

Main-chain liquid crystalline coelastomer systems: Influence of component proportion in the system properties.

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Liquid crystalline elastomers (LCE) have been extensively studied due to their combination of the liquid crystalline order and the elastic behaviour of polymer networks. The length-changing ratio with respect to temperature (being as large as 400%) is one of the most remarkable properties of main chain (MC) LCEs. The difficulty to achieve such materials relies in the orientation method of the polymer chains. Hence, the so-called liquid single crystalline elastomers (LSCE) can be prepared via a 2-step crosslinking process¹ or photocrosslinking of surface oriented polymers.^{2, 3} Most of the synthesized MC LCE consist in the combination of a single mesogenic monomer with a chain extender.⁴⁻⁶ But as already used in LCD displays,⁷ employing a mixture of monomers can decrease/increase the transition temperature of the LC mesophases, favour the nematic mesophase formation and tune consequently the isotropization temperatures.

In the present work, three series of MC-LCCoE and their mesomorphic and mechanical properties are presented. The first two series of coelastomers contain two calamitic mesogenic monomers in different proportions. The first possesses a trisiloxane chain extender (HMTS) whereas the second presents a shorter tetramethyldisiloxane (TMDS) spacer. The last series is constituted of LCCoE containing a calamitic mesogenic monomer and a bent core monomer within their structures; TMDS was the chain extender in all the samples.

LCCoE with two calamitic mesogenic monomers exhibit dependence of isotropization temperature with the monomers proportion. A relationship between the chain extender and the stability of the nematic mesophase is also observed. In the case of bent-core analogues, interesting results such as network deformations and kinetically dependent mesophases were confirmed, indicating that the shape of the monomer influences significantly the mesomorphic behaviour of the product. Since the determination of their mechanical properties is also important for their potential actuator applications, rheological studies such as DMTA were performed to some samples, revealing the change in their Young and shear moduli with temperature as well as the hydrodynamic region.

The ensemble of this study demonstrates that a simple binary mixture approach can be applied to achieve LC actuators with controllable glass/isotropization temperatures, and that by modifying the chain extender the number and stability of the mesophases can be controlled.

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