other hardware features include AutoSync for automatically synchronizing to the source refresh rate ensuring the utmost accuracy, an external trigger port allowing remote measurement activation from a push button or peripheral device, a Secure Digital (SD) port for measurement storage, and a long lasting rechargeable lithium-ion battery. http://www.glenspectra.co.uk

Interview with Ifor Samuel from Lumicure

Ifor Samuel founded and directed the Organic Semiconductor Centre at the University of St. Andrews in Scotland since 2000. Prior to that he received his Ph.D. from Cambridge University with post-doctoral research at CNET-France Telecom, and set up his own research group at the University of Durham. He is the winner of the 2007 Beilby Medal and Prize awarded by the Institute of Materials, the Royal Society of Chemistry and the Society of the Chemical Industry. He is also one of the founders of a recent spin-out company from the University of St. Andrews called Lumicure, which uses wearable OLED lighting to help treat skin cancer lesions.

Before we discuss Lumicure, please tell us about the activities at the Organic Semiconductor Centre at the University of St. Andrews. The Organic Semiconductor Centre (OSC) brings together physicists and chemists to perform interdisciplinary research on organic semiconductors. We perform a wider range of measurements to understand both materials and the devices made from them, and we use that understanding to improve them. The centre provides lots of advanced equipment from femtosecond lasers to a scanning near field optical microscope which allow us to study both the photo-physical and electrical properties of materials and devices. This enables structure-property relations to be identified, and guides the development of improved materials.

One of the areas of research at the OSC is focused on organic semiconductor lasers. Please expand on your work in this area. Following the excellent progress in organic semiconductors for display applications, we now feel it is worth investigating them as laser materials. The idea is that they could give low-cost, flexible, easy-to-make, visible lasers, and the properties could be tuned by changing the material – many of the advantages that these materials have for OLEDs. The very strong absorption of organic semiconductors means that they can also have enormous gain, so organic semiconductor lasers can be very compact – micron cavity lengths are feasible. So far, all organic semiconductor lasers have been optically pumped i.e. another laser is needed to supply the energy to them which makes them lase. Along with other groups, we have worked on reducing the laser threshold so that small pump lasers can be used, and ultimately so electrical pumping could be achieved. To do this we've worked on the optical design and related the photonic band structure to the lasing behaviour. We've reduced the size of the pump laser from a laser which fills a lab, to a laser the size of a box of cooking matches, and more recently a very small gallium nitride laser, so we are making good progress. We've also demonstrated polymer optical amplifiers, an all-optical switch and femtosecond pulsing of a polymer laser.

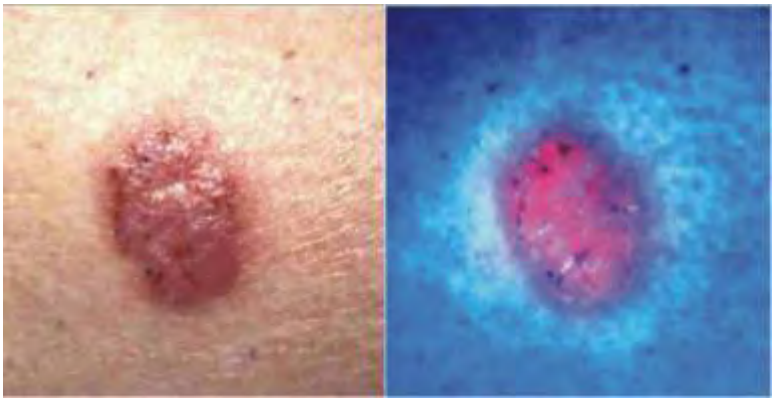
You've been working on light-emitting dendrimers for some time now. Tell us about the advantages that these materials offer over small molecule or polymer based OLEDs. Light-emitting dendrimers are highly branched molecules which consist of a core, branches and surface groups. The core defines the key electronic properties, whilst the surface groups control the solubility and processing properties. The advantage of this modular molecular architecture is that different parts of the molecule have different functions so it is possible to control the electronic and processing properties independently, and so make better materials. I've developed light-emitting dendrimers with Paul Burn (now at University of Queensland, Australia) and we've shown that they can give solution processed LEDs with efficiencies of up to 16%, 55 Cd/A or 46 lm/W. Hence they combine the very high efficiencies of small molecule OLEDs with the solution-processing convenience of conjugated polymers.

Why do you think the primary focus in the OLED market has been in the area of polymers rather dendrimers? The light-emitting polymers were invented much earlier, and much more resource has been put into their development.

Do you foresee commercialisation of dendrimer-based OLEDs any time in the near future? This really depends on CDT. I certainly think dendrimers are the ideal materials for highly efficient solution-processed LEDs, and could be commercialised quickly.

Lumicure is a spin-off company from the University of St. Andrews. Please tell us about the company. Lumicure is developing a new approach to skin cancer treatment and has developed and tested a wearable OLED light source that can treat common skin cancers. It's a very attractive alternative to surgery or conventional photodynamic therapy.

Tell us how photodynamic therapy works. Photodynamic therapy (PDT) involves the use of light in combination with a pharmaceutical cream to treat a tumour. The cream contains amino-laevulinic acid which is metabolised to a porphyrin. The porphyrin absorbs the light, leading to a photochemical reaction which kills the tumour. Current light sources are lasers or very large and powerful lamps, and the patient has to sit very still under them. Although it's very attractive compared with surgery, some patients experience a lot of pain. However, a very good feature is that the porphyrin preferentially forms in the tumour, giving excellent selectivity. You can see this in the photograph – on the left is a skin cancer, and on the right is the same lesion illuminated by ultraviolet light. The red fluorescence of the porphyrin marks out the tumour. It's so clear it's sometimes used for diagnosis as well as for treatment.



On the left is a photo of a typical skin cancer; on the right is the same lesion showing porphyrin fluorescence under ultraviolet light.

How did the idea to use an OLED light source for purposes of photodynamic therapy evolve? It came from a meeting with Professor James Ferguson who is Head of Photobiology at Ninewells Hospital in Dundee. We discussed our work and realised that organic LEDs could transform PDT by replacing large hospital-based light sources with a small wearable light source. This would mean that patients could walk around during treatment, no specialised equipment would be required and ultimately treatment at home would be possible. In addition a wearable light source would mean that lower light intensities could be used for a longer time. We expected this both to be more effective and reduce pain.

Can your solution help cure all skin cancers? Our approach can treat many, but not all skin cancers. It's not suitable for melanomas because they are so opaque. Fortunately they are also relatively rare. Our technique is ideal for superficial basal cell carcinomas, which are very common.

What do you envision is the size of the market for the Lumicure solution? We're still working on estimating the market size, but we do know that in the region of 10% of the UK population, 40% of the US population and a staggering 75% of the Australian population get at least one skin cancer in their lifetime. Alarmingly the number of skin cancers has been increasing rapidly – approximately doubling every 10-15 years.

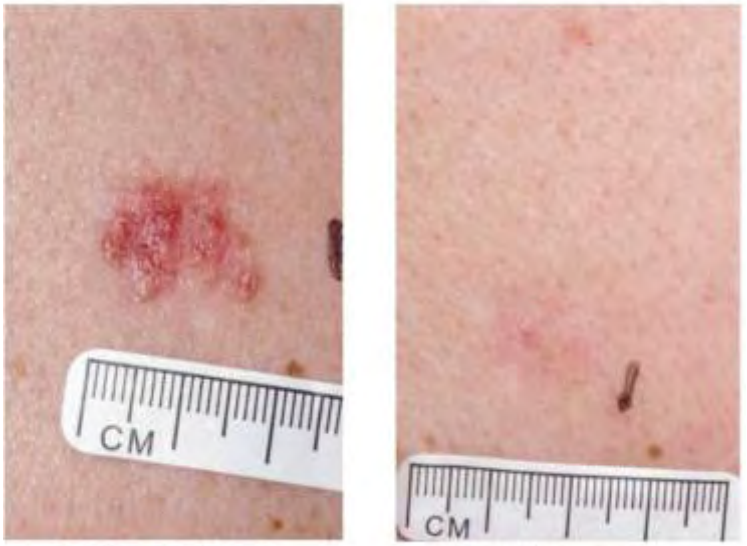
The OLED is packaged in a band-aide-like structure and applied directly to a skin cancer lesion.

Aside from skin cancer, do you see other medical conditions that OLED-based photodynamic therapy will address? OLED-PDT could also be useful for its anti-bacterial action – with applications from controlling hospital infections to dealing with inflammatory acne.

In trials to date, to what extent is the Lumicure solution effective in curing skin cancer lesions? So far we've conducted a pilot trial which has shown equivalent effectiveness to conventional PDT.

Is the treatment painful? No and this is a major advantage over conventional PDT. The lower light intensity means that patients do not experience significant pain. A small number of patients who have had both OLED-PDT and conventional PDT have expressed a strong preference for our approach. I remember meeting a patient who had suffered very bad pain with conventional PDT and had had to stop the treatment after only a minute. However he was fine with our lower-intensity treatment for a longer time.

Does the light cure leave any residual blemishes or other side effects? The cosmetic outcome of PDT (conventional or OLED) is very good compared with surgery – so it is often difficult to see where the lesion was.



Before Treatment After Treatment

About how much do you expect the treatment will cost? We envisage a disposable light source for OLED-PDT with a retail price in the region of 100 pounds ($200). Our approach is much less staff intensive than the alternatives, and does not need dedicated hospital space, so overall it could substantially reduce the cost of skin cancer treatment, whilst also providing a means to deal with a rapidly growing problem.

Will the treatment be as simple as an over-the-counter solution, or will a doctor need to be involved in the treatment? I envisage a doctor making the diagnosis and then being able to offer this treatment. Although it's very simple I can't see any cancer therapy being over the counter.

Your initial solutions are built on glass. Do you envision plastic or other flexible substrates in the future? Yes a flexible or conformable device would be ideal and exploit the advantages of OLEDs to the full.

Considering your background using dendrimer-based OLEDs, do you plan to use dendrimer or polymer materials in the Lumicure solution? Both classes of materials are suitable so it really depends what manufacturers can offer us.

What are the next steps in the development of the Lumicure product? We need to address the considerable regulatory issues for a medical device. This will involve a small amount of additional design work followed by a multi-centre clinical trial.

Are there any technical problems with which you are still struggling? We've already been able to treat patients, so have what we need really. Increases in power efficiency would always be welcome.

When do you expect the Lumicure product will be commercially available? We aim to launch the light-emitting sticking plaster (band aid) at the end of 2009.

How do you plan to produce the product? We'd like to subcontract the manufacture.

How do you intend to market the product? We envisage selling through distributors.

Please describe what you think Lumicure will look like three years from now. I expect Lumicure to be transforming the treatment of skin cancer.

Interview with Merv Rose from Quantum Filament Technologies

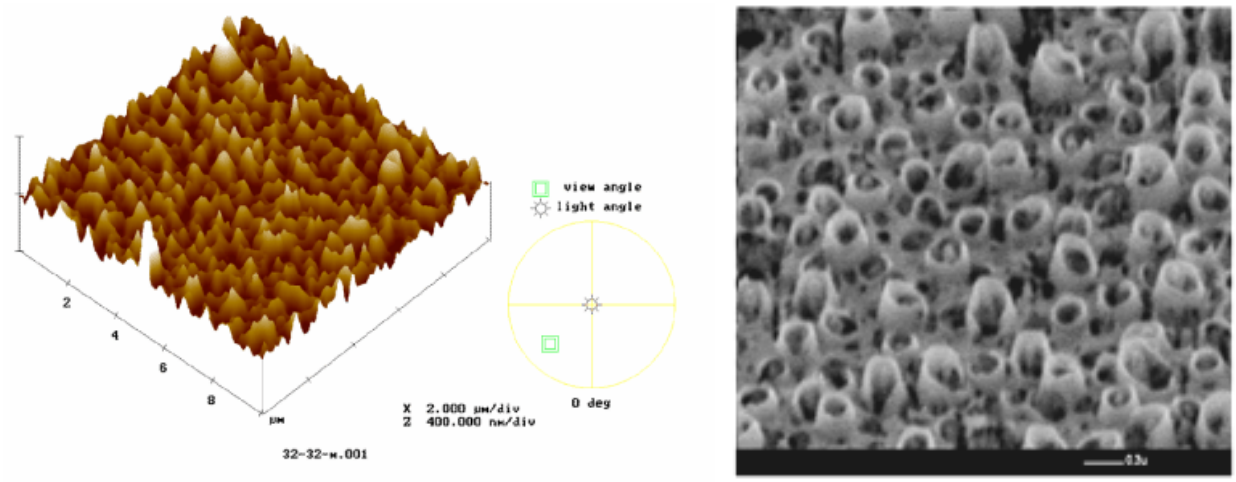
Merv Rose was appointed Professor of Physical Electronics at Dundee University in 2004 and is the currently Head of Division of Electronic Engineering and Physics. He has been on the University Academic staff since1992, He obtained his Doctorate from Dundee in Memory Device Technology and his research interests are in Solid State Physics, Thin Film Devices, Materials, Nano-technology, Medical Devices and Displays and Optoelectronics. He is Director of the Amorphous Materials Research Group and his current work involves the development of a new electron source for display and medical applications. This has led to the creation of a new spin out company, Quantum Filament Technologies Ltd, aimed at exploiting the research work for new flat panel display devices. He is also Director of DisplayMasters, an Inter-University Masters Program aimed at training a new generation of Display Technologists for future high technology applications. He is a member of the EPSRC College, a panel member of the DTI/EPSRC Information and Storage Device Committee, and a DTI consultant on Display Technology. He was elected a Fellow of the Institute of Physics in 2004.

Please tell us about the origins of Quantum Filament Technologies. QFT is a spin-out from the University of Dundee and the University of Surrey. The Dundee Amorphous Materials Research Group was responsible for the pioneering work in amorphous silicon and the first thin film transistor that led to active matrix liquid crystal displays. The Advanced Technology Institute at Surrey is one of the leading centres for nano-technology. The two centres have had a long history of collaboration and Ravi Silva, the Institute Director is co-founder and Director of QFT. Ravi Silva and I had been working on laser processing of silicon and field emission. Our teams produced some interesting work on laser interactions with thin film silicon, and we discovered some effects that were related to other so-called filamentary devices. The work delivered devices that showed extremely high uniformity of emission, no hysteresis (unusual for thin film emitters) and a low threshold for emission. Whilst making three terminal gated structures, we realised that we had a simple process that used standard tools and processes known to the displays industry. Roy Clarke, a colleague at Dundee, saw the commercial potential of this and helped us found the company. The company was founded on modest private investment, and Peter Denyer became Chairman in 2005. He co-founded and chaired Micro Emissive Displays (MED), the world's leading developer of polymer organic light emitting diode (P-OLED)-based microdisplays.

What exactly is a quantum filament? Ha! Good question! We have studied filamentary conduction in thin films and amorphous silicon devices for some time. These filaments are found in inhomogeneous nano-scale and granular structures. They may be familiar to you in terms of breakdown in semiconductors devices, but stable filamentary conducting channels result in interesting effects, such as bi-stability and electron emission at low electric fields. The filamentary channels are determined by the distribution of nano-particles and act as emitters. They are rather like virtual nano-wires, and when dimensions are particularly small we see evidence of quantized resistance. We coined the term "quantum filament" to describe the convergence of these effects.

We were also looking at creating nano-crystals and granular structures through laser processing amorphous silicon with particular metals. We were studying surface roughness and detected anomalously high field factors in emission, not due to geometric effects. It seemed that we had created the conditions for stable filaments with the internal structure required for field emission without conditioning and at low thresholds. It was an exciting moment. We subsequently heard that the Starship Enterprise bumped into a quantum filament somewhere in the Universe. It must have been rather larger than one of ours. Quantum Filament Technologies Ltd may seem rather a mouthful, so we are usually affectionately known simply as QFT.

Please provide an overview about your technology. The key to our technology is a very simple backplane. The attractive feature is that it is based on amorphous silicon, which is now a mature technology, and on excimer laser processing, the tool for the low temperature polysilicon process. In our case we simply deposit a patterned cathode metal, followed by hydrogenated amorphous silicon. This is then directly processed with an excimer laser with a distinct beam profile at modest average energies. The result of this is a film that has a very rough surface, and which contains the necessary internal structure for filamentary conduction. Thin film silicon nitride is then deposited over the surface structures (the same material as a TFT gate dielectric) and thin film metal deposited on top of this. The structures are then simply etched by RIE to expose the microtip. This process has the effect of etching from the top of the structure through the metal to the insulator, leaving a free standing filamentary micro-tip surrounded by a metal gate isolated by the insulator. Each “tip” is a fraction of a micron, so each pixel has tens of thousands of emitter sites. If you consider the steps we have just described, it is rather like the thin film processing of a TFT, but with no lithographic steps. The backplate is now complete and forms the cathode plate. The device is completed by forming a vacuum space with a phosphor coated anode plate.



QFT’s process requires the laser crystallization of hydrogenated amorphous silicon (a-Si:H) to produces a high density of emission sites. The resulting structure shows a high uniformity of electron emission. A typical surface structure is shown below in the image to the left. The field emission is caused by proximity effects of highly conducting particles in an insulating matrix where the resulting morphology enhances the internal electric field. The image to the right is a micrograph of a 3-terminal backplane structure showing individual emitter sites surrounded by gate metal.

After the collapse of Candescent, Pixtech, PFE, and most other efforts at Field Emission Displays, the technology has left a sour taste in many mouths. Any inputs on how QFT intends to overcome these ongoing negative perceptions about FED? FED does have an interesting life story. The technology is so appealing because of the distinct advantages over many other types of display. I think it is fair to say there is now a renewed vitality and resurgence, thanks mainly to nanotechnology solutions. The companies you mentioned were very innovative, produced some of the best display demonstrators I have seen, and many of the people involved are still in the field and champions of the technology. The problem each company faced was largely complexity. The photo-lithographic steps involved were too complex and expensive for scaling and industrialization. We believe that the simplicity of our structure and the emission mechanism will lead to a truly manufacturable solution to these problems. We are not limited to looking at high-end niche products, but open to the low cost high quality displays opportunities. Because of fewer components we predict a low cost. We are looking at a production cost model that predicts substantial cost saving on TFT LCD. Unlike other FED products, we are not limited by complexity. We are currently working on early stage demonstrators. If we can demonstrate a device that has a large cost benefit then I believe perceptions will quickly change.

Please differentiate your technology from that of competing technologies (LCD, PDP, AMOLED, and FED). All flat panel technologies are amazing. The level of technical innovation over the past few years is

spectacular, and it makes for one of the most exciting and competitive sectors of the electronics market.

- The closest relatives to our technology, I guess, are the CRT and AMLCD. The comparison with CRT is obvious with electron beams striking a phosphor. However the main advantages with FED of course is a flat profile and low power consumption. The comparison with LCD is perhaps not immediately obvious, except for the flat profile. However, manufacture of our technology would be based on existing factories used by the AMLCD community. This is because we need the deposition facilities for the TFTs, and the laser devices for creation of polysilicon based on amorphous silicon precursors. However, in our case we remove the backlight, optical components, diffusion and enhancement films, polarizers, the liquid crystal, the TFT photomasks etc. Our equivalent of the colour filter plate is the phosphor anode, and it can be made using very simple and inexpensive processes.
- PDP is enjoying a place in the market, and competing in the TV market with LCD. The traditional problems remain, however, with lifetime, burn in and resolution. The biggest hurdle for PDP is the pixel size which has a lower limit of around 0.3mm. This limits the applications.
- AMOLED is a very interesting technology for future lightweight high quality displays and plastic electronics. They are driven either by amorphous silicon TFTs or polysilicon TFTs. Amorphous silicon would be ideal from a cost and simplicity point of view. The meta-stability of amorphous silicon and the current driven nature of the OLED means complex compensating circuits are required in pixels to resolve threshold stability issues. Forming polysilicon TFTs on plastic is a challenge, but OLED is a driver for an improved poly process.

If we compare our technology to other FED technologies, we can claim some advantages. The simplicity of process and subsequent cost saving is the major one, but also we have a backplane where the “emission filaments” are embedded within the material. Conventional Spindt tip emitters rely on geometric confinement at the sharp tip, and any surface adsorption can change things. CNTs can also suffer from adsorption and from field screening effects etc. Our emitters are “embedded” and exist only with application of the field.

How about when compared to SED – how does the QFT display compare? The SED is one of the most impressive displays I have seen and has served to remind the industry and consumers that the way forward is an emissive technology display. The problem I see with SED is the nano slit formation complexity and the fact that it uses secondary electrons which to me seems inefficient. The contrast ratio is high, but seems to suffer in bright environments. I suspect this is because of efficiency losses due to the scattering mechanism. The company seems to be suffering delays in delivering, but I think these are more legal issues than technical problems. I don’t believe it was ever seen beyond the high quality niche market. We are aiming for low cost with high quality.

Do you see yourselves as competitive or complementary to the well-entrenched LCD? We believe we are the only FED that is not disruptive to the LCD market. I think initially we see ourselves as complementary to the flat panel LCD sector, especially in the polysilicon world. We would use tools and plants available to the LCD manufacturers so are not disruptive in that sense. I think the display world would then develop and the technical and cost advantages offered by our technology would find its place. Amongst the current FED developers we see ourselves as being the least disruptive.

What changes would an LCD manufacture need to make to their production line in order to incorporate the QFT technology? Well, none really. If an LCD manufacturer wished to make our display he could by deposition of TFT materials. Most of the components for an LCD manufacturer are bought in. The real manufacturing process is on the active plate. We would require the deposition part of that line but without the photolithography. Our anode plate would be unfamiliar, except for a black matrix, but much cheaper to fabricate than an LCD colour filter plate. Our technology has been designed to fit into existing LCD manufacturers’ facilities. LCD manufacturers are competing on cost and quality. We believe that an LCD manufacturer should consider our FED. The technology is supportive and non disruptive, using the

amorphous silicon they are familiar with. I can see a time when such a platform could lead to a technology that would add to their breadth by resolving some issues that LCD may struggle with. Our belief is that our technology is truly scalable and will be attractive as a large panel technology of the future.

Will your technology require a low-temperature poly-silicon manufacturing process, or can amorphous silicon production facilities also be used? The precursor for poly-silicon is amorphous silicon. In our case, however, we don't need a pre-dehydrogenation step as the hydrogen release during laser processing is part of the formation process of the internal nano-scale granular features. Poly is now very attractive for hand held devices, notebooks and as an enabling technology for things like OLED. This is leading to a maturation of the laser process that we can take advantage of. There are a number of interesting developments in laser processing. Tools are being developed for larger throughput, and lasers can also be used in the device sealing process and in phosphor efficiency improvement.

You have suggested that QFT's displays are expected to require considerably less material than a comparably LCD. Please elaborate. A state of the art AMLCD is a complex device and is the product of many years' development and innovation. The bill of materials for a typical LCD covers backlight, optical components, LC, active matrix materials, lithography and photo-masking. As cost will be the main driver in the future, the bill of materials will have to reduce considerably. There are only smaller margins to be gained in going to larger glass size, and state of the art backlights may become more expensive for a time before costs become competitive. An attractive feature is that as prices for raw materials for LCD fall, they fall for us also.

Do you also expect QFT displays will be less expensive from the processing side of the cost equation? Please explain. Today, a typical LCD would use 4-5 photomasks for an amorphous silicon device, and 7-8 for a polysilicon device. Although we are using amorphous silicon, silicon nitride and thin film metal, we do not pattern them using lithography. We are removing the photomask stages and costs and the associated chemicals and processes to pattern them

What sort of cost benefits do you anticipate will result due to the material and production savings enabled by your technology? We know we cannot simply compete on cost as it is in the market today. We are looking 4 or 5 years ahead. We have always set out to have a lower cost technology and are driven by the target of being at least 1/3 lower than LCD in 4-5 years time. We are developing a cost model and continually refining things so that we can continue to meet this target.

You have suggested that one of the advantages of your technology is that the brightness of each pixel can be controlled dynamically, giving you the opportunity to showcase an extremely high dynamic range. Please explain why this is such an advantage. There has been a lot of exciting development in the area of dynamic backlighting for high quality displays. Also the high brightness and control of emissive FED technology give many opportunities, e.g. in avionic displays. There are a number of driver schemes for FED that gives some flexibility and room for innovation. It is possible that FED can be used as a backlight for LCD. FED can achieve a very high contrast ratio. Contrast ratio in PDP and LCD is poor, because there is always some residual light. Dynamic contrast helps but comes at a cost. We would be very interested to explore with a manufacturer the possibility of our technology as a dynamic backlight. Backlight can be up to a third of the materials cost.

Another performance advantage you claim is related to high switching speeds. What does this mean to the end user? The end user is going to be interested in cost saving and performance. We hope to deliver state of the art performance for very low cost. The speed advantage comes for free. Field emission is a quantum mechanical process and happens on the nanosecond timescale. This means we can think of ways exploiting the advantage in terms of driving the display and perhaps in developing ideas in the 3D domain where speed and resolution are crucial. Liquid crystal displays are slow in the sense that the switching speed of the liquid crystal is slow, and the line at a time method of rendering a frame results in motion artefacts

which are visible on larger LCD displays. Our quantized resistance effects imply ballistic transport. If the ballistic transport through the material was optimised, then the speed of electrons from cathode to anode will be fast. Speed limitations may come in at high frequency with capacitance effects, etc.

In the past, FEDs have had problems achieving high pixel densities. What's different about your technology that will enable you to achieve high pixel densities? The ideal emitter will be one with high uniformity and number of emitter sites, exhibiting ballistic transport. In this case there would be highly uniform illumination and little cross pixel interference, as the electrons should leave the surface in a perpendicular direction. This would remove the requirement of complex focusing structures.

Early problems in FED will have been determined by lithographic limitations to get a large number of effective emitters to give good uniformity. We believe we have resolved this limitation. Our emitter sites are fractions of a micron apart and are formed using a "self –aligned" method. Each emitter is exactly the same distance from the gate set by the thickness of the insulator and the isotropic etching techniques. In a typical high resolution pixel we would have in excess of 50,000 emitter sites. Only a fraction of these will be required to give a uniform pixel.

Considering that FEDs require a vacuum, are your displays still a good candidate for flexible substrates? Vacuum devices are not good candidates for flexible displays. Even moderately thin glass will distort. This is understood and not really a problem if you don't want to enter that race. There are other advantages in the technology however that reduce the weight, and can give a real weight advantage. In order to go flexible we would need a solid state version of the device. This might be possible.

What do you see as your biggest remaining technology hurdles? We are an early stage company and are making modest devices. We can model and predict many features of the technology as well as doing laboratory tests. We know we have to resolve many issues in scaling.

Aside from displays, can QFT devices be used in any other applications? Field emission devices have many applications, x-rays, imaging, microwave etc. A highly uniform emitter for example would be very attractive for 3D x-ray imaging.

Is there a particular market segment that will best benefit from your technology? Large area, notebook, aerospace, but primarily notebook. Long term there should be no constraints to the sectors we address. Benefits of our technology should be power saving, cost saving, high brightness, thinness, lightness, etc.

Going from early prototype stage to commercial production is a big effort, especially in the display market. Please tell us about your commercialisation plans. I have been describing our technology in terms of materials available to LCD manufacturers. Today of course that means Gen 8 plants etc. and infrastructure of billions of dollars. It would not be realistic for a small company to manufacture large displays for the display market. However, there are many fabrication plants around that may be looking for a new destiny, and polysilicon plants with the necessary tools. We are pushing ahead with improving devices with a view to engaging with major players and incorporating our technology into their products. We are interested in keeping open the possibility of joint ventures with manufacturers. We are a small company and a licensing route may be appropriate. We are ambitious however and would hope the technology will be come ubiquitous and are looking for the best opportunity to turn that aspiration into reality.

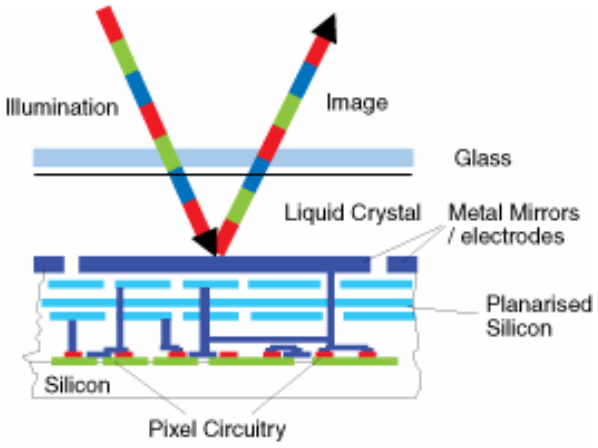
When do you expect we'll first see a prototype that is adequate to show off in a public forum? If we mange to form a partnership that can take our technology into a device, we should be able to show a demo that shows all the competitive features of the technology within 18 months. We will be showing our early stage demonstrators to potential partners very soon.

Interview with Greg Truman from ForthDD

Greg Truman is managing director of Forth Dimension Displays. He has served in that position since the formation of CRLO Displays Ltd. since its formation in September 2004, and of its predecessor, CRL Opto, he led the successful fund raising that formed Forth Dimension Displays. He has also participated in the formation of new displays companies Opsys and AccuScene. Prior roles have included Corporate Development Manager of Scipher plc, where he was part of the core team working on VC fund-raising (GBP 5 million) and, subsequently, the IPO of the Company (raising GBP 30 million) in February 2000. Earlier, Greg Truman held roles in sales, marketing, R&D project management and integrated circuit design within Thorn EMI, GEC and in a joint venture in Malaysia. Greg Truman has a BSc in Computer Science from the University of Hertfordshire.

Please give us some background information about Forth Dimension Displays. Forth Dimension Displays develops, manufactures and supplies the world's most advanced microdisplays using a proprietary, fast-switching liquid crystal technology. The company - previously named CRLO Displays Ltd - was formed in September 2004, funded by an "A" series round from Amadeus Capital Partners and Doughty Hanson Technology Ventures. The company is located in Dalgety Bay, Scotland across the River Forth from Edinburgh, with offices in California. In 2006, 82% of ForthDD's rapidly-growing revenues were from products shipped to international (non-UK) customers, mostly to the US, Germany, and Japan. ForthDD's proprietary, high-speed liquid crystal display and driver technology has major advantages in performance and cost. A portfolio of more than seventy patents protects ForthDD's Time Domain Imaging (TDI) technology.

What advantages do your ferroelectric devices have over competitive devices? The biggest advantage is that the technology is all digital. It processes images in the time domain (TDI) on a single chip, without RGB sub-pixels, separate RGB beams and optics, and without tilting mirrors. This combination allows both amplitude and phase modulated imaging. It provides high native resolution, full 24-bit colour for showing high-speed motion. The very fast switching (100 times faster than nematic LC) characteristics of the ferroelectric LCD material offers benefits in a number of applications. The most relevant of these to Forth Dimension Displays is the ability to produce high performance, colour sequential displays where it has major advantages in performance and cost. The technology is well-matched to the new LED and laser diode light sources. In addition, there are cost advantages: the single chip has no moving parts, so it is built using standard CMOS wafer processes. The absence of separate RGB light paths enables customers to use simpler, lower cost optics in their system integration.



On the left is a cross-section of a liquid crystal-based microdisplay in operation. On the right is on of ForthDD's microdisplay solutions. The company is focused on producing high-performance displays for near-to-eye applications such as head mounted displays (HMDs), which are often used to simulate scenarios that may be too dangerous or expensive to replicate in the real world. ForthDD is the world's leading supplier of microdisplays into high-end immersive training and simulation HMDs.

You recently made some sizable staff reductions as a result of strategic decision to shift the focus of your business. Tell us more. We decided that the prospects of success in the rear projection TV market were being determined more by the price reductions in LCD TV than by the ability of Forth Dimension Displays to meet the product specifications. Price decreases in LCD TVs have been far greater than any analyst forecast and this made it very difficult to compete with a "high performance, value" RPTV product proposition. Forth Dimension Displays already had an established reputation as the leading supplier of premium, high native resolution microdisplays in training and simulation systems for military and aerospace customers. The company's business is expanding with products to customers in areas such as:

- Confocal microscopy and image injection for medical diagnostic and surgical systems
- Digital printing and imaging systems
- High-resolution industrial metrology and process systems
- Advanced 3D and holographic imaging systems

So the decision was made to drop the RPTV market and focus on those markets with better prospects.

Given your decision to withdraw from the rear projection TV market, can you share your thoughts about the future of RPTVs? A quick review of the news and forecasts from the RPTV market, since we withdrew, quickly shows that the pressure from LCD TV has continued to drive forecasts down and cause problems for those companies continuing to focus on that market. It is going to be very difficult for RPTVs to compete in anything other than the largest sizes (55 inch+) and emergent areas (e.g. 3D TV). Without some radical breakthrough, there seems little future for RPTV in the mainstream 36-42-inch diagonal TV market.

Please share your opinions about the new class of "pico-projector" products. The pico-projection business has the prospect of being a large market in terms of unit volumes, the challenge will be achieving profitable manufacture of microdisplays/microdisplay chipsets at the low prices they will be sold at.

So you're now focusing all of your efforts on high-resolution near-to-eye devices. How big do you see this market? It is very difficult to know, as there is little good market data and it depends largely on whether you perceive that high-resolution near-to-eye (NTE) devices will ever penetrate the consumer market in high volumes.

You are a fabless company, but still have semiconductor integration capabilities. Please tell us how your supply chain works. Actually, we are not really "fabless" but "partially fabless"; we receive silicon wafers manufactured on our behalf by a silicon foundry (the fabless bit) but do all subsequent processing (coating, laminate assembly, cell filling, mounting etc.) within our own Dalgety Bay manufacturing facility. This gives us a lot more flexibility and control versus trying to use a totally fabless approach and is one of our core strengths.

Although ForthDD does not produce its own silicon wafers, their facility in Dalgety Bay, Scotland does all the processing (coating, laminate assembly, cell filling, mounting, etc), providing advantages related to quality and scheduling.

What is your current production capacity? Currently around 20,000 microdisplays per annum but we can increase capacity in Dalgety Bay to over 100,000 per annum should the market demand be there.

In terms of improving performance, is there one area in which you are focusing your development efforts? The technology already performs extremely well in our key applications, so we are focused on making small improvements across the board (while trying not to introduce negative side effects) and reducing cost of ownership to allow our customers to expend their markets.

Your current solutions are at 1280x1024 pixels. Do you see a need to move to higher resolutions? Yes, we expect to move from the current 1.3M pixel displays to 2M pixels and beyond.

What are the pitfalls in moving to higher resolutions? Is it more than just a larger die size? The key challenges include the larger die size (or reduced pixel size) and the high data rates required. A high refresh rate (120Hz), 2M pixel display requires around 10 Gbits/second to be delivered to the display.

What are the most promising applications for high-resolution near-to-eye devices? Forth Dimension Displays is the clear global market leader supplying high resolution microdisplays for near-to-eye (NTE) devices in the training and simulation market and, right now, this is the best market for us.

Do you see 3D as a big opportunity for Forth Dimension? It already is, we supply a lot of our systems for use in binocular, stereoscopic head mounted displays.

Tell us one of your favourite customer satisfaction stories. I would prefer not to put words in our customer's mouths – and suggest you contact Marc Foglia of NVis. http://www.nvisinc.com. *We contacted Mr. Foglia, who provided these insights about ForthDD:*

> "ForthDD has been our supplier for microdisplays since our company was founded in 2002, enabling NVIS to build an entire product line of high-resolution head-mounted and hand-held displays. While most microdisplay suppliers turn away low volume manufacturers, ForthDD (then CRL Opto) welcomed the opportunity to work with us. Over time, great suppliers start to feel more like partners, and ForthDD always treated NVIS as a partner. They made it clear to us that our success was an important part of their business. This was evident in their responsiveness to our requests for technical information, documentation, and at times, demanding delivery schedules. As a small manufacturer, our ability to support our customers is often tied to our suppliers' support for us, and in this capacity our relationship with ForthDD has been vital to our success. We see a bright future together with ForthDD as both our businesses grow."

The NVis nVisor ST uses ForthDD's high-resolution ferroelectric liquid crystal on silicon. The illumination scheme includes an RGB LED mounted on the top-face of a polarizing beam splitter prism. The microdisplay is illuminated by the light reflected off the polarizing beam splitter surface. Colour is generated by the LED using an advanced color sequential algorithm that rapidly switches between red, green, and blue light which is synchronized with the pixels on the LCoS device to generate a 24-bit color image.

Given your earlier financial troubles, when do you expect to reach profitability? We have not had any financial issues since the formation of CRLO Displays (later Forth Dimension Displays) in September 2004. We have always had positive cash in the bank and have very supportive investors/owners. We expect to achieve break even in late 2007 and move into sustained profitability in 2008.

Please describe what you think Forth Dimension will look like three years from now. I would expect that we have grown substantially, are consistently profitable and cash generative and have a value that justifies our investors' belief and investment in us.

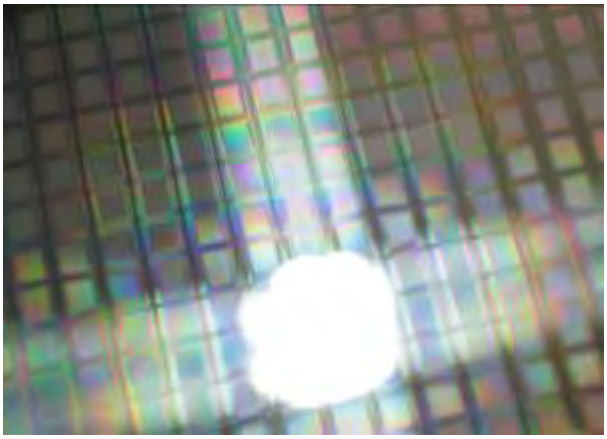
Interview with Ian Underwood from MED

Ian Underwood is CTO and a co-founder of MED as well as co-inventor of its P-OLED microdisplay technology. Prior to 1999 he was at The University of Edinburgh where he carried out pioneering research and development in the field of liquid crystal microdisplays between 1983 and 1999. He is a Fulbright Fellow (1991), Photonics Spectra Circle of Excellence designer (1994), British Telecom Fellow (1997), Ben Sturgeon Award winner (1999), Ernst & Young Entrepreneur of the Year (2003), Fellow of the Royal Society of Edinburgh (2004), and Gannochy Medal winner (2004). He is recognised worldwide as an authority on microdisplay technology, systems and applications. In 2005, Ian was named Professor of Electronic Displays at The University of Edinburgh. In addition to his full-time post at MED, he sits on the Council of the Scottish Optoelectronics Association and the Steering Committee of ADRIA (Europe's Network in Advanced Displays). He is co-author of a recently released book entitled Introduction to Microdisplays.

Please give us some background information about MED. MicroEmissive Displays (MED) is a leader in polymer organic light emitting diode (P-OLED) microdisplay technology. The company was founded in 1999 and has developed a unique emissive microdisplay technology by using a P-OLED layer on a CMOS substrate. In late 2004, MED floated on the Alternative Investment Market of the London Stock Exchange (AIM) following a fourth successful funding round, which raised £15.7M. Funding has been used for proof of principle, technology development and establishing pre-production facilities in Edinburgh, culminating in the first product release and commercial shipments of MED's' eyescreen microdisplays in December 2005. MED has been awarded ISO 9001:2000 registration for the research, design, development and marketing of digital microdisplay solutions and is working towards full accreditation in 2007. MED is headquartered at the Scottish Microelectronics Centre, Edinburgh, Scotland and its manufacturing site is in Dresden, Germany. The company employs 62 people and also has sales representatives and applications support located in Asia, the USA and Europe.

Do you regard yourselves primarily as a display company or as a semiconductor company that happens to be making displays? MED is a displays company whose displays happen to use a CMOS active matrix backplane. So, like all microdisplay companies, our manufacturing and cost base is very semiconductor-like.

Please provide an overview about your technology. MED's eyescreen products are the world's only polymer organic light emitting diode (P-OLED) microdisplays. The full colour eyescreen combines superb TV quality moving video images that are free from flicker, with ultra-low power consumption, enabling greatly extended battery life for the consumer. This enhancement in battery usage time made possible by the eyescreen will play a vital role in the widespread adoption of portable head-sets for personal TV and video viewing in the consumer marketplace. The design of the eyescreen, with its integrated driver ICs and its digital interface, offers product design engineers a robust design-in solution for smaller, lighter-weight, stylish products of the future, all for a size comparable with the pupil of the human eye.



MED builds its display devices on a CMOS active matrix device. This photo of a wafer shows how more than a hundred devices can be manufactured on a single die.

You are currently very close to offering a complete "display on a chip" in a CMOS process. What remains to achieve this goal, and what advantages are derived from offering a complete solution? Display-System-on-Chip (DSoC) means that the microdisplay component is the only

high-value or active component required. MED's eyescreen microdisplays offer emissive operation which is equivalent to having an "integrated" backlight. The use of a CMOS backplane allows the functionality of the display driver IC to be integrated. The display has a high level of integrated configurability such as brightness control, image orientation, frame rate, switching between digital data formats, down-scaling of incoming data stream, etc.

More generally, what are the primary advantages of OLED microdisplays as compared to LC microdisplays? The primary advantages are:

- Lower power equating to longer battery life
- Higher contrast equating to a more vivid image
- Higher pixel fill factor equating to higher perceived image quality

In 2004, your display was listed in the Guinness Book of World Records as the world's smallest colour TV screen. Is this still true? Do you have plans to make even smaller displays? MED's original display was the ME3201 (320x240 monochrome). The backplane of the ME3201 was used to create a colour microdisplay – ME1602 (160x120 colour) by applying colour filters over a 2x2 array of monochrome pixels to create a single colour pixel. ME1602 made it into the Guinness Book of World Records in 2004 and 2005. But Guinness has more records than they are able to put into the book each year so MED has not appeared in the book since 2005.

As a CDT licensee, does CDT's polymer OLED development work in large area displays translate without problem to your microdisplays? CDT is a developer and licensor of generic IP in polymer OLED technology. MED and CDT have worked very closely together to ensure that MED achieves the best possible implementation of that IP in its field of application.

OLEDs generally face problems related to barrier layers to protect from moisture and oxygen. Do you face these same problems, or is it actually much simpler to adequately protect a microdisplay versus a larger display? All OLEDs must be encapsulated in order to ensure reliable performance by protecting the OLED layer from the detrimental effects of atmospheric oxygen and moisture. MED has developed an encapsulation strategy that is appropriate for, and compatible with, P-OLED microdisplays.

In terms of definition, you currently show off 320x240 pixels. Since this is less than even standard TV, are you under any pressure to increase the resolution? 320xRGBx240 (QVGA colour) is a typical definition for low-cost, low-power consumer video glasses. Viewing TV or video content from a personal DV player or iPod, users are normally satisfied with that. Even those who would prefer say VGA may not readily accept the additional cost, bulk and power consumption.

MED's tiny eyescreen microdisplay with a 6mm (0.24-inch) diagonal pixel array can be combined with magnifying optics to produce a large virtual image, that appears to the eye to be equivalent in dimensions to the picture on a TV screen or computer display.

What size do you typically achieve with regard to the "virtual" image? Does magnifying to larger sizes diminish the image quality? In other words is there some "sweet spot" related to device size and virtual image size? The virtual image is best described in terms of "Field of View" – the angle subtended at the eye by the diagonal of the image. The norm is to make the FoV as large as possible without the individual pixels becoming resolvable. (If individual pixels can be resolved, this reduces the perceived quality of the image). The appropriate FoV depends on a number of factors relating to the display, the system and the application; these include display definition and pixel fill factor. For eyescreen ME3204 the appropriate FoV is typically around about 20 degrees.

Your devices are entirely digital with no analog interface. Tell us about what this means in terms of cost/performance. The future is digital. MED has implemented two interface possibilities into eyescreen ME3204 – CCIR 656 and serial RGB. An all-digital signal path maintains flexibility, reduces power and maintains best possible image quality. In the case of an application where the data source is analog, e.g. composite video, a low cost/power video pixel decoder can be used to convert incoming data to CCIR 656.

Your eyescreen devices have recently been showcased in systems that utilise Qualcomm's MDDI protocol. Why is this important and do other mobile standards (such as the MIPI standard) provide similar results? MDDI (Mobile Digital Display Interface) allows an all digital signal path and has provision for driving an external display. This realises all of the benefits of eyescreen from a cell phone. The MDDI/eyescreen demo runs from the cell phone battery – it does not require an external battery box.

Tell us about the markets you intend to address? MED is aiming specifically at consumer markets with existing or potential for high volume. Our first target is video glasses and we also plan to target electronic viewfinders for applications including digital cameras, video cameras and night vision systems.

Mobile TV is still something of a question mark. Please give us your thoughts about this market. 3G took off in Korea and Japan, migrating to Europe then USA and onwards. Similarly, mobile TV is now taking off in Korea.

If mobile TV takes off, what will entice users to consider near-to-eye devices that incorporate MED microdisplays? Considerations such as:

- Enhanced viewing experience in any environment (e.g. bright sunlight or fluorescent light); the NTE device can be configured to block ambient light
- Larger image than that available from cell phone or iPod or other pocketable device
- Privacy (no one can look over your shoulder)
- Consideration for others (what you are watching does not disturb the person sitting next to you in a plane or train)

Tell us about your work related to developing 3D video glasses? MED worked with the EPICentre at the University of Abertay and Thales Optics (now Qioptiq) to develop a stereoscopic 3-D headset using eyescreen microdisplays. That project, called EZ-Display, was sponsored by the UK Department of Trade and Industry and finished in 2006.

One of the historical issues associated with near-to-eye devices is related to nausea. Adding 3D to the equation and it seems like you'll need to add "sanitary bags" to your bill of material. What sorts of things can you do to minimise these inner-ear problems? MED is not a developer and manufacturer of video glasses. Optimisation of the end product to provide a comfortable viewing experience rests with the system manufacturer.

If someone already wears glasses, do they need to wear prescription video glasses? MED is not a developer and manufacturer of video glasses. Some video glasses can be worn over prescription spectacles and some cannot; some have focus adjustment and some do not; some could incorporate custom prescription lenses and some cannot.

Your new manufacturing centre in Dresden, Germany is a big step forward. When do you expect to have commercial products ready to ship from the facility? On 24th July 2007, MED announced that it had made its first production shipment from its Dresden manufacturing facility on schedule.

Why did you choose to build in Dresden rather than in Edinburgh or elsewhere? Dresden was an ideal selection because it has the Fraunhofer IPMS at its heart and is at the very forefront of electronic innovation. We are very proud to be part of Silicon Saxony and are looking forward to sharing our success in such a vibrant technological and cultural centre.

Governance of the UK Displays and Lighting KTN

ADVISORY BOARD

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Board Members	Stuart Evans, David Monk, Paul May, Gareth Jones

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FLEXYNET (Plastic Electronics) Sub group Industrial Committee

Chairman	Keith Rollins	DuPont Teijin Films
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ET (Emerging Technologies) Sub group Committee

Chairman	Chris Rider	Kodak
Committee Members:	Pelikon, Sharp Labs, HP Labs, Dow Corning, CAPE, U o Swansea, U o Manchester, CDT	

SPURSS (Systems, Professional Users, Regulations, Safety, Standards) Sub Group Committee

Chairman	Ken Vassie	NPL
Committee Members:	CAA, Ginsbury Electronics, DSTL, POPAI/IQ Group, Philips Lighting, iSuppli, Commonwealth Broadcasting Association, PACSnet, RNIB, HSE, Health Protection Agency, U o Middlesex, DeMontfort University, CIE	

Contacting UKDL

Most of the information you will need about the UK Displays & Lighting KTN and its events and activities are found on the website: http://www.ukdisplaylighting.net. General queries can be sent to info@ukdisplaylighting.net, but if you would like to have direct contact with us, please feel free to do so:

In Scotland: Our Scottish office is located in Dundee, and is manned by Robbie Sharpe, who is also responsible for our national activities in the LABL Sub group. Robbie@ukdisplaylighting.net.

In Wales: Dr. Eifion Jewell, who is located at the University of Wales, Swansea, is seconded to UKDL, and is responsible for part of our FLEXYNET and ET activities, particularly with skills training in printing of functional inks. eifion@ukdisplaylighting.net.

In England: Dr. Ric Allott, Deputy Network Director, has responsibility for organization and delivery of all domestic events and activities, and is specifically responsible for FLEXYNET and ET. ric@ukdisplaylighting.net.

All marketing and promotion of UKDL activities is handled by Nick Kirkwood, who is also responsible for SPURSS. Contact Nick at nick@ukdisplaylighting.net.

All event planning, including location booking around the UK and overseas, is handled by Louisa Chanter Louisa@ukdisplaylighting.net.

Administration is handled by Kay Davenport. Kay is based at our Bletchley Park Headquarters, and is the friendly voice that enquirers will first meet if phoning through to us. Kay can be contacted at Kay@ukdisplaylighting.net.

Finance and accounts matters are handled by Cathy Williams, cathy@ukdisplaylighting.net.

Overall responsibility for the KTN, and specific responsibility for UKDL's overseas activities lies with the Director, Chris Williams. He can be contacted at chris@ukdisplaylighting.net.

If you prefer to contact us by phone, the general number is +44 (0)1908 276665. This number is manned during normal UK office hours, and reverts to voicemail at all other times.

UKDL Events

The UKDL is hosting/sponsoring numerous events in the coming months throughout the UK. Dates highlighted in **red** are still tentative. For latest updates and registration information: http://www.ukdisplay.net

SEPTEMBER 2007			
3	Plastic Electronics Strategy Workshop	The Mansion, Bletchley Park	Workshop Invitation Only
13	Integration of Printing Manufacturing for Reel-to-Reel Processes	Timsons Ltd, Kettering	Tutorial
18-19	Printed Plastic Power	The Vale Hotel, Cardiff	2-day Residential Seminar
26-28	PLG: Strategy Workshop on Emerging Technologies in Displays and Lighting	Wordsworth Hotel, Grasmere	Workshop Invitation Only

OCTOBER 2007			
10	Novel Light Sources	Ceravision	Tutorial
16	Enabling Technologies with Atomic Layer Deposition	Daresbury Laboratory, Daresbury	Workshop
17	Organic Electronic Devices Printed in a Single Step	To be confirmed	Tutorial
24	Flexible Displays - New Concepts	To be confirmed	Tutorial
NOVEMBER 2007			
5-6	Challenges in Organic Electronics	Core Technology Centre, University of Manchester	2-day Residential Seminar
8	Innovate 2007	QEII Conference Centre, London	Exhibition
13	Modifying Surface Functionality	OAS (To be confirmed)	Tutorial
15	Thermal Management of LEDs	Universal Science	Tutorial
27	Polymer Films for Light Harvesting	Microsharp (To be confirmed)	Tutorial
26-29	Korean Mission	Menzies Hotel, Cambridge	Workshop/Visits
DECEMBER 2007			
There are no events currently scheduled for December			
JANUARY 2008			
15-16	Metalization & Dielectrics 2008	Billesley Manor Hotel, Alcester, Stratford-upon-Avon	2 day Residential Seminar
23-24	Projection Displays - Components and Systems	Edinburgh, Scotland To be confirmed	2 day Residential Seminar
30-31	Showcase of Emerging Technologies + Grand Challenges	The Moller Centre, Cambridge	2-day Residential Seminar
FEBRUARY 2008			
7	Health & Safety of Whiteboards and Projection Displays	Renaissance Hotel, Reading	Workshop
19	Measurement of Display Lifetime	To be confirmed	Tutorial
21	Environmental Testing	To be confirmed	Tutorial
26	Update on Transistors on Plastic	Southampton To be confirmed	Seminar

MARCH 2008			
5	Investigating 3D Technologies	To be confirmed	Workshop
12	TP Dissemination Event	To be confirmed	Seminar
APRIL 2008			
1	Lighting for Mood	To be confirmed	Workshop
2-3	Future Lighting Debate	McDonald Linden Hall, Longshorsley, Northumberland	2 Day Residential Workshop
8	Characterizing Thin Films	To be confirmed	Workshop
21-22	Gregynog		

From left to right: Kay Davenport (Bletchley Park Administrator), Nick Kirkwood (Marketing Manager), Ric Allott (Deputy Network Director), Eifion Jewell (UKDL Embedded Research Fellow Swansea University), Robbie Sharpe (Knowledge Transfer Coordinator), Louisa Chanter (Events & Exhibitions), Chris Williams (Network Director), Cathy Williams (Managing Director of UKDN Ltd, the administration company that runs UKDL)