

Ferroelectric Liquid Crystalline Elastomers: From the Analysis of the Molecular Dynamics to the Design of Nanomachines

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In ferroelectric liquid crystalline elastomers (FLCE) the properties of ferroelectric liquid crystals are combined with that of polymeric networks.

With use of refined synthetic techniques, it is possible to align the chiral mesogenic groups in FLCE on a macroscopic scale ($\sim \text{cm}^2$). By employing that set of methods, the development of a new class of materials has been achieved having an extraordinary profile of features, among them the following: (1) FLCE are piezoelectric because of the ferroelectric order of the chiral mesogens and because of the fact that the polymeric network prevents flow. (2) Due to a photochemically or thermally induced cross-linking reaction the viscoelastic properties of FLCE can be adjusted over a wide range. (3) The coupling between the elastomeric network and the (polar) chiral mesogens can be modified by chemical engineering, hence offering the possibility to tailor the piezoelectric as well as the viscoelastic properties of FLCE. (4) It is possible to prepare thick ($\sim 100 \mu\text{m}$), thin ($\sim \mu\text{m}$), and ultrathin ($\sim \text{nm}$) films of macroscopically oriented FLCE, as self-supporting or as transferred samples. With this combination of properties FLCE have made a strong technological impact as basic materials for sensors and soft actuators in the area of microsystems technology. The present contribution is focused on the piezoelectric effect in FLCE and its molecular interpretation.

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