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Session iv. Liquid crystals for new functional materials, organic electronics and photovoltaics

Semiconducting nematic liquid crystals: properties and devices

M. O'Neill and S. M. Kelly

Departments of Physics and Chemistry, University of Hull, Hull UK



Mary O'Neill

Department of Physics
The University of Hull
Hull HU6 7RX
United Kingdom

[http://www.hull.ac.uk/
organophotonics/](http://www.hull.ac.uk/organophotonics/)

We have recently pioneered a liquid crystal approach to organic semiconductors, whereby thin, uniform films of light-emitting and charge-transporting nematics are formed as insoluble polymer networks by photopolymerisation using ultraviolet light. The orientational anisotropy of these materials allows polarized electroluminescence and the alignment direction is patternable using photoalignment techniques. A further advantage is that photolithography can be used to pixellate a full colour display. We demonstrate these properties [1], and show that the materials have very high order parameters and birefringence, greater than 0.9 in both cases [2].

We also discuss a liquid crystal composite approach to make photovoltaic devices [3]. Firstly an electron-donating, visible-light absorbing, nematic liquid crystal blend is used to form a nanogrooved surface with a large interface area to an overlying electron-accepting layer. This forms a bilayer photovoltaic device with a distributed interface to allow efficient separation and transport of the photogenerated electrons and holes. We show that nematic liquid crystals provide reasonably high charge carrier mobility and we discuss the performance of the photovoltaic devices.

Finally we report photoinduced surface gratings on these materials. We discuss the mechanism of their formation and possible applications.

References

1. M. P. Aldred *et al.* *Adv. Mater.* **17**, 1368 (2005)
2. K. L. Woon *et al.* *Liq. Cryst.* **32**, 1191 (2005)
3. M. A. Carrasco-Orozco *et al.* *Adv. Mater.* **18**, 1754 (2006)