Biomedical and Biological Applications of Liquid Crystals

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Liquid Crystals have a long history in biologically related sciences starting with the work on fatty acids by Heintz in 1849[1] and on cholesterols by Reinister and Lehman in 1888.[2] Many biological materials from DNA to phospholipids have been shown to exhibit either or both thermotropic and/or lyotropic liquid crystals. As research into self-organizing systems developed synthetic chemistry took over a leading role in the discovery and development of new materials. However, after the 1930’s this activity faded, but the investigation of biological substances continued albeit at a low level. Even the early work of George Gray on the synthesis and characterization of synthetic systems waned in favour of researches on lipopolysaccharides and cell membranes of bacteria such as Psuedomonas Aeruginosa and their longevity in antiseptics such as Dettol.[3]

The invention of liquid crystal displays, particularly at RCA, in the 1960-70’s, changed the focus of LC research because of the technological revolution that they engendered. Consequently, the number of practitioners of the subject grew dramatically, and the numbers involved in biological research fell proportionately, possibly because there were very few applications of liquid crystals in biology or medicine. Remarkably, although DNA was found to be liquid crystalline, this knowledge had not been used in practical applications until the recent and beautiful work of Safinya and his researchers on gene therapy. [4] This development may be as significant for liquid crystals than displays were in the 1970s.

However, as yet, a connection between liquid crystallinity and biological or biomedical application/function in terms of cause and effect has to be unequivocally demonstrated. For example, it is known that certain LC glycolipids found in cell membranes are implemented with neurological diseases, but it is not clear that their liquid crystal behaviour is relevant or not.

This presentation will not deal with liquid crystallinity as a cause or effect in biomedical applications. Instead it will be split into aspects of pharmaceutical characterization, prosthetic devices, cell imaging, and biological systems in materials. For example, the determination of enantiopurity of chiral pharmaceuticals using nematic hosts, and the use of biocompatible oesteoconductive polymers in fracture repairs and their biodegradable properties will be discussed. [5]

References:

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