

## DYNAMICS OF STRUCTURAL CHANGE IN MAIN CHAIN LIQUID CRYSTAL ELASTOMER UNDER STRAIN

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Liquid crystal elastomers (LCE) undergo anisotropic deformations induced by external stimuli such as temperature, mechanical stress, electrical or optical field making them good candidate for artificial muscles [1-3]. At the heart of their mechano-optical behavior is the interaction between the naturally disordered polymer chain and the tendency of the mesogenic moiety to develop long-range orientational order. Basic understanding therefore of the structural dynamics of these LC elastomers during and after deformations is essential. We present here results of our quantitative investigation of the structure and dynamical changes in a smectic main-chain LCE revealed by *in-situ* synchrotron x-ray scattering. Initially random layer orientation is observed in as-formed elastomer which is retained at low strains. As the strain increases, the smectic layers begin to orient parallel to the strain direction. Beyond a threshold strain of  $\sim 50\%$ , layer undulations evolve into chevron-like smectic structure as revealed by the four diffuse spots in the small angle region of XRD patterns. We found strain dependent enhancement of the smectic order and two relaxation time constants corresponding to two regimes during strain recovery upon removal of the stress, evident from the layer tilt angle of the smectic phase. Quantitative analysis of the structural evolution with strain and temperature provide important insight into their molecular level and collective relaxation.

### References:

1. W. Gleim and H. Finkelmann, *Side Chain Liquid Crystalline Polymers*, edited by C. B. McArdle, Blackie and Son, Glasgow (1989).
2. H. Finkelmann, *Liquid Crystallinity in Polymers*, edited by A. Ciferri, VCH, Weinheim (1991).
3. H. Wermter and H. Finkelmann, *e-Polymers*, 13 (2001).

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