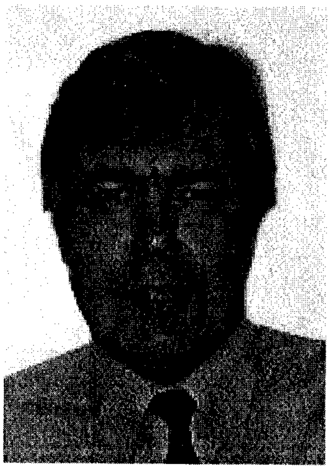
BRITISH LIQUID CRYSTAL SOCIETY

LIQUID CRYSTAL NEWS

November 2003

GW Gray Medal for 2003
Harry Coles



Harry Coles completed his undergraduate studies in Physics at Queen Elizabeth College, the University of London in 1971 with the award of his bachelor's degree and the Goldsmith Prize for Theoretical Physics. He went on to Brunel University as a post-graduate student from 1971-1974 where he completed his PhD in 1975 while doing a further year as a Post-doctoral Research fellow. His PhD thesis was on Electro-Optics and this naturally brought him into contact with liquid crystals at a very exciting time when new materials for technological applications and new liquid crystal devices were developing rapidly. Following a year as Royal Society European Fellow at Strasbourg, he returned to Brunel University for one year as an SERC Research Fellow before returning to Strasbourg to the Universite Louis Pasteur for 3 years as visiting lecturer. He then went to the University of Manchester as lecturer in 1980. Promotion followed through Senior Lecturer, Reader, and Director of the Manchester Polymer Centre and led ultimately to his appointment as Professor of Applied Physics in 1991. He remained at Manchester until 1995 when he accepted the position of Professor of Physics and Director of the Liquid Crystal Institute at the University of Southampton. Finally, he left Southampton in 2002 to take up his present position as Professor of Photonics of Molecular Materials in the Department of Engineering in the University of Cambridge.

His first publication on liquid crystals appeared in 1976 and he has been researching with vigour and foresight in the field since then. However, his earliest research was on the use of laser light to characterise biological cells, viruses and DNA, specifically the scattering of near infra-red laser light by bacteria and other particulates, using the Zimm method to interpret the data and monitor their behaviour. His early research also involved in depth studies of the Optical Kerr Effect in biological and polymer systems, and this led on naturally to studies of liquid crystal systems.

Any attempt to review Harry's extensive published research since 1974 would demand much more space than is available here, and one can only attempt to summarise the main features briefly. Essentially Harry is distinguished internationally for his pioneering work, much of it seminal, on physical studies of soft condensed matter, latterly largely liquid crystals. The physical techniques that he has designed and developed for this purpose have involved many forms of light scattering, confocal Raman microprobe dynamic spectroscopy, the optical Kerr Effect and others as applied to low molar mass liquid crystals, liquid crystal side group polymers, organic liquids and multifunctional liquid crystals. This range of materials has involved him at the interface of chemistry and physics, and biology too, and it is this multidisciplinary approach which characterises his work, and which has led him to make such advances in the fundamental knowledge of liquid crystals and so many practical innovations such as applications of liquid crystals in thermography, optical data storage, non-linear optics and optoelectronic devices.

His innovative capacity and his uniqueness as a physicist who understands chemistry and molecules has led him to patent many novel materials and applications relating to devices such as "rewritable many times" compact discs, complex large area flat panel ferroelectric and anti ferroelectric displays and to telecommunication devices. Among his latest successes are those in the area of nematic flexoelectric materials and the exciting family of self-organising organosiloxane liquid crystals, again of interest for ferro- and antiferro-electric applications and for their inherent property of micrsegregation which bestows upon them a degree of ruggedness.

As a physicist with multidisciplinary abilities, Harry has therefore become an important and influential national and international figure in the field of liquid crystals. He is not however an aloof and unapproachable personality, and his warmth, the twinkle in the eye and his humanity enthuse and invigorate those around him, including the many PhD students and post-doctoral researchers who have trained with him over his nearly 30 years of academic research. His personality also promotes success in the collaborative research interactions in which his group is involved with other universities and with several major industrial concerns. From the latter he succeeded in bringing in very high levels of funding for his research activities. Also, his enthusiasm for liquid crystals has always guaranteed that he gives unsparingly of his time to promote national activities in the field. He was for example a mainstay of support and hard work for the Tenth International Liquid Crystal conference in York in 1984, as he was again in 2002 for the Nineteenth Conference in Edinburgh. He has also willingly organised meetings of the national body - the British liquid Crystal Society, which promotes presentations of young workers in the field.

As noted earlier, Harry was Professor of Physics and Director of the Liquid Crystal Institute in Southampton from 1995-2002, but the success of the institute was always limited by the lack of new, young staff to help to bind the different internal units together and to promote and expand its unified activities. Eventually, perhaps frustrated by such matters he left Southampton in 2002, taking with him his entire group and also the Faraday COMIT Partnership which he had newly set up as its Director. Together I am sure with those who may read this, it is a pleasure to wish him success and happiness in Cambridge.

It was with pleasure that I presented to Harry at the British Liquid Crystal Society Meeting in Cambridge in 2002, the medal which bears my name and was first conceived by Geoffrey Luckhurst to mark the award to me in Japan in 1995 of the Kyoto Laureate and Gold Medal in Advanced Technology. The award to Harry of the George Gray Medal marks his pioneering and innovative contributions to liquid crystal science, and it is my belief that his achievements are fully in accord with those of the earlier eminent recipients of the medal since its inception.

Professor G W Gray FRS CBE

BRITISH LIQUID CRYSTAL SOCIETY

First Announcement

The BLCS Annual Conference 2004

All Saints
Manchester Metropolitan University
April 5 – 7th 2004

The BLCS annual meeting (AGM) and conference will be held from April 5th to 7th All Saints Manchester Metropolitan University. The main emphasis of the conference is for students to present their latest research work along with invited talks and the Sturgeon lecture. Papers are requested on any topic related to liquid crystal materials and their applications.

For more information please see the website:

http://www.sci-eng.mmu.ac.uk/blcs2004/

Report on Luminescent Liquid Crystals meeting IOP, March 5, 2003

Recent advances in organic electroluminescence and lasing has triggered renewed interest in liquid crystals which are light-emitting and/or charge transporting. The BLCS sponsored a half-day meeting on "Luminescent Liquid Crystals" to discuss new developments in the area. Eight oral presentations were made to an audience of 35, packed into the Guthrie room of the Institute of Physics. The presentations were divided into two categories: chiral systems, where the emission properties are modified by the 1-D photonic stopband of the helix, and liquid crystals for electronic charge conduction or electroluminescence. J Schmidtke from Freiburg gave a quantitative analysis of the enhancement of photoluminescence at resonant frequencies at the stop-band edge of chiral helices. This property can be exploited in mirrorless laser systems as detailed by J. Wilmott from Cambridge and M. Grell from Sheffield. Schmidtke introduced a new defect laser mode with a reduced laser threshold.

K. Woon from Hull discussed circular polarised emission from a novel luminescent chiral LC with an unusually broad stopband. An iridescent traffic light device, where the three colours are observed at different angles, was described by K. Bjorknas from Oxford. Liquid crystalline polymer networks are a potentially low-cost option to fabricate multilayer electroluminescent devices with the added advantage of being photolithographically patternable. S. Kelly from Hull discussed these properties and also introduced new luminescent mixtures that are nematic at room temperature. P. Glarvey from Sheffield outlined the synthesis and characterisation of reactive mesogens with polymerisable oxetane end-groups for polarised emission. Finally, A. McNeill from Leeds showed how the modification of surface layers dramatically enhances current injection and conduction in discotic LCs.

Mary O'Neill

CMMPE (CM^{2}PE) is up and running

A new centre for the study of photonics opened in February at the Cambridge Science Park. The venture brings together three groups from the University's Engineering Department, in collaboration with several other University departments and industrial partners to investigate the different aspects of photonics, applications and materials.

CMMPE will specifically look at the application of polymers, nano-structures and liquid crystals to display, telecommunications and light emitting devices. An underpinning research theme of the Centre will be the applications of organic materials and related hybrid structures to photonics and electronics.

The Centre will be led by Professor Harry Coles, a leading researcher in this field recently recruited by Cambridge from Southampton University. It will also provide a forum for collaboration between University research groups, in particular those headed by Professor Ian White, Dr Eugene Terentjev, Professor Richard Friend, Professor Bill Milne, Professor Bill Crossland and Professor Andrew Holmes.

CMMPE's Director, Professor Coles said: "The launch of CMMPE puts Cambridge at the cutting edge of photonics research. Through inter-departmental and industrial collaboration, the Centre will enable significant advances that will filter down into the marketplace with the emergence of new 3D TV displays and telecommunications devices, such as mobile phones and palm tops."

The proximity of the Centre to other industries on the Science Park is an important factor - industrial interest will be provided through strategic partnerships and discussions have already been held with companies including Dow Corning, Pi-Photonics and CRL.

BLCS Young Scientist Lecture 2003

The complementary polytopic interaction in discotic liquid crystals

OWEN R. LOZMAN
SOMS Centre, Leeds. (owenl@chem.leeds.ac.uk)

Introduction

Discotic liquid crystals are formed by disk-like molecules with aromatic cores and hydrophobic (thermotropic) or hydrophilic (lyotropic) side chains. The nematic discotic phase can be the first to form as the melt is cooled; the molecules are oriented with their short axis parallel to the director of the phase but have no positional order. More commonly the more ordered columnar phases are the only ones to form. A hierarchy of columnar phases are possible and as with the smectic phases formed by calamitic molecules, the columnar mesophases are characterised in terms of their symmetry and the degree and range of orientational and positional ordering of the molecules (Figure 1).[1]

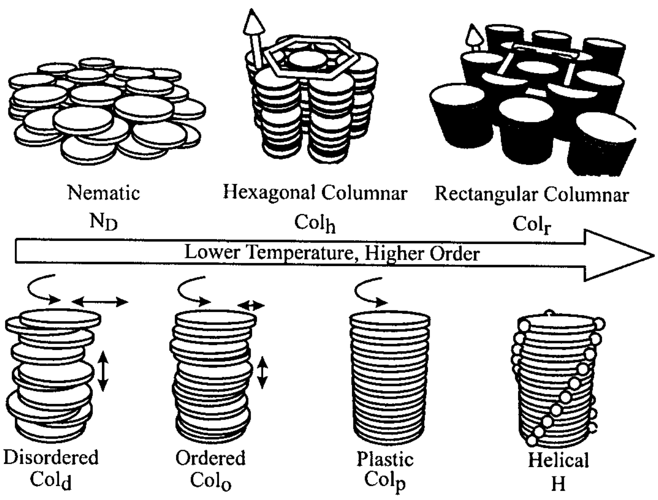
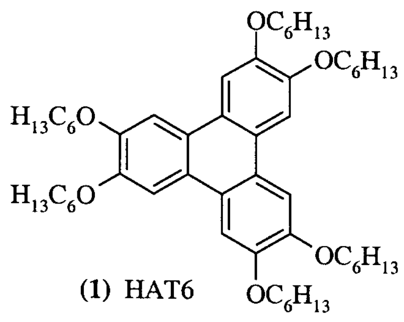


Figure 1. The hierarchy of columnar phases exhibited by disk-shaped molecules.

This article summarises our recent efforts to improve the applicable properties of triphenylene based discotic liquid crystals, particularly with regard to their use as one-dimensional molecular wires.

HAT6 (1) exhibits a hexagonal columnar phase between 70 and 100°C, in which the molecules are stacked into columns with the columns arranged on a hexagonal lattice. The stacked aromatic nuclei of the molecules form the conducting core of a one-dimensional molecular wire with the flexible alkyl side-chains providing enough insulation to prevent the charge carriers hopping between columns. The columnar liquid crystal phase effectively constitutes an array of wires, with each wire measuring just 2.2nm in diameter (figure 2).[2]



(1) HAT6

The molecules within the columns are in constant motion, rotating and diffusing column to column, allowing defects to be annealed out and providing an attractive advantage over solid-state alternatives (Figure 2). The self-healing nature of the liquid crystal phase provides us with the advantage that any defects can be annealed out relatively easily. The disadvantage is that the local disorder narrows the band structure and reduces the mobility of the charge-carriers. An ideal one-dimensional molecular wire would be where the balance between order and disorder is such that the advantageous self-healing process is still possible but sufficient long-range order persists to allow efficient passage of charge along the aromatic cores. [3]

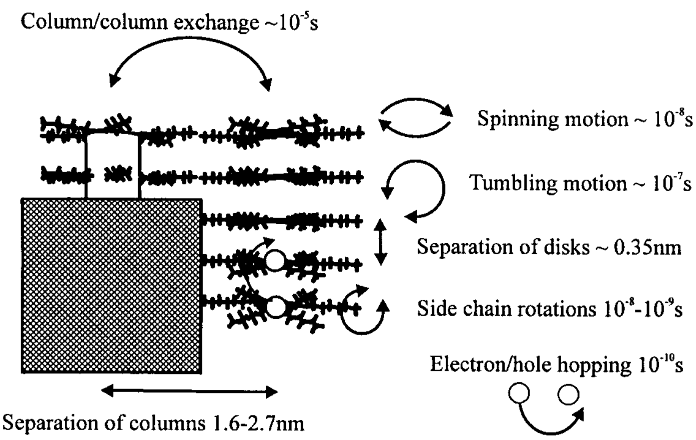


Figure 2. The columnar phase can behave as a dynamic array of molecular wires (shaded box; insulating side-chains, unshaded box; conducting core). Typical rate constants for the Col_{ho} phase.

Engineering of stabilised columnar stacks – Net quadrupolar interaction

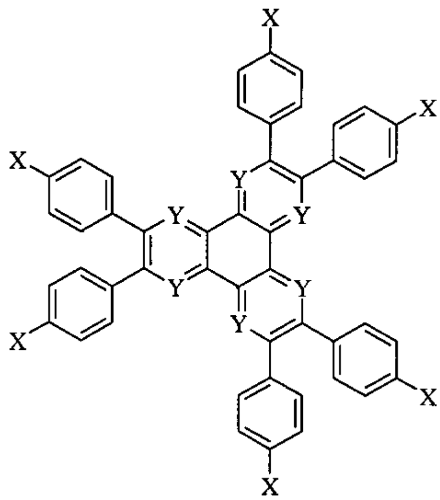
It is possible to increase the mobility by creating systems with large aryl cores, but such materials are; sparingly soluble, difficult to obtain in high purity and yield and suffer from alignment problems (clearing temperatures are often too high to allow thermal annealing and they tend to align planar rather than homeotropic). A more attractive solution to the mobility problem is to create systems with more ordered stacks such as the helical phase of 2,3,6,7,10,11-hexakis(hexylthio)triphenylene (HTT6).[4]

Although van der Waals interactions stabilise ordered face-to-face, in-register aryl core alignment, this geometry is often destabilised by unfavourable coulombic interactions such that, in the crystal, the molecules adopt a herring-bone arrangement (as in benzene). However, quadrupolar interactions can be made to stabilise face-to-face, in-register stacking if we create alternating $(AB)_n$ two component systems where the molecules A and B bear opposite quadrupole moments (such as benzene + perfluorobenzene) . Hence a good strategy for creating more ordered columnar mesophases higher charge carrier mobility is to create a two-component alternating stack with the proviso that the two components have similar ionisation potentials (so that charge-carriers do not experience a strongly undulating potential on their path to the counter electrode).

In the past discotic liquid crystals have been mixed with electron poor species such as TNF. The net quadrupolar interaction between electron rich and species produces more stable columns with better charge transport properties. Mixtures of HAT6 and TNF are non-stoichiometric, indicating that there is not a strong overall tendency to form an alternating $(AB)_n$ stack. In order to improve the packing between the triphenylene molecules and the electron deficient species one must aim to improve the "complementarity" of the two molecules. Consideration of the interacting molecules as net-quadupoles leads to the conclusion that by increasing the magnitude of the opposite interacting quadrupoles one can improve the coulombic contribution to the intermolecular interaction. This treatment also allows the simulation of bulk phase behaviour (via monte-carlo simulations using Gay-Berne disks with associated net quadrupoles). In practice however this method does not allow the quantitative calculation of an intermolecular interaction between two "real" complementary molecules. The electronic and steric influences of the molecules on one another cannot be averaged over the whole surface of intermolecular contact especially as the molecular complexity increases.

XED (extended electron distribution) Systems

Hunter and Sanders used the XED approach to rationalise the geometry of interacting porphryin rings and found that the sum of the interactions at individual points of molecular contact were far more important in determining the geometry of the interacting rings than was the net quadrupolar interaction.[5] Indeed we have found that this provides a far more comprehensive description of coulombic interactions than the net quadrupolar model. By distributing pi and non-bonded electrons away from the atomic centres a more realistic charge-distribution can be calculated that includes the contribution from the individual points of intermolecular contact. By allowing for these disperse multipolar interactions we have been able to model a wide range of AB mixtures and successfully predict compounds that compounds are formed when they are observed to do so empirically.[6]



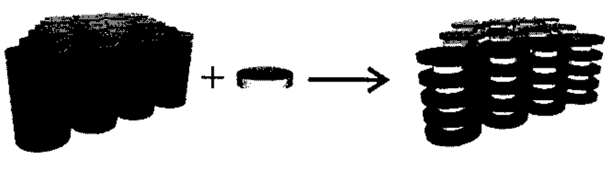
(2) PTP9, X=C_9H_{19}, Y=CH
(3) PDQ9, X=C_9H_{19}, Y=N

Discotic liquid crystals stabilised by complimentary polytopic interactions

We introduced the term complimentary polytopic interaction (CPI) to describe the combined effect of many weak intermolecular interactions over the entire contact surface of two molecules. Each contribution to the interaction, whether it be coulombic or steric in nature, is relatively insignificant when taken in isolation, but the sum of the interactions across the many interacting sites can produce a significant overall interaction. In the case of the triphenylene discotics the complimentary molecule chosen was hexaphenylated triphenylene (2) or aza-triphenylene (3).[7] In these molecules the peripheral phenyl groups are arranged in a propeller-like array to provide both: 1) a bay of sufficient size to accommodate the triphenylene discotic and 2) strong dispersed quadrupole-quadrupole interactions. The resulting liquid crystalline mixtures have properties very different from the component molecules, displaying a higher melting point and greater mesophase range, more significantly there is a better ordering of the aromatic core of the molecules with the columns.[8] The side chains of the mixture maintain the fluidity of the phase, producing a liquid crystal in which most of the disorder is in the peripheral region of the molecular wire, leaving the conducting central core relatively ordered in comparison to other low molecular weight discotic liquid crystals. In other words this satisfies the criteria previously outlined as the paradigm of a self-assembled one-dimensional molecular wire.

Enhanced liquid crystal properties of CPI Discotics.

Unlike the mixtures formed between HAT (1) and the TNF (2) derivatives the polyphenylated materials exclusively form compounds with exact 1:1 stoichiometry. These compounds melt isothermally and are immiscible with either component. For the range of polyphenylated compliments studied the phase diagrams are remarkably similar, showing large biphasic regions and a flat liquidus. The phase transitions were successfully modelled by assuming that the HAT/PTP mixture is ideal and the only parameters required for these fits are the transition temperatures and enthalpies of the components and the binary CPI compound. For these reasons we feel that is more accurate to describe the stoichiometric mixture of HAT with polyphenylated (aza) triphenylene as a "compound" (in the thermodyanamic sense) rather than a simple mixture. This compound is only held together by intermolecular CPI's; chromatographic analysis shows the components to be easily separated indicating that there is no permanent covalent bonding between the components. The compounds are also invariably the same colour as the component materials, proving that there is no charge-transfer accompanying the formation of the compound (the UV/VIS spectrum of the compound is the linear combination of the component spectra). This is one of few known instances where such strong complimentary binding has been observed in the absence of charge-transfer (and hydrogen bonding).[8]



It has also been shown that the applicability of the CPI principle is almost universal in its effects on triphenylene containing molecules, inducing liquid crystalline phases into non-mesogenic materials and improving the bulk ordering and alignment properties in polymeric systems.[9] We have also shown that block copolymers containing repeated triphenylene units can be made to micro phase-separate into well-defined domains of polymer chain and CPI-discotic liquid crystal.

Enhanced conduction in CPI discotic liquid crystals.

These mixtures not only provide a novel way of designing π-stacked systems but the mixtures obtained in this way are also better photoconductors, with higher charge carrier mobility's than the discotic liquid crystal **1*n*** on its own. HAT11+PTP9 has a hole mobility of μ_{+}~$2x10^{-2}cm^{2}V^{-1}s^{-1}$ compared to μ_{+}~$3x10^{-4}cm^{2}V^{-1}s^{-1}$ for HAT11 alone). This enhanced mobility begins to approach the highest known values for discotic liquid crystals ($1x10^{-1}cm^{2}V^{-1}s^{-1}$ in the H phase of HTT6).[10]

Engineering of CPI systems.

Although the initial discovery that the HAT systems could be stabilised so dramatically through combination with stoichiometric amounts of PDQ9 was made by accident, it took careful theoretical and empirical treatment before a satisfactory understanding of these phenomena were reached. The treatment of the complementary polytopic interaction as a combination of dispersed quadrupolar and van der Waals terms has been applied successfully to other complementary AB mixtures found in the literature, such as these arising through arene-perfluroarene interactions. In order to now exploit this technology and design new supramolecular architectures we are now working towards the de-novo design of new complementary molecular pairs.

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Hot LCD News

Sharp goes LCD 3D

NTT DoCoMo Inc has been releasing a succession of new mobile phone models with a built-in camera that enables the user to take pictures of more than one million pixels. It started selling the "Mova SH505i" model on June 20, 2003. One of the features of the SH505i is that it is equipped with a liquid-crystal display (LCD) panel that shows three-dimensional images.

In March 2003, five major Japanese companies formed a 3D Consortium to encourage the growth and development of a mass market for 3D products and applications. The Consortium's objective is the commercialisation of 3D stereographic displays without glasses including the creation, development and distribution of content.

The five steering members of the Consortium are Itochu Corporation, NTT DATA Corporation, Sanyo Electric Co. Ltd., Sharp Corporation and Sony Corporation. In addition to the five steering members, the 3D Consortium includes a number of hardware manufacturers, software vendors, content vendors and providers, system integrators, video production houses, broadcasters and academic organizations.
In September 2002, Sharp announced the start of manufacture of 3D liquid crystal displays. Members of SLE described the development of the technology. The initial concept was demonstrated using two separate liquid crystal displays.

In 1994, the first single panel system was demonstrated by interlacing two different images on the same LCD. A parallax barrier was used to reveal them to the left and right eyes of the viewer, simultaneously and independently. This was a fixed 3D system. The invention of a light barrier, which made use of light exclusion from polarisation effects, made it possible to switch a display mechanically from 2D to 3D. Then in 2001, another breakthrough made it possible to switch the display electronically from 2D to 3D. This finally achieved the goal, of a full resolution 2D display that can be rapidly and electronically switched to 3D. The user can then perceive depth in the image, without having to wear glasses, or use other aids. The image is also comfortable to view for long periods. It is this technology which Sharp is now putting into production.

Huntington Beach, California, October 13 - Sharp Systems of America today announced the Sharp Actius RD3D, the world's first notebook computer that incorporates Sharp's 3D TFT-LCD technology.

Details at www.sle.sharp.co.uk.

LG.Philips LCD Rated Number One LCD Supplier (according to DisplaySearch)

DisplaySearch has released its 300-page Customer Satisfaction Report: TFT LCD Manufacturers, in which buyers representing 60 percent of large-area display purchases rate their flat-panel suppliers on quality, technology, logistics, service and support, and commercial terms. In the report, system makers Acer, AmTRAN, AOC, ASUSTeK, BenQ, Clevo, Compal, Coretronics, Dell, Elitegroup Computer, FIC, Fujitsu, Fujitsu Siemens, Hitachi, HP, IBM, Jean, Lite-On, NEC, Philips, Proview, Sampo, Samsung, Sharp, Tatung, ViewSonic and Wistron rated leading display suppliers.

LG.Philips LCD was the top-rated supplier for the second consecutive year, earning the highest score from LCD-monitor brands, notebook-PC brands, and notebook-PC OEMs, although its score from LCD-monitor OEMs was below the mean. Hitachi finished second overall, followed by Samsung, CMO, and AUO. LG.Philips LCD earned the highest score from LCD-monitor manufacturers in technology, logistics, commercial terms and service/support, while Sharp was rated the highest for quality. NEC enjoyed the highest year-to-year improvement according to LCD monitor manufacturers.
On a regional basis, Korean suppliers led every category in LCD monitors. In notebook PCs, Japanese suppliers led in quality and logistics, Korean suppliers led in service/support and technology, and Taiwan suppliers led in commercial terms.

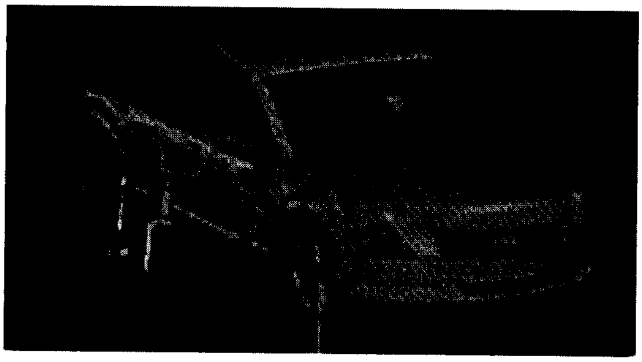
Information: www.displaysearch.com.

Spatial Light Modulators Enable 3-D Holographic Displays at Video Frame Rates

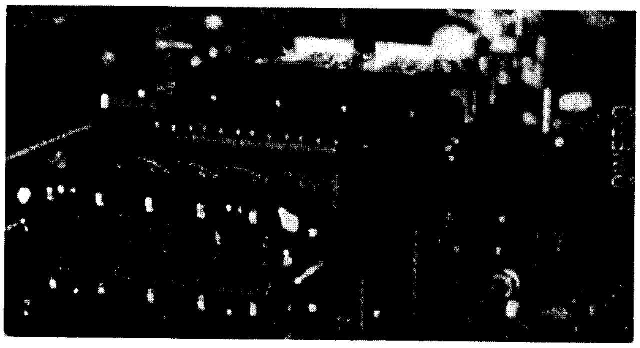
Reconfigurable computer-generated holography, or electro-holography, uses computer-held data to generate interactive, high-quality 3-D displays. Sophisticated applications such as tactical information displays and medical data visualization drive requirements for these types of displays, which include huge pixel counts, video-rate projection speeds, and compatibility with simultaneous, multi-user viewing in a natural environment without special virtual-reality gear.

Achieving the required specifications is a very challenging proposition. Consider a full-parallax, monochromatic image with a lateral extent of 0.5m, a 30° field of view, and a 500-nm readout beam. The associated display system would require 10^{12} Pixels. Various techniques can help compress the pixel counts to more manageable levels of 10^9. Still, these specifications put heavy demands on the computer-generated hologram (CGH) design algorithms and display engines. Now, researchers in the Innovative Displays Group at QinetiQ (Malvern, UK) have developed a display engine technology based on spatial light modulators that is compatible with these requirements.

The display engine combines an electrically addressed spatial light modulator (EASLM), an optically addressed spatial light modulator (OASLM), and imaging optics. The system works by segmenting the large CGH dam sets into tiles, or smaller image sections, for sequential display on the EASLM. These 2-D data segments are imaged onto the photosensor of the OASLM. The image is then read out from the other side of the OASLM using a laser beam. This architecture takes advantage of the high temporal bandwidth of the EASLM by writing tiles sequentially across its active area at interactive display rates.



This full -parallax, 3-D image produced from a CGH (left) can be produced by systems such as this 4 x 1 channel AT unit (right), which delivers a CGH of W pixels. At the front of the device is the amorphous silicon ferroelectric liquid crystal OASLM with a 140 mm x 35 mm active area.



The entire OASLM can be addressed at video rates by synchronising the appropriate frames from the EASLM with shutters on the write side of the OASLM. This approach is highly parallel, so it is possible to run separate image channels. The system can be designed so that multiple channels can be stacked together in parallel to deliver the required pixel counts. This design also minimises the required dam feed rates for each channel. Once the CGH pattern has been built up and displayed on the OASLM, the pattern can be used to diffract a coherent readout beam. After passing through Fourier transforming and magnification optics, the desired 3-D image is formed in space and can be viewed and manipulated.

CGH pixel-pattern calculations based on diffraction-specific algorithms yield image resolutions consistent with that of the human eye. This permits a tradeoff between image quality and computational speed. 'These images contain all the depth cues used by the human visual system' says QinetiQ's Chris Slinger. Projection of the display requires conversion of the CGH from electrical pixels to optical images.

Recent technical demonstrations include fixed color and monochromatic images from the CGH with pixel counts in excess of 2 x 10^9 and holographic images in excess of 300 mm (see figure). The group has demonstrated a four-channel system that generates 3-D, full-parallax, monochrome images from a reconfigurable CGH containing 10^8 pixels (20,480 wide x 5120 high x 6.6-um pixel spacing), a significant advance over previous reports of 36 x 10^6 pixels. At a size of 450 mm x 220 mm x 110 mm, this four-channel active-tiling system is compact, modular, and scalable to the 10^9 to 10^{10} pixel counts required for a practical electro-holographic 3-D display system. –

Michael Brownell (SPIE news)

Toshiba Demonstrates 'System on Glass' Display with Built in Image Capture

Toshiba America Electronic Components, Inc. (TAEC)* has developed the world's first input display, a novel concept that allows it to capture images directly via sensors within a thin film transistor (TFT) liquid crystal display (LCD).
The prototype is a 3.5-inch diagonal low-temperature polysilicon (LTPS) TFT LCD with QVGA (320 x 240) resolution format. In addition to the ability to display color images, it includes a data input function that enables it to capture images such as photos or printed text. The input resolution at which the image is captured and re-displayed is up to 960 x 240 (for monochrome images). The input function is achieved through photo sensor devices embedded in the LCD.

Toshiba Matsushita Display Technology Co., Ltd (TMD) is pursuing LTPS as a core technology for future development of System on Glass (SOG) displays. The company's first step in developing SOG capability using LTPS technology was to fabricate peripheral driver LSI circuitry directly onto the LCD. As a second step, TMD has successfully provided LCD modules with built-in static random access memory (SRAM) and digital analog converter (DAC) for the cellular phone market. Today, TMD has successfully developed a prototype LTPS TFT LCD with an input function.

The input display is different from a camera, in that it inputs an actual-size image directly from the built-in image sensors. The input display technology opens opportunities for new applications for personal and business use. For example, this technology could be used to capture data from a catalog, read barcodes, recognize and authenticate fingerprints for security applications, or import a private route map into a PDA from a navigation system. TMD will continue to refine the technology to improve software and resolution and to develop applications such as fingerprint recognition for e-commerce and financial transactions.

Information: www.toshiba.com

Three Five spin off an LCOS arm

TEMPE, Ariz., Aug. 27 Three-Five Systems, Inc. (TFS), today stated that the previously announced spin-off of its Microdisplay division will become effective September 15, 2003. When the spin-off is completed on that date, the Microdisplay division will operate as a separate company called Brillian Corporation.

Jack Saltich, President and CEO of TFS, said, "This spin-off is a rare opportunity for the shareholders of TFS to own stock in two very exciting, public companies. We expect that the spin-off will facilitate the growth of the microdisplay business, allow TFS' stockholders to participate directly in the growth potential of Brillian Corporation, and enable TFS to more quickly return to profitability. As previously announced, I will remain President and CEO of TFS. I will also serve as Chairman of the Board for Brillian Corporation, and Vincent Sollitto will serve as President and CEO. Together we will work to enhance each company's growth opportunities and prospects."

After the spin-off, TFS and Brillian Corporation will each continue to maintain corporate headquarters in the Tempe, Arizona facility, which is owned by TFS and houses Brillian Corporation's high-volume microdisplay manufacturing operations. Brillian will also maintain its Personal Display Systems Group in Boulder, Colorado.
Brillian Corporation will continue to focus on developing, manufacturing, and marketing innovative, high-performance, cost-effective microdisplay products and systems. These products address both existing and emerging markets, including rear-projection high-definition televisions, multi-media front projectors, and near-to-eye products, such as monocular or binocular headsets or viewers for industrial, medical, military, commercial, and consumer applications. Brillian's LCoS(TM) microdisplay technology cost- effectively addresses the market demand for high image fidelity, high resolution, and power efficiency. As a separate company, Brillian will have greater freedom to innovate and independently explore and expand the most appropriate growth opportunities for that business. The separation will also benefit Brillian by enhancing opportunities for strategic alliances and partnerships with key customers, suppliers, and developers. Separate management and ownership will also provide incentives for Brillian's management and ensure direct accountability to public investors.

Information: www.threefive.com

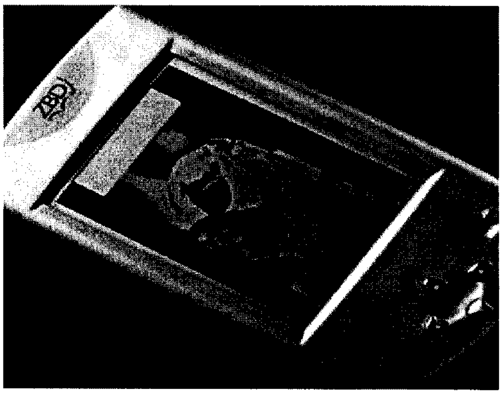
ZBD Displays Limited paves the way to zero power colour displays

ZBD Displays Limited (ZBD), a leading supplier of rugged, high quality displays for portable devices, is firmly on the route to colour displays which use zero power between updates, having demonstrated four error-free analogue grey levels.

ZBD's latest demonstrator is constructed to provide greyscale to an excellent degree of clarity by varying the shape of its proprietary grating within each individual pixel. Unlike other bi-stable displays, such as bi-stable twisted nematic, electrophoretic inks and cholesteric displays, the production of greyscale on a ZBD display begins at the design stage when the grating is put down, resulting in reproducible greys at no additional cost. In addition, ZBD displays are suitable for use with commercial off-the-shelf display drivers.

As a result, ZBD is paving the way to colour displays that rival TFT displays' front-of-screen performance at considerably lower cost and power. ZBD displays also have the advantage of being able to leverage all the technological advances made in other LCD technologies, including brightness enhancement, electronics and colour filters.

Henri-Luc Martin, CEO, ZBD Displays Limited, comments, "This is an extremely exciting time for ZBD. The development of the greyscale demonstrator shows the capabilities of our technology to offer both greyscale and eventually colour."



Information: www.sid.org

Samsung vs LG: The World's Largest TFT-LCD Television?

Samsung has unveiled its Thin Film Transistor, Liquid Crystal Display (TFT-LCD) 54-inch television - the world's largest TFT-LCD TV at the time...

A flat panel TV of this size was previously possible only with plasma display panel technology. Now, the inherent qualities of TFT-LCD TV present a crisper image, higher resolution and much less power consumption - and a lighter weight. With the introduction of the new 54-inch TFT-LCD TV, Samsung Electronics is clearly demonstrating that it is ready to take the lead in living room big-screen TV.

Samsung's new 54-inch TFT-LCD TV also excels in performance. Its less than 12ms response time - a crucial indicator of a TFT-LCD TV's motion picture capability - ensures a smooth playback of even the most action-packed visual contents. With a 1920 x 1080 resolution and 16:9 screen ratio, it is fully HD ready and can accommodate future changes in broadcasting.

The image on screen is exceptionally bright, crisp and vibrant, with brightness of 500 nits (cd/m^2), a contrast ratio of 800:1 and colour temperature of 10,000 K.

Despite its unprecedented screen size, the 54-inch TFT-LCD TV is exceptionally thin and light, even for a flat-panel television. The TFT-LCD module is only two inches thick and weighs just 44 pounds - this makes mounting easier than all other models now available. The TV can also double as a gigantic computer display because of its built-in DVI-I port. These advanced features and unique screen size, combined with TFT-LCD's inherent crisp display characteristics, make 54-inch TFT-LCD TV one of the most advanced display products available in the market.

At FPD International 2003, LG.Philips LCD introduced its 55" TFT-LCD prototype, now the world's largest LCD panel -- by one diagonal inch. (Photo credit: Ken Werner)

Since the largest commercial LCD-TV in full-fledged distribution is Sharp's 37-inch, the war between Samsung and LG.P to produce the largest LCD-TV panel is very much a prototype war, with real flat-panel TV products over 40 inches all being based on plasma technology. But that has not kept the Korean LCD giants from struggling mightily with each other. The latest battle in the war has been won by LG.P, which is showing its 55-inch TFT-LCD panel (see photo), now the world's largest as it eclipses (by one diagonal inch) Samsung's 54-inch. This LCD battle is in part a contest between two LCD technologies, with LG.P championing Super In-Plane Switcing (S-IPS) and Samsung pushing the multi-domain vertically aligned (MVA) cell structure.

Sources: www.samsung.com and www.sid.org

SID on SID2003, Baltimore

Baltimore, Maryland, May 23 - At the Society for Information Display International Symposium, Seminar, and Exhibition (SID 2003), which is concluding here today, leading manufacturers of LCD television modules and receivers showed faster LCD panels - with gray-to-gray switching times in the range of 10 to 12 millseconds - that go a long way toward eliminating the smeared moving images that marred earlier generations of LCD-TVs. Sharp, Samsung, and LG.Philips were notable members of this group, with Samsung and Sharp promising even faster 7-millisecond panels within the next year.

Both Sharp and Samsung identified a third category of pixel switching - in addition to black-to-white and gray-to-gray - that requires special acceleration for smear-free images: mid-gray to white. In general, the latest speed increases have been accomplished by adding intelligence to the driving circuitry that "overdrives" each pixel to its next level using knowledge of both the current level and the forthcoming one. These systems vary in detail and have names such as Feed Forward Driving (Samsung, Optrex, Mitsubishi) and Over Driving Circuit (LG.Philips LCD). Sharp, according to Display Business Unit VP Joel Pollack, adds an additional twist by varying the drive according to panel temperature on the company's flagship 30- and 37-inch LCD-TVs. Pollack also announced that Sharp will now be selling its LCD-TV display modules to OEMs, as well as using them in the company's own TV sets. Optrex, in what may be a first, introduced Feed Forward Driving in a non-TV LCD, a 15-inch panel intended for gaming and other industrial applications. Samsung was showing its FFD technology, which it calls DCC, in the largest LCD at the show: an impressive 54-inch technology demonstrator with 1920 x 1080 pixels. Also on display at Samsung was a 46-inch LCD; and LG.Philips was showing its 52-inch. The LG.P 52-incher's 42-inch sibling will become commercially available later this year.

Samsung was also showing other advanced LCD technologies with applications to television. Among them were LCD panels using Clairvoyante Laboratories' Pentile Matrix™ - a revised sub-pixel geometry and driving scheme that permits images of essentially the same quality as conventional LCDs to be obtained from panels using fewer drivers. But, in side-by-side demonstrations, Samsung was not emphasizing this aspect of the Pentile technology. Rather, Samsung was showcasing what appeared to be brighter images and more subtle color rendition from its Pentile displays, characteristics that Clairvoyante itself has not emphasized. (Small STN-LCD Pentile displays were being shown by Wintek , and a Chi Mei Pentile AMLCD was being shown in the Clairvoyante booth.) Also in the Samsung booth was a prototype 17-inch LCD using the inherently fast optically-compensated-bend (OCB) mode. Side by side with a traditional 17-inch LCD, the OCB display produced much less smearing on a video in which the camera panned at moderate speed across a still image.

SID 2003 was characterized by interesting, and sometimes surprising, innovations at both the technology-development and product-introduction stages. Toshiba demonstrated an input sensor display that incorporates "an image sensor at each sub-pixel location." Place a business card or photograph on the display and press a button, and the display records a gray-scale (but not color) image much as a desktop scanner would do, but without moving parts.

Philips demonstrated the latest edition of its 44-inch scrolling-color, single-imager, 720-line, rear-projection (RP) LCoS TV. The image is impressive, and, unlike versions shown at previous SID shows, this one is a product. It will go on sale in North America in August in 44- and 55-inch sizes under the name Cineos at prices between $3000 and $4000.

Also on the Philips stand was an even more impressive scrolling-color set with a five-primary color system developed by Genoa Color Technologies. With a five-primary system, said Genoa CEO Ilan Ben David, each displayed color can be determined by a large - theoretically, an infinite - number of combinations of the primaries, but only one of them is optimal. A key to the Genoa system is an algorithm that determines the optimal combination on the fly. The result, said David, is a color gamut 60 percent larger than an otherwise equivalent three-primary system. Reds and yellows on the Philips system were notably rich and saturated. The five-primary system is a technology demonstrator.

Kodak and Chi Mei brought large OLED technology demonstration displays. Kodak's 15-inch OLED was made by manufacturing partner Sanyo, and should be available in three to four years, said Kodak Display Products Sales and Marketing VP Daniel D'Almeida. Chi Mei's 20-inch, shown at the IDTech stand, had line and pixel defects, which a Chi Mei representative attributed to contamination of the amorphous-silicon (a-Si) active-matrix backplane as it was removed from a standard LCD production line and carried to a lab for custom processing. Indeed, this was part of the story, as it had been widely believed that a-Si was incapable of delivering the currents required by OLED pixels. But, at SID 2003, several research groups - one of which included Chi Mei - reported on ways in which a-Si could be used. This creates opportunities for lower-cost AMOLEDs, an IDTech representative said. The Chi Mei panel produced fast-moving images with remarkably smooth, crisp, and artifact-free motion. This is a characteristic of OLED displays, said an IDTech engineer.

Philips Mobile Display Systems (MDS) showed several exercises in display integration. One, which combines the primary and secondary displays for a clamshell-style mobile phone, is currently used by Motorola. The "C4" technology demonstrator was even more impressive, combining primary and secondary displays, VGA camera, vibra-motor, and receiver.
The TFT primary display and STN secondary display share the same backlight. Production-ready C4 modules should be available in Q4, said Peter Hopper, CEO of Philips' MDS business group.

Sharp was showing its autostereoscopic (no glasses) 3D LCD in a cell phone. The display is now a product, and a 15-inch version is slated to be a product in Q4, said Sharp's Joel Pollack. Sharp was also showing its transflective "Advanced TFT-LCD" display technology in various sizes from 2.2 to 6.5 inches. These panels divide each subpixel into two parts, one part optimized for reflective use and one part optimized for transmissive use. The result is impressive, with legibility and colour balance changing only minimally as a million-candlepower spotlight was shone on the display, simulating the transition from indoor to outdoor use.

SID 2004 will, May 23-28, 2004 in Seattle, Washington.

Ben Sturgeon prize for 2003

The Ben Sturgeon Award is offered annually by the UK & Ireland Chapter of SID, for outstanding work by a young scientist in a field related to liquid-crystal display technology. Ben (short for Bennett) was for many years the research director of BDH Ltd, both before and after the company became part of the E. Merck Group. Among many achievements, he was the driving force behind commercialisation of the cyanobiphenyl liquid crystals, then newly discovered by Professor George Gray and his colleagues in collaboration with the displays group at Malvern. His energy, focus and judgement were an inspiration to the younger scientists who worked with him and are commemorated by the award.

The award has been won this year by Dr Tim Wilkinson from Cambridge University Engineering Department and was presented to him at the next on-day meeting to be held at Sharp Laboratories of Europe in Oxford on 25 June. Tim graduated from the University of Canterbury, New Zealand, in 1989 with a BEng (Electrical) with a First Class Honours. He remained at Canterbury, studying for his PhD degree. He was then awarded a Prince of Wales Commonwealth Trust Scholarship to study at the University of Cambridge. He completed his PhD at Magdalene College, Cambridge. He remained at Cambridge, firstly as a Research Assistant in the Engineering Department and he then as a Research Fellow at Pembroke College. He is currently a fellow of Jesus College and a lecturer in the University Engineering Department where he is responsible for spatial light modulator and liquid-crystal device fabrication and runs the photonics processing clean room. He is also involved in developing new applications for liquid crystal and LCOS devices including high resolution 2D and 3D displays, telecommunications, optical comparators for pattern recognition, adaptive optics and next generation LOOS technologies.

The Ben Sturgeon Award sub-committee is now seeking nominations for next year's award. Young scientists or engineers, under the age of 40 are eligible. They must have made significant contributions to the displays field over the past ten years. Ideally, the work for which they are nominated should be in the field of liquid-crystals including all aspects of the technologies used in LCDs. However, in exceptional circumstances, nominees from other display areas will be considered. In such a case, the international value of the work must be clearly demonstrated. Full information concerning the Ben Sturgeon Award and how to make nominations for next year can be found on the SID UK & Ireland Chapter web page (www.sid.org.uk).

Adapted from the SID UK newsletter (ouch!)

British Liquid Crystal Society Annual Conference
Fitzwilliam College, Cambridge
7th to 9th April 2003

The British Liquid Crystal Society Annual Conference has been operating in its present form since 1986 when it was host by the Department of Physics at the University of Manchester. For those further interested in the history of the event, the following venues were: University of Hull (1987), University of Strathclyde (1988), University of Sheffield (1989), University of Bristol (1990), University of Reading (1991), University of Oxford (1992), University of Manchester (1993), University of Hull (1994), University of Exeter (1995), University of Central Lancashire (1996), University of Southampton (1997), University of Leeds (1998), University of Durham (1999), University of Strathclyde (2000), University of Oxford (2001), University College London (2002).

2002 was a somewhat exceptional year, because the Society hosted the International Liquid Crystal Society Conference at Edinburgh, and so the British Liquid Crystal Society Conference was restricted to a one day event.

So here we are back to normality with a three day event at Fitzwilliam College, Cambridge. The venue was most impressive, a wonderful self-contained site for accommodation, meals and the conference. Not exactly close to the centre of Cambridge, but several pubs were within walking distance!

The conference opened with a lecture from Professor Richard Friend (Cambridge University) who provided an interesting and informative insight into light-emitting polymers (LEPs); their special properties and their potential applications. Such a lecture was unusual since it considered a different topic to liquid crystals, but nevertheless the technology is the closest rival to liquid crystals in applications, so the two are very much related.

Liquid crystals has always been a research topic dealing with many disciplines of science and technology, including chemistry, physics, mathematics, engineering etc. More recently, with the increase in computational power, aspects of mathematical modelling of liquid crystals have grown enormously, and this was reflected in the conference programme for oral and poster presentations. However, the modelling of liquid crystal systems is very important in all areas of the subject, and even though most of the remaining programme for the opening day was devoted to modelling, the presentations were all very good, and informative to the wider audience, and even had much to offer the synthetic organic chemist!

The first afternoon also saw the presentation of the BLCS Young Scientist Prize to Owen Lozman from the SOMs Centre at the University of Leeds. A thoroughly deserved prize for Owen, who has produced some exciting research in the area of discotic liquid crystals in terms of both synthesis and properties. His lecture interjected with the modelling presentations very well, and it was particularly good to see discotic liquid crystals being discussed again after several years in the wilderness!

The Sturgeon Lecture is always an event to look forward to; a special lecture to recognise the vital role of organic chemist Ben Sturgeon at BDH Chemicals in the early 1970s in producing commercial quantities of nematic liquid crystals for displays. This year IC Khoo (from Pennsylvania State University, USA) delivered an excellent presentation on photorefractivity in liquid crystals, which considered the special optical properties of liquid crystals and their use in photonic devices, particularly for the ever more complex area of telecommunications.

Other invited speakers set the scene well for the particular session. Carl Brown provided the audience with a great insight into flexoelectricity, Tim Wilkinson awakened participants on the morning after the night before with his usual enthusiasm in his talk on applications in the area of liquid crystal phase modulation, and Roy Sambles discussion on microwaves gave everyone something to think about for the future without giving away too many secrets! I gave a presentation on the chemistry of liquid crystals in terms of synthesis and structure-property relationships, hopefully it was interesting and useful for the wider audience *(it certainly was – ed).*

The quality of the presentations, both oral and poster, by the younger generation of liquid crystal scientists continue to improve each year. This year the best oral presentation was awarded to Eleanor Edwards of the Department of Engineering at Oxford, for her talk entitled *'Modelling the director structures in nematic liquid crystal cells containing surface relief structures using the Q order parameter tensor'.*

The organisation of the conference by Tim (and Caryn) Wilkinson and his team was first class, and the quality of the accommodation and catering was truly excellent. The scientific programme was well-planned, and contained an excellent blend of presentations from the many different, but of course related, areas of liquid crystals. Overall, a thoroughly useful, interesting and enjoyable conference, and we can all look forward to the 2004 British Liquid Crystal Conference, organised by Maureen Neal at Manchester Metropolitan University.

Mike Hird
University of Hull

British Liquid Crystal Society Winter Workshop

The British Liquid Crystal Society Winter Workshop is held over three days in December each year just before Christmas. The Workshop is an essential event for all those new to the field of liquid crystals, no matter what the area of science. The Workshop has now been held in the Department of Chemistry at the University of Hull since December 1994. Initially, the event was held over just two days, but time was extremely tight, and a three-day format has been operating successfully, and at minimal cost for many years now.

The Workshop is specially designed for new entrants to the field of liquid crystals, particularly PhD students, but post-docs, technicians and industrialists also have much to gain from the event. Areas covered by the Workshop include a general introduction to liquid crystals, the synthesis of liquid crystals, liquid crystal polymers, identification of liquid crystal phases by optical microscopy, differential scanning calorimetry, and X-ray analysis, the physics of liquid crystals, liquid crystal devices, and modelling of liquid crystals. Theory and practical work is included, and there is ample opportunity for social activities. The topics covered are presented by experts in the area, and all participants are provided with notes for each of the topics covered.

In 2002, the British Liquid Crystal Society Winter Workshop was held from lunchtime Monday 16th December to lunchtime Wednesday 18th December 2002.

The three-day format of the Workshop is now well established, and appears to be very popular and successful. The support received by the Winter Workshop has been excellent in recent years. The 2002 Workshop was (eventually) extremely well attended with a total of 44 delegates; 6 industrial delegates, 28 academic delegates and 10 non-residential delegates from Hull. The Workshop continues to attract some continental delegates (4). All of the delegates seemed to enjoy themselves, and I am sure that they all benefited from the academic and social programmes. For 2002, the cost of the Workshop was held at £120- (academic) and £240- (industrial).

The 2003 Workshop will again be held in the Department of Chemistry at the University of Hull, this year from lunchtime on Monday 15th December to lunchtime Wednesday 17th December. The Workshop will operate with the same scientific format as last year, however, a move to hotel accommodation was necessitated by a change to the semester dates at the university. Accordingly, the cost of the workshop has had to be increased to 140 pounds for academic delegates and 240 pounds for industrial delegates, however, the Workshop still represents excellent value for money, as the price includes all accommodation, meals, refreshments for the duration of the Workshop, and notes for each topic covered.

With hotel accommodation now being involved I urge everyone interested in the Workshop to send their registration forms to me as soon as possible.

Full details will be sent to all known university and company contacts working in the area of liquid crystals shortly, and these details can be found at the website:

http://www.hull.ac.uk/chemistry/research/BLCS/wwindex.htm

Dr Mike Hird,
Department of Chemistry
University of Hull
Hull, HU6 7RX, UK
tel. 01482 465866
fax. 01482 466411
e-mail m.hird@hull.ac.uk

Maureen Neal moves to Manchester

The BLCS Committee Membership secretary, Professor Maureen Neal, has moved from Coventry, where she was in the School of Mathematical and Information Sciences, to take up a position as Dean of Science and Engineering at Manchester Metropolitan University. She took up the position on September 1st and her new e-mail address is : M.Neal@mmu.ac.uk.

Maureen is well-known to the British liquid crystal community, not only for her work on behalf of the BLCS, but as an active modeler. She (with Nigel Mottram of Strathclyde and Helen Gleeson of Manchester) has been instrumental in putting together the bid based on liquid crystal devices under the current EPSRC call for Modelling Consortia. The bid has reached the second round and a decision will be made on whether or not to support it later this year.

Report on FLC '03 Trinity College Dublin

'Does Guinness have a DeVries phase transition?'

The bi-annual event that is FLC was held this year in Trinity College Dublin under the careful chairmanship of Prof. Jagdish Vij. Held amongst the 18th century buildings of Trinity College, the FLC conference was enjoyed by nearly 200 delegates from all around the world. All of the usual suspects were there and there was a certain air of both expectancy and uncertainty as to the commercial future of FLCs. Hence the sudden arrival of the Citizen Watch company with their FLC based electronic newspaper was a great and most welcome surprise.

The topic of the conference seemed to be lead by the requirements of the microdisplay and spatial light modulator industries, with both Displaytech and CRL-Opto having a distinct presence at the conference. The key issues seemed to be linked and revolved around the mechanisms of chevron formation and bistability in FLC materials. Of particular interest were a group of relatively unknown materials first published by DeVreis in MCLC in 1976 which show no layer shrinkage in the transition from smectic A to smectic C. The questions posed were how did this effect occur and could it produce a chevron free smectic C material. These ideas were presented by several groups who have all converged on the work by DeVries simultaneously.

The conference was opportunely opened with a plenary by Bill Crossland who highlighted how important bistability was in the applications of FLC materials. This includes both display and non-display (such as telecomms) application of FLCs. The significance of this talk was further enhanced by the demonstration of a bistable passive matrix FLC display by the Citizen Watch company as well as the renewed interest in the work by DeVries as the phase transition of the Smectic C phase seems to heavily dominate possible bistability mechanisms as well as chevron formation.

The second plenary was given by Noel Clark who talked about the exciting new developments in the characterisation of phase transitions in Banana shaped FLC materials. This included an analysis of the complex interplay between chirality and polarity in these materials. The huge variety of strictures and phase relationships from B1 to B7 shows us that there is still plenty we don't know about these materials. Of particular beauty were the images he showed of strange tubular growth in the B7 phase. The complexity of these relationships was further demonstrated in the rather baffling plenaries given by HR Brand from Bayreuth and H Takazoe from Tokyo. As an engineer I was truly out of my depth at this point!

On the controversial side were the plenaries given by John Goodby and Mike Hird from Hull. They both cast dispersions on the theory that an FLC material had to be chiral before it could be switched. They both emphasised measurements and results taken from achiral materials which were clearly being switched under electric fields. A series of theories were formulated around these two talks which disputed this observation, but the fact still remains that they do switch. Obviously plenty of room for further discussion in this area.

There were many other talks within the conference which were of a suitably high calibre, far to many to mention here. One particular talk was by the irrepressible Sh Kobayashi who demonstrated (with no help from his laptop) that field sequential colour displays based on V-shaped switching materials are alive and well and due to appear in a PDA near you. Also very impressive was the talk and demonstration by the Citizen Watch Company of their staggering 3840x1920 pixel fully bistable passive matrix addresses post-card sized display. This was one of the first times I have been convinced that there will be a future in electronic paper after all.

Another highlight of the conference were the posters which displayed a massive variety of topics and concepts. Once again, my pitiful knowledge of both chemistry and physics hampered the perusal of these delicacies, however upon asking suitable experts I was in no doubt that the quality and content showed that FLC research was still thriving. Also of note was the pre-dinner talk given by Sven Lagerwall which review some of the historical and classical mathematical theories behind FLCs. The post dinner speech by George Gray was entertaining as well as though provoking. All this surrounding a good dinner made for a memorable night.

Overall, the lasting impression I got from the conference was that there is still plenty of research waiting to be done on FLCs. The commercial side is still tense and there is a sense of anticipation of what future market will provide. I am not sure whether the killer application will be in displays or lies in more esoteric applications such as telecomms or digital holography.

Tim Wilkinson

British Liquid Crystal Society
Registered Charity (328163)
Balance Sheet at 28th March 2003

Description of Income	**£**	**£**
Cash at Bank		
General Fund	14958.94	
Sturgeon Fund	6110.82	
Total Cash at Bank		21069.76
Subscriptions		
General	322.00	
Total Subscriptions		322.00
Hull Winter Workshop 2001		631.29
Interest (29/9/01 to 18/4/02)		
General Fund	1.53	
Sturgeon Fund	.63	
Total Interest		2.16
Total Income		**22025.21**
Description of Expenditure	**£**	**£**
BLCS Young Scientist Prize 2002		200.00
BLCS Bursaries for ILCC 2002 Edinburgh		5040.00
GW Gray Medal 2003		257.33
BLCS Committee Meeting Expenses		117.43
Cash at Bank		
General Fund	10299.00	
Sturgeon Fund	6111.45	
Total Cash at Bank		16410.45
Total Expenditure		**22025.21**

Treasurer's Annual Report

The General Fund at the start of the financial year showed a healthy £14958.94 plus a further £6110.82 in the Sturgeon Fund, giving a total of £21069.76. A situation that has been somewhat consistent for the past couple of years, following the considerable growth of 2000.

The Society's funds have been put to good use over the past year with £5040 used to enable student members of the Society to attend and present their work at the 2002 International Liquid Crystal Society Conference at Edinburgh. The BLCS annual conference has not generated any income since 2000. The December 2001 Winter Workshop at Hull generated a surplus of £631.29, but the position regarding the 2002 event is not yet known. Income from general subscriptions (£322) was well down on last year (£644), and there was no subscription income from conferences.

Interest earned on the Society's funds is recorded as very low in the accounts because interest from the high interest savings account, opened nearly a year ago, has not yet been credited. The Society is a Registered Charity and so all interest is paid without the deduction of tax. The capital value of the Sturgeon Fund has remained virtually the same as last year.

The Society's funds remain very healthy at a total of £16410.45, with no major expenditure being planned at present.

Editor: Tim Wilkinson
Contributions to tdw@eng.cam.ac.uk

I would like to do an issue earlier in the year, but to do this I need contributions, think of it as a cheap publication!

Disclaimer

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