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Editorial: The 2009 Luckhurst-Samulski Prize

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EDITORIAL

The 2009 Luckhurst-Samulski Prize

Last year saw the announcement of a major new award in the field of liquid crystals: *The Luckhurst-Samulski Prize* [1]. The Prize was named after Geoffrey Luckhurst and Ed Samulski, not only in honour of their roles in founding the journal *Liquid Crystals*, but also for their outstanding contributions to liquid crystal science. The Prize is awarded for the best paper published each year in *Liquid Crystals*. A description of the Prize and its associated terms and conditions can be found on the Journal's website [2].

In 2009, *Liquid Crystals* published 139 articles describing all areas of liquid crystal science and technology and from these the Selection Committee was given the unenviable task of choosing just one to become the inaugural Luckhurst-Samulski Prize-winner. In the first pass, five articles were selected which were all considered to be of the very highest quality, from which the winner was chosen. This was a tremendously difficult task and any one of these papers would have made an outstanding winner of the Prize.

I am delighted to announce that the 2009 *Luckhurst-Samulski Prize* has been awarded to the paper by John Goodby and his colleagues, entitled *Molecular complexity and the control of self-organising processes* [3]. This conceptual paper provides excellent insight into understanding the relationships between intermolecular interactions and phase behaviour for a very wide range of molecular architectures and many of these ideas are clearly conveyed using a range of beautiful illustrations. The winners will be presented with their Prize at a ceremony to be held at ILCC 2010 in Krakow.

The remaining four articles were highly commended and these included, in chronological order, the paper by Frank Müller and Ralf Stannarius entitled *Comparison of the rupture dynamics of smectic bubbles and soap bubbles* [4]. In this paper, the authors describe a beautiful and ingenious experimental study of the bursting of smectic bubbles and explain their striking results using a semi-qualitative theory.

The second of these papers was by William Thurmes and his colleagues, entitled *Germanium liquid crystals*, [5] in which the authors synthesised and characterised the phase behaviour of a new type of liquid crystal. This paper provides the most comprehensive and detailed overview of this class of liquid crystal published to date and describes over 130 new germanium liquid crystals.

The next paper was by Patrick Oswald entitled *Experimental study of the growth of cholesteric fingers subjected to an AC electric field and a temperature gradient* [6] which contains a combination of stunning photomicrographs, the description of complex macroscopic phenomena explained by simple fundamental physical principles and intriguing qualitative results that provide a demanding challenge for future theoretical work.

The last of these papers was by Nattaporn Chattham, Noel Clark and their colleagues, entitled *de Gennes' triclinic smectics - not so far-fetched after all* [7]. In this paper, the authors present original

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INVITED ARTICLE

Molecular complexity and the control of self-organising processes

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In this article we investigate the complexity of the molecular architectures of liquid crystals based on rod-like mesogens. Starting from simple monomeric systems founded on fluoroterphenyls, we first examine the effects of aromatic core structure on mesophase formation from the viewpoint of allowable polar interactions, and then we model these interactions as a function of terminal aliphatic chain length. By incorporating a functional group at the end of one, or both, of the aliphatic chains we study the effects caused by intermolecular interfacial interactions in lamellar phases, and in particular the formation of synclinic or anticlinic modifications. We then develop these ideas with respect to dimers, trimers, tetramers, etc. We show, for dendritic systems, that at a certain level of molecular complexity the local mesogenic interactions become irrelevant, and it is gross molecular shape that determines mesophase stability. The outcome of these studies is to link the complexity of the molecular interactions at the nanoscale level, which lead to the creation of the various liquid-crystalline polymorphs, with the formation of mesophases that are dependent on complex shape dependencies for mesoscopic supermolecular architectures.

Keywords: liquid crystal polymorphs; liquid crystal modelling; ferroelectric and antiferroelectric liquid crystals; dimers; trimers and tetramers; polymer liquid crystals; dendrimers; supermolecular liquid crystals

1. Introduction

Up until the last decade, the basic design of the molecular structures of thermotropic liquid crystals had changed very little. Materials that exhibit liquid crystal mesophases typically have molecular structures that can be classed as spherical, rod-like or disc-like, with combinations of the two producing phasmidic liquid crystals. The discovery that materials with bent molecular structures exhibited whole new families of mesophases has led the charge towards investigating the liquid crystal properties of materials with widely varying molecular topologies: from pyramids to crosses to dendrites. For materials with rod-like molecular shapes the prototypical molecular design involves the incorporation of a central aromatic, heterocyclic or alicyclic core unit, to which are attached terminal aliphatic chains (*1–3*), thereby engendering dichotomous structures with rigid or semi-rigid sections surrounded, or segregated, by flexible fatty chains, see structures **1** and **2** in Figure 1. When molecules with this type of architecture self-organise, they generally do so with their rigid, aromatic parts tending to pack together and their flexible/dynamic aliphatic chains orienting together. Thereby the overall system becomes so-called '*locally microphase segregated*'. Consequently, the main target of materjal design has been, by default, the variation in the structure of the central core region of the molecules in the belief that the core is more important in influencing mesophase incidence, mesophase temperature range, isotropisation point, melting point, mesophase sequence, dielectric and optical anisotropy, elastic coefficients and the reorientational viscosity associated with the mesophase (*4–8*).

One of the more important applications of liquid crystals is in display devices. The bedrock of the liquid crystal display (LCD) industry has been built on the twisted nematic liquid crystal display (TNLCD) device, which was developed in the early 1970s. Nematic liquid crystals designed for applications in TNLCD technologies typically have strongly polar groups situated at one terminus of the molecular structure to engender large positive dielectric anisotropies (*9–13*). The structural design for nematogens with such anisotropies are exemplified by the cyanobiphenyls shown in structure **3** in Figure 1. Similarly, modern LCD TVs utilising in-plane switching (IPS) modes (*14–16*) with wide viewing angles also employ nematogens with positive dielectric anisotropies. Conversely, competitive LCD TV technologies based on vertically

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Figure 1. The 2009 Luckhurst-Samulski Prize Winner.

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experimental evidence for the existence of a triclinic smectic phase which had previously been theoretically predicted by de Gennes although he thought its actual existence rather unlikely.

I would like to thank everybody who published work in *Liquid Crystals* during 2009 and the selection committee for their hard work in selecting the 2009 Prize-winner. The 2010 competition is already well underway and John Goodby and his colleagues' paper has unquestionably set an extremely high standard for future winners of the *Luckhurst-Samulski Prize* to live up to!

C.T. Imrie
Editor

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