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Liquid crystal soft robotic elements: Triggered 2d and 3d morphing

Since their development in the 80's of last century, reactive mesogens (RM's) form a versatile class of soft matter materials that have find their way to a wealth of applications. The frozen-in molecular order of the polymer networks that they form upon polymerization brought a new dimension into liquid crystal technologies. Initially developed for their use as low shrinkage, low thermal stress coatings, the RM's demonstrated their function especially in optical applications. The large, temperature-stable and adjustable birefringence was adopted by the display industry for many purposes, varying from viewing angle enhancement to optical-retarder based 3D imaging optics. Presently, advanced optical applications for augmented reality and astronomy lenses are drawing much attention as well their use for soft responsive elements by triggered 2D or 3D shape deformations. The use of RM's for soft robotics applications is presently studied by many academic and industrial institutes. Triggered by heat, light or humidity the polymers change shape, surface structure or porosity. At Eindhoven University, we developed self-sustaining oscillators, cilia based micro-transport devices and haptic surfaces. Films deform from a flat to a complex, but pre-designed, shape with prospects to light-triggered origami and self-folding plastic elements. A completely new development relates to coatings that switch their surfaces from flat to corrugated with a preset topography. Or, in a different design, from dry to wet by controlled secretion of liquid. Properties that enable controlling properties as friction, grip, lubrication, stick, soil rejection, particle manipulation, etc. The lecture will discuss our newest developments in responsive liquid crystal polymer materials, giving a preliminary view on the future of RM's with advanced applications in the fields of oscillatory films, smart coatings, soft robotics and haptics.

Speaker Biography

Dirk J Broer is materials scientist specialized in polymer structuring. He joined Philips (Eindhoven, Netherlands) in 1973 where he developed materials for data storage, telecommunication and display optics. From 2003 to 2010 he was senior research fellow and vice president at the Philips Research Laboratories. In 2010, he was appointed as fulltime professor in Eindhoven to chair the Department Functional Organic Materials with a research emphasis on clean technologies as energy harvesting, water treatment and healthcare. From 2015 he is staff member at the Institute for Complex Molecular Systems in Eindhoven and coordinates a program on responsive soft materials. He founded the Institute of Device Integrated Responsive Materials, a joint initiative of South China Normal University and Eindhoven University of Technology. Broer is member of the Royal Netherlands Academy of Arts and Sciences. In total, he has 275 publications in peer reviewed journals and more than 120 US patents.

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