Flexoelectricity of a Calamitic Liquid Crystal Elastomer swollen in Bent-Core liquid crystals

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We show that a Liquid Crystal Elastomer (LCE) system may be swollen with substantial amounts of bent-core materials. In the isotropic phase of both elastomer and solvent, the LCE swells until saturated at around 50% concentration. The swelling is characterized by two time scales, the shorter (~300 sec) comparable to standard rod-like LC solvents, and the longer (~8-10,000 seconds) reflecting the unusually high viscosity reported in the neat bent-core solvents.[1] Depending on the bent-core solvent, we prepared swollen LCEs exhibiting only nematic phases or a nematic-smectic-crystal phase sequence. Comparison of the global polymer chain order parameter to the global mesogenic order parameter shows that in the swollen LCEs the polymer chain order parameter decreases, while the overall orientational order of the mesogenic components is enhanced in the nematic phase.

Two measurement techniques are used to extract the flexoelectric coefficient for a bend deformation, e_3. One utilises air-pressure to induce a mechanical bend deformation and examines the current-time trace. The other uses a mechanical motor and scotch yolk with a lock-in amplifier to induce a mechanical bend deformation to extract the magnitude and phase of the flexoelectric polarization induced current. The second technique was previously used in liquid samples[2]. The flexoelectric coefficient, e_3 in the bent-core swollen elastomers was found to be comparable to liquid bent-core liquid crystals.[2] The temperature range of the flexoelectric effect was larger than that observed for liquid crystal samples; it was observed for over nearly the entire nematic range of 90K down to near room temperature at 35 K. The flexo-electric current increases linearly with the magnitude of the bend deformation and decays quickly with frequency.

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[2] J. Harden, B. Mbanga, N. Éber, K. Fodor-Csorba, S. Sprunt, J.T. Gleeson, A. Jákli, **"**Giant flexoelectricity of bent-core nematic liquid crystals"**,** *Physical Review Letters, 97, 157802 (2006)*