Theory and Modeling 1: 10:50 - 11:25 a.m.

Order, disorder and strain in smectic elastomers

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In this talk I will discuss disorder in smectic elastomers in relation to the crosslink density. During the last years we obtained rather different results for side-chain and main-chain elastomers (with mesogenic groups organized either 'side-on' or 'end-on'). The most extensive data so far are for a series of end-on side-chain siloxanes [1]. With increasing crosslink concentration a transition to disorder of the smectic layers is reflected in the x-ray lineshape. The latter can be fitted to a stretched Gaussian with an exponent of 1 (simple Gaussian describing finite-size domains) for low crosslink concentrations. The exponent decreases gradually with crosslink concentration, reaching a value of 0.5 (Lorentzian describing short-range correlations) for 20% crosslinks. For stiffer crosslinks values <0.5 (stretched exponential correlations) are found. A full interpretation of this trend is not available yet.
In main-chain systems the polymer chains couple directly to the lamellar structure and any polymer defect is translated into layer distortions. For some homopolymers studied the resulting x-ray lineshapes can be well described by Lorentzians. This is interpreted as an average of algebraically decaying order in domains with dimensions of hundreds of nm and a wide dispersion of sizes [2]. The much broader peaks in the corresponding elastomers have been attributed to strong non-uniform strain within the finite-size domains due to defects of the layer structure.
Finally I will discuss some recent results on a 'side-on' side-chain smectic elastomer [3]. Upon stretching along the layer normal we find for small loading a linear increase of the smectic layer period. These changes parallel the stress variation for the elastic part of the macroscopic stress-strain curve and saturate at larger strains. The attendant increase in width of the x-ray peaks indicates a decrease of the average domain dimensions. In the plastic regime neither distortion of the smectic monodomain structure nor layer rotation is observed. Instead the stress is relieved by 'melting' of the layer structure giving rise to a nematic-like state with short-range layer correlations.

[1] E.P. Obraztsov, A.S. Muresan, B.I. Ostrovskii, W.H. de Jeu, *Phys. Rev. E*, 2008, **77**, 020706.
[2] W.H. de Jeu, E.P. Obraztsov, B.I. Ostrovskii, W. Ren, P.J. McMullan, A.C. Griffin, A. Sánchez-Ferrer, H. Finkelmann, *Eur. Phys. J. E*, 2007, **24**, 399.
[3] (a) A. Komp and H. Finkelmann, *Macromol. Rapid Commun*. 2007, **28**, 55. (b) W.H. de Jeu, A. Komp, E.P. Obraztsov, B.I. Ostrovskii, H. Finkelmann, *Soft Matter,* DOI:10.1039/b915599a (in press).