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Polymer stabilised liquid crystals

Ingo Dierking

School of Physics and Astronomy
Manchester University
Manchester, M13 9PL, UK

http://reynolds.ph.man.ac.uk/~dierking/

Polymer stabilised liquid crystals are formed by uniformly dispersing bifunctional photoreactive monomers within a liquid crystal matrix and subsequently forming a polymer network within the liquid crystal phase through illumination with UV light. During the polymerisation process the forming polymer network phase separates from the liquid crystal and a bicontinuous structure is eventually formed.

The self-organised order of the liquid crystal is transferred onto the polymer network, which forms a structural template of the liquid crystal host in which it was formed. We will present several examples of such templating, from simple nematics, chiral superstructures and twist grain boundary structures to the morphology of topological defects. Polymer stabilisation can thus be used as an easy method to visualise liquid crystal director fields, in two- and with certain limitations also in three dimensions.

Polymer stabilisation of liquid crystals offers promising applications for example in the fields of reflective displays (electronic paper), heat repelling and automatically switchable windows for homes and greenhouses, the formation of photonic structures, or the mechanical improvement of fast switching ferroelectric devices. Using polymer stabilised ferroelectric liquid crystals (PSFLCs) we employed a rigorous experimental routine, together with a novel Landau description of PSFLCs to quantitatively determine the interaction between a polymer network and its liquid crystal matrix. We show that this interaction increases linearly with increasing polymer content, and comprises about 10-15% of the total potential of the liquid crystal at maximum. This implies that the preferential electro-optic properties of ferroelectric liquid crystals are not significantly compromised for the benefit of mechanical stabilisation. This will be demonstrated explicitly through electro-optic experiments.