Response and Characterization 1: 2:00 - 2:35 p.m.

Synthesis of micrometer sized actuators from liquid crystalline elastomers

Christian Ohm [a] , Christophe Serra [b], Rudolf Zentel [a]

[a] *University Mainz, Duesbergweg 10-14, 55099 Mainz, Germany*
zentel@uni-mainz.de

[b] *Laboratoire d'Ingénierie des Polymères pour les Hautes Technologies, CNRS UMR 7165, ECPM, 25 rue Becquerel, 67087 Strasbourg Cedex 2, France*

The use of liquid crystalline elastomers for actuator applications has been reported since several years. To realize strong shape changes, it is necessary to orient the mesogens into a liquid crystalline monodomain before the polymer is crosslinked. This orientation step is very crucial in the preparation of good LC based actuators. Until now, methods like the drawing of fibers or the stretching of pre-crosslinked films have been used mainly, yielding macroscopically structured actuators. Using microfluidics, we realized a continuous flow synthesis of spherically shaped particles from a crosslinked liquid crystalline polymer. In this approach, a mixture of a liquid crystalline monomer with crosslinker and UV-initiator are melted and injected through a very thin needle into a co-flowing stream of silicon oil.

The size of the particles can be controlled by several parameters, mainly the viscosity of the silicon oil and the flow rate ratio between oil and monomer. Thus we obtained particles with a diameter between 200 and 500 micrometers with a size variation coefficient as low as 1%. Due to the parabolical flow velocity profile in the tubing, the mesogens in the monomer droplets are preferentially oriented parallel to the flow direction when the polymerization takes place. This gives the particles characteristics of a liquid crystalline monodomain.

Upon heating them into the isotropic phase under a microscope the particles change their shape from a spherical to a rod like conformation. Thereby length changes of more then 70% can be observed. The actuation is completely reversible and very fast, which was shown by rapidly cooling particles in the stretched conformation by a flow of cold air. We also show that the intensity of the shape change strongly depends on the flow rate at which the particles were polymerized. The same conformational change can be achieved by swelling the particles with a suitable solvent, which also induces a phase transition.