

# Structure, Function, and Responsiveness in Liquid-crystalline Elastomer Particles

James Taylor<sup>1</sup>, Kirsty L Davies<sup>2</sup> and Verena Görtz<sup>1\*</sup>

<sup>1</sup>Department of Chemistry, Lancaster University, Lancaster (UK)

<sup>2</sup>Department of Chemistry, University of York, York (UK)

The three-dimensional topology of liquid crystal droplets in hosts such as water results in characteristic modes of self-organisation within the droplets, which are sensitive to changes in the host environment. In particular Abbott *et al* have shown ordering transitions to be triggered by the presence of a variety of biomolecules (lipids, surfactants, proteins, and viruses), and thus they provide a mechanism for sensor applications. Further, liquid crystal elastomers show remarkable mechanical properties, such as a macroscopic shape-change, or actuation, stimulated by a variety of external triggers.

In this talk, I will discuss parameters that control the confinement textures, the self-assembly, and the optical and shape responsiveness in a series of nematic and chiral nematic liquid-crystalline polymer and elastomer particles we currently investigate. We use heterogeneous polymerisation techniques to prepare particles in various size-ranges and explore their responses to external stimuli such as temperature changes, mechanical deformation, electromagnetic fields, and the uptake of guest substances.

I will discuss our findings for smaller particles (1-5  $\mu\text{m}$ ), produced by dispersion polymerisation, where we observed the confinement structure to most commonly correspond to either a bipolar or a radial configuration, i.e. two topologies with opposing surface anchoring (Figure 1(a) and (b)), and where we also observed a rather remarkable switch from bipolar to radial confinement upon a subtle change in monomer structure. Further, in these systems distinct and reversible optical transitions can be triggered by changes in the host environment, by mechanical deformations, or the uptake of guests.

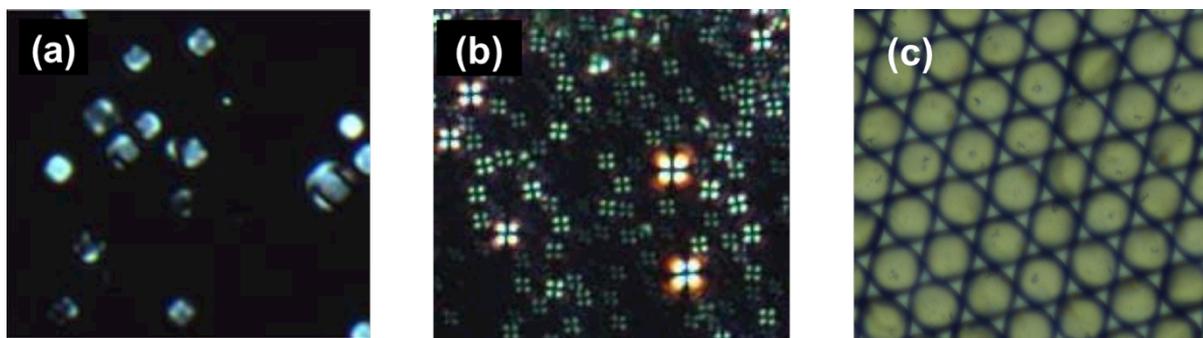


Figure 1: POM images of (a) bipolar, (b) radial particles ( $\times 100$ , 2-5  $\mu\text{m}$ ) obtained by dispersion polymerisation and (c) actuating LCE particles obtained by microfluidics.

I will further report on the preparation of larger nematic elastomer particles (20-50  $\mu\text{m}$ , Figure 1 (c)) via microfluidics methods which provided surface rather than flow induced control of the alignment, good control of the monodispersity, as well as the optical and actuation properties of the obtained LCE particles.

\*Corresponding author e-mail: [v.gortz@lancaster.ac.uk](mailto:v.gortz@lancaster.ac.uk).