SOCIETY FOR INFORMATION DISPLAY

UK & IRELAND CHAPTER

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Chairman's Report

Myrddin Jones

Welcome to the latest SID UK & Ireland Chapter newsletter.

On February 15th this year we held a 'Displays for challenging environments' meeting at the Heritage Motor Centre in Gaydon, arranged and managed by Lee Skrypchuk from Jaguar Land Rover. This was a well-attended meeting and was an attempt by the organisation to appeal more to 'users' of display products. After all, for every display manufacturer there are thousands of companies integrating displays into systems. Sharing experience and expertise among this user community can only be positive.

Myrddin Jones

The meeting was primarily aimed at display users working in the automotive, avionics and industrial markets where challenging environments require careful design and selection of the display for the equipment. There were 10 presentations from a wide range of companies including GE Avionics, Westland Helicopters, BAE Systems, NCR and Raymarine. Topics included display readability in harsh and high ambient light environments, ruggedisation, marine environments and modelling and simulation. A report on this meeting appears on Page 5.

'Advanced materials for displays' was the theme of a one-day technical meeting at Merck's Technical Centre near Southampton on the 14th April 2011. The meeting was arranged and managed by Joe Sargent from Merck Laboratories. The meeting was primarily aimed at display experts from academia and industry working on current and emerging display technologies. Most of the nine presentations were provided by Merck and covered a wide range of topics including materials for 3D TV, organic electronics, OLED and electrophoretic technologies. In addition, a presentation from Brunel University introduced inorganic phosphor technology and Liquavista (now part of Samsung) talked about electrowetting. There was also a tour of the laboratories and the breadth and depth of Merck's technology was clear to all. A report on this meeting appears on Page 7.Many thanks to both the Heritage Motor Centre and Merck for their great hospitality.

On the 5th and 6th of September the SID Organic Electronics UK 2011 conference will be held at Imperial College London. The preliminary programme and secure booking registration is now available on our website www.sid.org/Chapters/uki.aspx

The plenary speaker is confirmed as Professor Stephen R. Forrest, Vice President for Research from The University of Michigan with a number of confirmed speakers from industry and academia. The meeting will cover all aspects of organic semiconductors and their use in displays and other technologies, including:

- OLEDs (OLEDs, OLED based displays, OLED backlights, etc);
- OTFTs (OTFTs, OTFT based displays, OTFT display electronics, etc);
- OPVs and OPDs for power generation and imaging;
- Materials (semiconducting polymers, dendrimers, small molecules, fullerenes, emissive materials, charge transport materials, insulators, electrode materials, etc);
- Oxides and hybrid systems;
- Fabrication (patterning, fabrication, production methods, etc);
- All other aspects of organic semiconductor electronics and photonics for displays and other technologies

We look forwards to meeting you at Imperial College on the 5th and 6th September.

CONTENTS

SID ORGANIC ELECTRONICS UK 2010

Report on the two-day meeting at Imperial College, London on 20-21 September 2010 by Alasdair Campbell

SID Organic Electronics UK 2010, organised by the UK & Ireland Chapter of the SID, was held at Imperial College London on 20th and 21st of September, 2010. It was the fourth Organic Electronics meeting held at Imperial and covered all aspects of the area including organic light-emitting diodes (OLEDs) and thin-film transistors (OTFTs), polymers, small molecules and fullerenes, dielectrics and conductors, display electronics, oxides and hybrid devices, organic photovoltaics (OPVs) for power generation, device and circuit modelling, and printing and fabrication methods.

The meeting was opened by the organiser and Chair Dr Alasdair Campbell, who welcomed the speakers and delegates.

The Plenary Address was given by Professor Christoph Brabec from the University of Erlangen, Germany on the **Product and production aspects of organic solar cells**. Christoph has worked at both Konarka and Siemens, and is one of the worlds leading researchers in OPV technology. He first stated that the world's energy needs are estimated at 14,000 GW by 2050, rising to 33,000 GW by 2100. One nuclear power station provides about 1 GW. In comparison solar power can potentially provide up to 100,000,000 GW. Conventional Si photovoltaics are efficient but still too expensive in terms of cost per unit area. OPVs instead can be fabricated over very large areas using roll-to-roll (R2R) printing techniques such as gravure and flexo. Such high volume R2R techniques can reduce the cost component due to fabrication to a few percent. Konarka has fabricated flexible substrates of up to 1.5 metres wide at a speed of 100 feet per minute, a one power station equivalent (1 GW) per year fabrication potential. The performance of single junction OPVs have also made great progress and have now reached an efficiency of about 8%, approaching their theoretical maximum efficiency of about 10%. Dual junction, tandem OPVs may push this even further. Initial OPV products include ICT applications such as Konarkas solar bag for charging mobile phones and portable electronics. This has now been scaled up to include remote, off-grid applications such as bus shelters in San Francisco and sun-shade umbrellas. The next target for OPVs is larger area, roof-top power generation before moving on to on-grid.

The first invited presentation was on **Flexible Displays – a first application for organic electronics** by Dr Paul Cain, Senior Manager of Plastic Logic, UK. OTFT performance increases have opened up more and more products and markets. Initial products such as Plastic Logic's electrophoretic based eReader should lead via increased performance to OTFT based LCDs to AMOLED displays. Critical criteria include a high charge carrier mobility, air-stability, a transistor channel length of 10 microns, an ability to be processed over large areas and a uniform performance over large areas. Paul also discussed such factors as how laminating the backplane to the electrophoretic structure, versus building the whole structure sequentially on the backplane impacts display yield. The second invited presentation of the meeting was given by Dr Gerwin Gelinck of the Holst Centre/TNO, Holland on **Polymer ferroelectric transistors and diodes**. He described a novel low-cost, non-volatile, reprogrammable memory technology based on a simple crossbar array of ferroelectric polymer capacitors. Applying an electric field to each array element flips over the dipoles in the ferroelectric polymer, giving a clear polarization hysteresis curve. This state can be read out, as well as flipped back to its original state, using a reverse voltage. Thermal embossing can result in a multiple layer thickness, allowing multiple bits to be stored on one pixel at different biases, and the polymer can be additionally used as a negative photoresist allowing photolithographic patterning. In the capacitor array the readout is destructive, but using the polymer as the dielectric in oxide and organic TFTs gives non-destructive readout which lasts for months. By blending with polythiophene, diode memory arrays have also been created in which the switching changes the diode injection barrier characteristics and therefore its resistance. Holst are now scaling this new memory technology up to R2R level fabrication.

After the lunch break, the afternoon session started with an invited talk given by Dr Neil Greenham of the University of Cambridge, UK on **Controlling and Imaging Nanostructures in Organic Photovoltaic Devices**. He described how using solvent assisted nanoimprint lithography (SANIL) it is possible to imprint an array of columnar holes of width 25 to 100 nm and depth 55 to 80 nm into films of conjugated polymers such as P3HT and F8TBT. It is then possible to back-fill these holes with PCBM to create nanostructured OPVs. This simple technique allows complete nano-scale structural control of the device. Although device performance so far is no greater than the blend control devices, increasing the column depth should improve efficiency. Neil also showed how scanning transmission electron tomography (STEM), in which the sample is tilted in the electron beam, can be used to give 3D images of inorganic-organic hybrid photovoltaic films. Imaging CdSe-polymer blend films was able to resolve a nanoscale structure consisting of interconnected and separated networks. This was followed by a presentation by Piers Barnes, Imperial College London, UK on the **Concentration Dependent Hole Mobility and Recombination coefficient in Bulk-Heterojunctions Determined from Transient Absorption Spectroscopy**. Piers has been able to use a simple analytical model based on the Multiple Trapping and Release (MTR) approach, involving a mobility edge and a trap distribution, to successfully fit transient absorption spectroscopy data from OPVs. He was able to explain the variation of the photogenerated charge carrier density with time as being dominated by recombination at short timescales and charge transport at long timescales. Dr Dolores Caras-Quintero from OMIC, University of Manchester, UK then gave a talk on **Towards Inkjet Printed High Efficiency Bulk Heterojunction Solar Cells**, showing new results on ink jet printed OPVs

consisting of PCPDTBT/PC70BM blends, with a particular focus on the new type of morphology produced by using this technique. Dr Ric Allott from the UK Electronic, Sensors and Photonics KTN (ESP KTN) then gave a presentation titled **Looking for Funding? – Europe could be the place for you** in which he discussed the latest European Commission funding available for both industry and academia in the area of organic electronics.

After the tea and cake break, the next invited talk was **Hybrid inorganic nanocrystal / polymer solar cells,** presented by Dr Saif Haque, Imperial College London, UK. Hybrid solar cells combine both inorganic and organic semiconductors. However, state-of-the-art CdSe tetrapod/ polymer hybrid PVs only achieve an efficiency of about 3%, which is much lower than conventional blend OPVs. Inorganic nanoparticles have to have coated with an organic layer to improve solubility and morphology, which seriously reduces charge separation and transport. To get round this, Saif has mixed a CdSe nanoparticle precursor into a hole transporting polymer, which upon heating allows the CdSe to grow into clumps and networks within the polymer. Using different polymers and different annealing conditions, this promising approach to hybrid PV fabrication has already reached an efficiency of 2% in an inverted device configuration. This was followed by an invited presentation titled **Design and Simulation of Organic Electronics** by Dr Euan Smith, Cambridge Display Technology (CDT), UK. He described the multiple levels required in modelling organic electronic devices: firstly quantum chemical modelling of materials; then Monte-Carlo simulations of charge transport; then printing and film formulation modelling; then electrical and optical simulations; then SPICE/ray tracing; and finally full system modelling. In single molecule systems, trends are predicted well by quantum chemical calculations. Modelling ink-jet printing involves computational fluid dynamic calculations of the drying droplet, but although the modelling process is reasonable, there are a lot of problems; the contact line is very difficult to model and they can't model the final stages of drying. He also discussed optical simulations to look at light outcoupling in OLEDs. Euan concluded that we really need to develop a full modelling approach similar to that used in the conventional inorganic semiconductor industry if we want to push plastic electronic technology forward. The last talk of the day was a presentation by Professor Poopathy Kathirgamanathan of Brunel University, UK on **Electron Transporters Based On Lithium Complexes: Transition from Electron Injecting to Electron Transporting Characteristics**. PK discussed a selection of new small molecule materials for multilayer OLEDs, which included a lithium quinoline which gave very good performance as an electron injection layer.

Euan Smith

Poopathy Kathirgamanathan

The first day then closed with the poster session and a drinks and nibbles reception. Over 17 posters were presented by authors from a number of UK Universities including Imperial, Sheffield, Manchester, Brunel and Hull. Topics covered all aspects of organic electronics. The winner of the Best Student Poster Prize for PhD students supported by Merck was John Labram with a poster titled **Monitoring microstructure evolution in polymer: fullerene blends using field-effect transistors**. The winner of the Plastic Electronics DTC MRes Best Student Poster Prize supported by CDT was Roland Piper with a poster titled **Triplet-Triplet Annihilation Upconversion: towards a molecular intermediate band solar cell**.

The second day opened with an invited talk by Professor Jorge Morgado, IST Lisbon, Portugal on **Exploring polyfluorenes cross-linking functionality for optoelectronics**. Jorge has developed a series of UV cross-linkable, photo-patternable polyfluorenes such as F8 and F8T2 based on oxetane sidechains. This enables not only the direct photolithographic patterning of organic electronic devices, but also the easy fabrication of multilayer devices, something normally very difficult with polymers due to the solubility issue (the solvents used to deposit the upper layers can dissolve those underneath). These materials can be used in OLEDs, OFETs and OPVs. Using a laser and a scanning near field optical microscope (SNOM) it was possible to pattern arrays of 1 micron sized columnar features. A similar structure was fabricated by simply spincoating the crosslinkable polymer with polystyrene, the resultant phase separation allowing the fabrication of well-defined columns down to diameters of 80 nm. By back-filling with PCBM, it was possible to create a nanostructured OPV, the short-circuit current increasing with decreasing column diameter. After this was a presentation **Phosphorescent copper (I) coordination complexes: the 'low cost' alternative to Iridium?** by Dr Paolo Coppo, Brunel University, UK in which he discussed the problems facing iridium based PHOLED technology. Ir is the 4th rarest element in the earths crust, costs $23,000 per kg, and only 2 tonnes are mined per year. To meet future PHOLED displays and lighting needs, copper-based triplet emitters may be a promising alternative. Paolo has recently synthesized a Cu(I) trinuclear complex with a photoluminescent efficiency of 57% in the green region of the spectrum. This was followed by the second invited presentation of the day on **Organic light-emitting transistors as a multifunctional platform for efficient light generation** by Professor Michele Muccini, CNR Bologna, Italy. He stated that there is a technology bottleneck in the development of AMOLED based displays which is integrating the OTFTs of the backplane with each OLED device.

One way round this is to use organic light emitting transistors (OLETs), which greatly simply fabrication and circuit design. However, so far OLET performance has been very disappointing, only reaching an external quantum efficiency (EQE) of approximately 0.8%. By using electron and hole transport layers on either side of the emissive layer to improve charge transport and reduce polaron-exciton quenching, Michele has been able to fabricate vacuum sublimed OLETs with an EQE of 5%. This should be compared to an optimised OLED with the same material system which only achieved an EQE of 2%. Emission across the whole transistor channel was also achieved. This is a major breakthrough, showing for the first time that OLETs can produce enough light emission for use in displays and other applications.

Paul Wöbkenberg

After the morning coffee break, Professor David Lidzey of the University of Sheffield, UK gave an invited presentation titled **Excitons – strong coupling in an optical microcavity**. He has been investigating the properties and the physics of 1-dimensional microcavities formed by sandwiching an organic semiconductor film between a semi-transparent metal mirror and a highly reflective diffuse Bragg reflector (DBR) mirror, effectively a highly-reflective version of the optical structure of a single layer OLED. When light is shone on the cavity, strong coupling occurs between the photons and any excitons in the cavity, creating a single quantum mechanical particle called a cavity polariton. The optical path length of the cavity, like an LCD, has an angular dependence, producing upper and lower polariton branches in the cavity reflectivity spectrum. Polaritons are bosons, and at low energies in the cavity form a Bose-Einstein Condensate (BEC), the type of quantum mechanical state which occurs in super-fluid Helium. Using J-aggregated cyanine dyes with very narrow linewidths, and very high reflectivity Ni mirrors to give the cavity a high Q value, David has been investigating the variation of the photoluminescent emission with pump intensity, angle and temperature. His results indicate that excitons created in the cavity are scatted by acoustic phonons into the lower energy polariton states on very short timescales of 10 fs, and therefore may be a potential route for building an organic semiconductor laser.

Hiroto Sato

This was followed by a presentation from Dr Paul Wöbkenberg of Imperial titled **Interlayer Lithography for Organic Field-Effect Transistors**. This is a simple patterning technique which involves fewer processing steps than conventional photolithography. Paul demonstrated its use for fabricating the source and drain in both top and bottom gate OFETs using PEDOT, Au and chemically derived graphene (CDG), resulting in high performance n- and p-type and ambipolar transistors, as well as low-voltage devices with SAM gate dielectrics. The next presentation was **High Performance Organic Single Crystal Transistor Fabricated by Solution Process** from Dr Kazuhito Tsukagoshi at MANA, NIMS, Japan. Single crystal OFETs offer very high performance, but are very difficult to process in terms of positioning, contacts and crystal uniformity. By spincoating the small molecule OSC C8-BTBT with PMMA to allow self-organisation via phase separation, and combining it with vapour phase annealing, he was able to create well controlled, very large single crystals with an OFET mobility of 3 cm^2/Vs. The mobility increased with decreasing temperature, a potential signature of band-like transport.

After lunch, the afternoon session started with an invited presentation titled **Electronic paper and organic electronics by** Dr Adrian Geisow from HP Labs, Bristol. HP are developing a demonstrator similar to the iPAD and e-ink readers, and are targeting a range of products using flexible, light-weight displays. About 60% of the total cost is from the display itself and for the TFT backplane most costly are the photolithographic processing steps. To get round this, HP have developed Self Aligned Imprint Lithography (SAIL). This involves a single stamp which imprints different thicknesses of photoresist, which combined with reactive ion or wet etching allows the different layers to be patterned. It can be done by R2R, and amorphous Si TFTs have been fabricated for an e-ink display. However, so far the TFT yield has been a problem, and they are moving to passive matrix. Pixels have been fabricated side by side or in a stack for colours. He also noted how crucial aperture ratio is for reflective displays.

This was followed by a presentation titled **Fabrication of 5-inch QVGA flexible OLED displays driven by organic TFT arrays** by Dr Hiroto Sato from the Japan Broadcasting Corporation (NHK). NHK have fabricated a PhOLED (>10% EQE) based display driven by pentacene TFTs. The fabrication involved a lamination process of SiOx coated PEN onto glass, and the bottom gate, bottom contact TFTs were very stable to bias stress and air exposure. The final display was very flexible and robust with a luminousity of 50 cd/m^2. The next presentation was on **Spray-deposited Li-doped ZnO thin-film transistors with electron mobility exceeding 50 cm^2 / Vs** by Aneeqa Bashir from Imperial. She discussed how ZnO, traditionally used as a sun-block in lotion or as a replacement for ITO in displays, is conventionally processed under high vacuum or using high substrate temperatures. By spray-coating from acetate-based precursors, she was able to process ZnO on a low-temperature substrate, producing highly transparent TFTs with a mobility and on/off ratio of 54 cm^2/Vs and 10^7 respectively.

This was followed by the afternoon tea and coffee break.

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DISPLAYS FOR CHALLENGING ENVIRONMENTS

Report on the one-day meeting at the Heritage Motor Centre, Gaydon

on Tuesday 15 February 2011, by Elvir Hasedzic

This one-day meeting covered the design, development, and application of displays for challenging operating environments. Lee Skrypchuk (JLR) opened the meeting. He highlighted the importance of operation and design constraints and the working requirements within extreme environments. Products specially designed for the extreme environments are furthermore challenged and pressurised by global competitors.

The first talk, entitled**,** ***Enhancing the display readability*** was given b***y*** Steve Riches (GE Aviations Systems) He stated that splitting the ENDVIEW TSB project with partners resulted in an outstanding display product. The lack of readability of displays is a pervasive problem in harsh lighting conditions, particularly in safety-critical applications, where misinterpretation of the data is possible. The ENDVIEW TSB project has tackled this issue through a multi-disciplinary approach involving human-factors studies, modelling and measurement to develop a high-brightness LED array for displays relevant to aerospace/defence, marine and ATM sectors, where a two to three times improvement in readability has been demonstrated in harsh lighting conditions. Through the presentation, Steve shared experimental results for Luminance Just Noticeable Differences (JND) and the use of Luminance JND method to assess the readability of displays. The presentation also showed a brightness LED array integrated with a display having a front of screen luminance of >1500cd/m^2 and a greater than three times increase in JND (readability metric) with options for RGB LED colour tuning and an ITO EMI shield. Steve ended with the optical and thermal modelling capabilities for optimisation of the internal structure and the display.

Steve Riches

This was followed by ***Manufacturing ruggedised displays*** in which Steve Varley (Ginsbury Electronics) highlighted the use of displays for military/non-military, aircraft, shipboard, handheld, in-vehicle and ground-based programmes. Steve emphasised five important design and manufacturing constraints: temperature, humidity, shock and vibration, EMC and sealing IP rating.

The last morning presentation was given by Keith Stickels (Agusta Westland) on, ***The evolution of ruggedised displays in helicopter cockpits.***

Keith discussed how modern helicopter missions are difficult/impossible to fly without multifunction displays. He highlighted that flying in crowded controlled airspace will mandate new sensors and equipment. In addition, today's helicopters are more reliant on technology from other industrial sectors than ever before and long-term support is difficult, as it requires a systematic approach to obsolescence planning. He advised how new avionic infrastructures are required to support high data rates and reliability requirements.

The lunch break gave delegates a great opportunity to visit the very interesting Heritage Centre Motoring Museum. The museum tells the history of the motor car and houses the world's greatest collection of British cars.

The first afternoon talk session ***Displays for challenging environments, w***as given by Chris Knight and Dave Eldridge (Brimar). They stated that old and new technologies can be successfully integrated into highly rugged assemblies fit for military service worldwide. However, when designing displays, the following challenging environments must be considered:

Chris Knight

- Temperature ranges from -50°C to +50°C or over, potentially wider, considering effects of nearby equipment, such as solar radiation, air-conditioning vents etc. Solar effects or equipment location within vehicles can increase top temperature limits to more than 70°C.
- Mechanical vibration profiles for vehicles (like tank track patter), which can be over 4.2gm for a 20Hz-2kHz random vibration profile. The optical output device (CRT, LCD, OLED etc) and electronics need to withstand this constant battering.
- Bump (up to 50g) and gunfire-induced shock (up to 200g). To achieve the levels of ruggedness needed, at commercially acceptable costs, requires that the base technology is suitable right from the start. To add to the complexity of evaluating basic technologies, other factors such as dust and moisture ingress have to be included in the investigation. Other factors affecting the design are tolerance to chemicals and EMC.

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Chris Knight stated that the steps towards designing and building a successful display are:

- Understand the application and physical environment.
- Check environmental specifications against available candidate technologies.
- Test candidate technologies, to destruction if necessary, to establish survivability limits.
- Design the display to prevent elements from experiencing the maximum survivability limits.
- Test and iterate if necessary.
- Integrate the necessary level of housekeeping software (thermal management etc).
- Integrate the necessary HMI (application software).
- Go to field trials and qualification.

This contribution was followed by a presentation on ***Integration of thin film encapsulated flexible organic light emitting diode (OLED) into composites by*** Emile Galand (Huntsmann) She described the integration of OLED into carbon-fibre composites using the racing car ORECA 01 as an example. Huntsman currently offers flexible OLED prototypes. These are prepared via a batch-to-batch process (Holst) and with one to three years shelf life. They are currently studying the impact of physical stresses on OLED lifetime. Huntsman aim to transfer the technology to roll-to-roll at Holst, within the framework of the F2L program. They expect to build the pre-pilot line at Holst by 2011 . Emile advised it would be about three years before flexible OLEDs become commercially available.

Emile Galand

This was followed by ***Holographic projection display systems*** presented by Jamie Christmas (Two Trees Photonics). He talked about how phase only holography is capable of displaying high-quality video images and how early stage developments support this view. His company's technology plan is to optimise LCOS devices, light engines, and acceleration hardware to get closer to theoretical results. Very interestingly and ingeniously, the technology offers remarkable simplicity & efficiency, unrivalled robustness and unique flexibility.

Optimising displays for military fast-jet aircraft was the subject of Paul Barlow's (BAE Systems) contribution. He described:

- The fast-jet cockpit environment.
- The challenges presented to Cockpit Display suppliers and System Integrators.
- Measures employed to address some of these issues on modern combat aircraft
- How we prove the success (or otherwise) of these measures during aircraft development. Issues included a wide variation of temp/humidity/pressure e.g. -55°C to +125°C, high acceleration -3g to +9g, vibration, open cockpit with large acrylic canopy and windscreen, use of night-vision enhancement, limited space, growth of information in the aircraft and the move to emissive display technology with colour. Usability has safety implications for some displays (for example, for the first time, the aircraft uses HUD as primary flying instrument). Paul addressed imperative requirements such as single failures must not result in loss of the whole cockpit, all information displayed must be accurate and the system should be carefully segregated to ensure critical information remains displayed for all single failures.

Jim Colville

In a joint contribution on, ***Displays for use in exterior self-service environments,*** Dr. Phil Day and Jim Colville (NCR Corporation) discussed the increased use of self-service technology, i.e. kiosks & ATMs. These displays exposed to exterior environments, pose a number of challenges including extreme temperature changes, widely varied lighting conditions from dark to direct sunlight, ability to cope with heavy use, usability (whether a wheelchair user or tall person).

Phil Day

They outlined current approaches and presented evaluation results. Minimum requirements for self-service product displays include reliability, durability and long lifespan, legibility, high image quality, sunlight viewable (and yet not dazzling at night), resistant to the effects of glare and reflections, user friendly, high contrast, accessible to all, ability to use as touch screen, visible at a distance (advertising) and yet private (transactions), and most importantly, at the right cost.

There then followed a contribution on ***Display systems for the marine environment.*** This was presented by Richard Jales (Raymarine), who explained challenges in the marine environment; displays exposure to direct sunshine, glare, dark-adapted vision (e.g. dim the display to 0.1cd/m2 and show unlit buoys), water – waves and spray and lots of sea salt. **CONTINUED AT THE FOOT OF PAGE 7**

ADVANCED MATERIALS FOR DISPLAYS

Report on the one-day meeting at Merck Chemicals, Chilworth Technical Centre, Southampton on Thursday 14 April 2011, by Roger Kemp

In order to be at the cutting edge of display technology and stay there, industries and academics alike continue to develop highly functional materials. This one-day meeting focused on a number of advanced materials used in all aspects of displays; from organic electronics for the back plane and reflective fluids for the front plane. Also a number of presentations dealt with creating environmentally-friendly lighting.

The initial presentation by Dr. Johannes Canisius introduced the host venue - Merck Chemicals Ltd, detailing the growth of Merck KGaA in recent years and explaining where the Chilworth Technical Centre fits into the bigger picture as a hub for innovation.

Following this, Prof. Robert Withnall from Brunel University centred on materials for creating white LED's. Essentially by including an advance material to convert some blue light emitted from an LED to yellow; the combination of yellow and blue creating white light. Phosphors were desirable over quantum dots (QD) due to high re-absorption of the QD's. Details of the desirable properties and possible composition of phosphors was supplied.

Dr. Holger Winkler (Merck KGaA) continued the discussion on advanced phosphors in blue LED's for lighting applications. Highlighting that in using LED lighting a vast amount of energy may be saved. At Merck the knowledge of including a yellow phosphor in a blue LED to provide white light has been applied. Merck can provide a series of phosphors which have a broad range of emission colours.

Edgar Böhm (Merck KGaA) finished the morning session by discussing the development status of OLED materials. The active research area is to move from evaporation to solution-processed materials; advantages being ease of process, cost, large-area application and flexible displays. At present, processability has been improved without impairing performance and a 'pool' of materials has been established.

The afternoon session began with an overview of organic electronics by Dr. Mark James (Merck Chemicals). The focus was that of organic thin field transistors (OTFT), the production of which can allow the creation of flexible displays that do not rely upon rigid substrates. Products have been developed at Merck that show performance equal to the a-Si; these products are due to be mass produced.

Moving from the back to the front plane Dr. Mark Goulding (Merck Chemicals) introduced dispersions used in reflective displays. These types of dispersions, currently used in e-readers (Kindle), are designed to mimic paper. At present are only black and white but full colour is desirable. As a result of this, Merck is working colour fluids; where a toolbox approach is applied – Merck aims to supply transmissive and reflective particles tailored to the display manufacturer.

Chris Nice (Samsung/Liquavista) presented recent progress of electrowetting displays. In this instance, electrowetting can be described as three-mode technology; reflective, transmissive and transflective. The electrowetting technology is used as a shutter allowing or preventing light passing through the display. The presentation culminated in a video showing a flexible display containing the technology.

The final talk of the day was by Dr. Graham Smith (Merck Chemicals) concerning application of reactive mesogens for 3D displays. Patterned reactive mesogens (polymerisable liquid crystals) layers in conjunction with polarised glasses are the core technology behind 3D displays. In a maturing market, it is crucial to stay at the forefront with the next generation, negative dispersion materials, currently being developed.

DISPLAYS FOR CHALLENGING ENVIRONMENTS

Continued from Page 6

He stated that the minimal information display requirement is to show basic textual navigational information e.g. heading, distance to the next course change, position. Additional requirements include to be able to display: the chart symbols to mark the way (turn left or right, away from danger), radar images, pictures to show expected view of arrival outside harbour (pilotage), weather charts and entertainment when moored, and finally to display information when the user wears the polarising spectacles. Richard highlighted how it is important to understand the supplier's specifications and what a 12 o'clock viewing angle means.

The final session, ***Physics-based optical-modelling and simulation for displays.was presented by*** Chris Grieve and Peter Moorhouse (Optis). They describe how their simulation software is capable of delivering predictive, photo realistic simulation highlighting potential problems. Optis has a complete toolset, showing problems and offering solutions. Usefully, Optis software has a proven virtual prototyping in context, which is saving on physical mock ups and getting to the market quicker with a higher quality. Optis offers total light management, from diagnosing problems to providing the optimized final product. Optis allows you to explore design alternatives instantly and minimize costly prototypes. In short, you can optimize the lighting performance, optical efficiency, visual appearance, perceived quality, and colours of your future products in a fraction of the time and cost of conventional methods.

UK AND IRELAND CHAPTER ANNUAL GENERAL MEETING

On Thursday 14 April 2011 at Merck Chemicals, Chilworth Technical Centre, Southampton

At the chapter AGM, the following officers were elected

Director	Dr Sally Day
Chair	Myrddin Jones
Vice-chair	Dr Alasdair Campbell
Secretary	Graham Weaver
Treasurer	Dr Lesley Parry-Jones
Membership secretary	Dr Lesley Parry-Jones
Meetings Registrar & Newsletter Editor	Dr John Mansell

It was announced at the AGM, that Mrs Pat Crofts, treasurer and membership secretary for many years, would retire. Pat joined the committee while working at RARDE, Chertsey and became Treasurer in 1990. In 1995 she also took on the role of membership secretary from Neville Milward. She continued with these two roles until her retirement from the committee.

Ian Sage thanked Pat for her valuable contribution to the committee for many years and made a presentation on behalf of the committee

Ian Sage making a presentation to Pat Crofts

The final invited presentation of the day was titled **Towards integrated organic photonics** by Dr Graham Turnbull from the University of St Andrews. Organic semiconductors have many advantages in terms of having a large optical gain, are compact, have broad emission, and are tunable across the visible. He discussed the fabrication of 1D-, 2D- and circular DBR gratings for optical feedback and gain. Using solvent-assisted micromolding with an elastomer mold, 2D-DBRs have been made with a pitch of 400 nm, allowing the fabrication of a corrugated OLED with much higher light output at the grating modes. UV nanoimprint lithography was used to fabricate 2D-DBRs with a pitch of 150 nm, resulting in a flexible, low threshold laser. Graham has developed an optical concentrator based on SU8 doped with a coumarin dye, which when pumped by an inorganic LED has a maximum input / output ratio at a 2-3% by wt dye concentration. The concentrator can then be used to pump an organic film, lowering the excitation threshold compared to using the LED alone by a factor of five. He then discussed the difficulties of making a good edge to an organic film for in-plane integration. By clamping the light emitting polymer layer between layers of a brittle material, it is possible to produce a high quality optical facet which halves the ASE threshold and can form an end-fired optical amplifier. This was followed by a presentation on **Electrical Characterisation and modelling of novel polymer OLED's** by Gerard Cummins from the University of Edinburgh. He was able to model the current-voltage characteristics and impedance response of photopaternable cross-linkable polymer OLED pixels for a micro-display fabricated by the University of Cologne within the EC HYPOLED project. The final talk of the day was a presentation on **Polymer Semiconductors as optically tuneable dielectrics in microwave devices** by Dr Theo Kreouzis from QMUL. He presented some unique work looking at the use of Al microwave antenna resonators fabricated on conjugated polymers such as P3HT. The carrier concentration in the polymer should affect the dielectric constant and hence the frequency response, and he found that the microwave phase shift between the input and output signal varied with the intensity of light shone on the P3HT film.

Finally, the prize for the best poster awards were announced, and the meeting was closed by the conference chair.

SID ORGANIC ELECTRONICS UK 2011

Two-day meeting 5-6 September 2011

Imperial College, London, SW7 2AZ

Numbers are limited, so early registration is recommended

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