Investigations on Discotic Liquid Crystals

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The self-organization of disk-shaped molecules leads to the formation of discotic liquid crystals (DLCs). These supramolecular assemblies are of fundamental importance not only as models for the study of the energy and charge migration in self-assembled systems but also as functional materials for device applications such as, one-dimensional conductors, photoconductors, light emitting diodes, photovoltaic solar cells and gas sensors.

The first observation of thermotropic mesomorphism in pure disc-like molecules was reported in 1977 at the Raman Research Institute. At the beginning of the DLC research, more attention was devoted to reveal and evaluate structure-property relationships in this new class of liquid crystals. In 1994, it was demonstrated that the columnar phases of DLCs possess very high charge carrier mobility along the column axes. It was realized that the supramolecular order of the columnar phases of the DLCs have the potential to act as active functional materials in organic electronic and optoelectronic devices. In 1997, it was demonstrated that the negative birefringence films formed by polymerized discotic nematic liquid crystals can act as optical compensation films to enlarge the viewing angle and to increase the contrast ratio of liquid crystal display (LCD) devices. These films have been commercialized and widely used in LCDs. In the 21st century, extensive efforts have been made to realize the use of these materials in devices like solar cells, light emitting diodes and sensors. The past decade has also witnessed an explosive development in the field of discotic nanoscience. A variety of zero-dimension (0-D), one-dimension (1-D) and two-dimension (2-D), metallic, semiconducting and carbon nanoparticles have been dispersed in DLCs or attached covalently to DLCs to alter the physical properties of these intriguing materials. Following these developments, an unprecedented growth of interest in the field of DLCs has been observed during the past few years. In this talk, I will present some aspects on my research on DLCs.

References

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Speaker Biography

Sandeep Kumar is a Senior Professor at the Raman Research Institute, Bangalore. He obtained his Ph.D. in Chemistry from BHU, Varanasi in 1986. After that he worked at MRC, Vadodara for about two years on the synthesis of food flavoring agents. During 1988-1995, he was a PDF at the Hebrew University of Jerusalem, at Technion, Israel Institute of Technology, at the Scripps Research Institute, USA and at the University of Mainz, Germany. He joined the Centre for Liquid Crystal Research, Bangalore to start a new Chemistry lab in 1995. In 2002, he moved to RRI. He was a visiting Research Professor at the NRL, Washington DC during 1999-2000, at the National Dong Hwa University, Taiwan during 2008 and E.T.S. Walton Visiting Professor at the Trinity College, Dublin during 2012-2013. He has published over 250 research papers in peer reviewed international journals. He also authored two books entitled Chemistry of Discotic Liquid Crystals (CRC Press) and Liquid Crystal Dimers (Cambridge University Press) and several book chapters. He is also having many patents in his credit. He was awarded the inaugural LG Philips Display Mid-Career Award by the International Liquid Crystal Society.