Polymer Science

There is a continuing need for new or improved materials to meet the ever changing demands of modern technology. Polymer systems offer considerable scope for designing materials with new or improved properties through the diversity of Organic Chemistry. The Davis Group is concerned with the synthesis of polymeric materials with unusual properties, optical, electrical, mechanical etc. In addition, in relation to the work on Spectral filters we have been concerned with aspects of material degradation and stability, this has lead to a series of other projects with for example National Grid and ultimately has lead to the design of some novel supercapacitors. (For more information see the Powerpoint presentation on supercapacitors which is available for download.) The work has involved extensive collaboration with other Departments including the Centre for Advance Microscopy, the Centre for Biomimetics, the Department of Horticulture and the Department of Electronics and Computer Science at the University of Southampton. Industrial sponsors

Electrospinning

Electrospinning provides an effective route to the preparation of nano and micro fibres of synthetic and biological polymers. It is an enabling technology with applications in medical, pharmaceutical, chemical, textile, and electronic industries. The technique produces very fine, nano to micrometer diameter, fibres in random mats as shown or in more controlled structures. (More information on the electrospinning project is available for download.) Materials are studied with a range of techniques including x-ray scattering, neutron diffraction (see Figure) and a range of microscopy techniques (http://www.reading.ac.uk/cfam/).

Liquid Crystalline elastomers

Optical properties of Polymers

We have designed and synthesised a range of polymers which interact with light in a controlled fashion; these include such as non-linear optical polymers and the use of photo-induced shape changes at a molecular level (for example through geometric isomerisation) to manipulate macroscopic polymer properties, such as refractive index and phase behaviour. Recently we have been involved in the synthesis of photonic band gap materials from block copolymers. As with the cholesteric liquid crystalline polymers these selectively reflect visible light. One particularly interesting area is the use of polymeric films to control plant growth as an alternative to chemical sprays (with Professor P. Hadley, Horticulture and Dr A.E. Wheldon, Engineering). Controlling the light incident on plants can influence a range of factors from total photosynthetic production, through to the sporulation of Botrytis and the generation of secondary products; for example the photo shows the influence of UV blocking materials on the development of phenolic materials in lettuce Lollo Rosso lettuce ‘Revolution’. The success of this programme can be gauged from the fact that the team were awarded the 1998 Science into Practice award from the Ministry of Agriculture Fisheries and Foods and Andersons for their innovative work on SMART greenhouse materials and the transfer of technology to their industrial partners; in addition a display focusing on these investigations was awarded a Silver Medal at the 2004 Chelsea Flower Show. The growth control films are marketed commercially as Solatrol (http://www.bpiagri.com/pdf/solatrol.pdf).
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