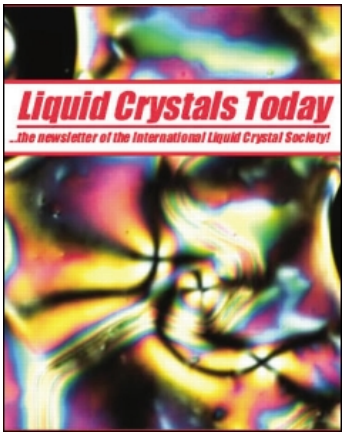

Liquid Crystals Today
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713681230

News

Simon Siemianowski[a]
[a] University of Manchester, Manchester, UK

Online publication date: 15 June 2010

To cite this Article Siemianowski, Simon(2010) 'News', Liquid Crystals Today, 19: 1, 34 — 35
To link to this Article: DOI: 10.1080/13583140903538751
URL: http://dx.doi.org/10.1080/13583140903538751

Liquid Crystals Today
Vol. 19, No. 1, June 2010, 34–35

Taylor & Francis
Taylor & Francis Group

NEWS

Simon Siemianowski

University of Manchester, Manchester, UK

News on liquid crystals in research

Taking a break from news on liquid crystals in industry, in this article I will be highlighting some of the recent developments in liquid crystal research. Over the past few months there has been a number of interesting developments in this field from scientific institutions around the world, showing the prominence that liquid crystal research still possesses on a global scale.

Graphene and liquid crystals

Graphene was a word that was wholly unfamiliar to the general physics community until as recently as a few years ago. Now, however, there are several new papers published every day on the subject, and the number of groups working on graphene continues to increase. With such a boom in the number of papers on this new material, it can be easy to neglect earlier papers and revisit problems that have already been solved. For this reason the review article by A.K. Geim (*1*) is an essential read to anyone currently working in the field, or indeed any physicist who has an interest in what has repeatedly been called 'a wonder material'.

There is little doubt that at some point in the near future, graphene will be implemented on a wide scale into applications due to its vast array of commercially advantageous properties. To name just a few, these applications include being the thinnest known material in the universe as well as the strongest, very large charge-carrier mobility and the ability to sustain current densities six orders of magnitude higher than copper. Another one of its properties that is of particular interest to liquid crystal-based applications is its inherent high transparency due to its incredibly small thickness.

Professor Geim suggests that electrodes made from graphene rather than a conventional ITO coating could one day be commonplace in liquid crystal displays, and work was recently conducted in collaboration with the liquid crystals group at the University of Manchester that demonstrated for the first time such a device (*2*). This 20-μm thickness device (filled with E7) successfully switched between a light and dark state when illuminated with white light producing a contrast ratio of approximately 100:1 under an applied field of 100 Vrms. With future developments working towards increasing the area of graphene that can currently be deposited onto a substrate through methods such as epitaxial growth, it would only be the high resistivity that would stand in the way of the commercial manufacturing of such devices. With the number of research groups actively working in the field of graphene, it would be of little surprise if both these problems had solutions in the near future.

Discotic liquid crystals towards semiconductor applications

The topic of discotic liquid crystals has been of interest to chemists and physicists alike for many years. The formation of a large aromatic core and a series of alkyl side chains is the result of a number of complex chemical synthesis techniques. Although such molecules are pleasing to the eye and produce some interesting physics, these materials have so far had limited use in applications. The exception to this rule is their use in compensator films to enhance the viewing angle of liquid crystal displays. However, a recent article by Feng *et al.* (*3*) highlights a promising route for future research in discotics.

The high charge-carrying properties of discotic liquid crystals have made them an ideal candidate for molecular electronics, combined with their affinity to self-assemble. The possible applications for such materials include field effect transistors and photovoltaic cells. In order for this idea to become a reality a number of parameters need to be optimised; most importantly the compounds must have the ability to self-organise with a minimal amount of defects. Also, the individual molecular arrangement needs to be maximised to ensure greatest charge transport. Both of these problems have been addressed and a suitable structure for such compounds has been deduced through collaboration between the Max Planck Institute in Mainz, Imperial College in London and DelftChemTech in Delft.

The reorganisation energy of a column of discotic molecules is inversely proportional to the size of the core of the molecule, and is also dependent on the shape of the core. Interestingly, however, this reorganisation energy is not affected by the geometry of its adjacent molecules. Contrary to this fact is a parameter known as the transfer integral that calculates the probability of

ISSN 1358-314X print/ISSN 1464-5181 online

DOI: 10.1080/13583140903538751
http://www.informaworld.com

an electron tunnelling between adjacent molecules. Rather unsurprisingly, the transfer integral decreases exponentially as a function of the distance between molecules. This parameter also varies with the angle between neighbouring molecules, and it is predicted that an angle of 600 results in optimum charge-carrying ability. Further experiments involving wide angle X-ray scattering and NMR show that the mobility of their subject material was 0.2 $cm^2 V^{-1} s^{-1}$ and through simulations they predict that a defect free structure would lead to mobilities in excess of 10 $cm^2 V^{-1} s^{-1}$.

References

(1) Geim, A.K. *Science* **2009**, *324*, 1530–1534.
(2) Blake, P.; Brimicombe, P.D.; Nair, R.R.; Booth, T.J.; Jiang, D.; Schedin, F.; Ponomarenko, L.A.; Morozov, S.V.; Gleeson, H.F.; Hill, E.W.; Geim, A.K.; Novoselov, K.S. *Nano Lett*. **2008**, *8*, 1704–1708.
(3) Feng, X.; Marcon, V.; Pisula, W.; Hansen, M.R.; Kirkpatrick, J.; Grozema, F.; Andrienko, D.; Kremer, K.; Müllen, K. *Nat. Mater.* **2009**, *8*, 421–426.