Strain dependence of the nematic fluctuation relaxation in liquid crystal elastomers

A. Petelin[a], A. Mertelj[a], M. Čopič[a,b]

a Jožef Stefan Institute, Ljubljana, Slovenia
b Faculty of Mathematics and Physics, Ljubljana, Slovenia

Dynamic light scattering experiments were performed on a monodomain liquid crystal elastomer. We measured relaxation rate of the orientational fluctuations of the nematic director as a function of temperature and applied strain in the direction parallel to the director and in perpendicular direction. When stretching the elastomer along the director, the relaxation rate approximately linearly increases with the applied strain which shows that the nematic director is coupled to the elastic strain as predicted by the theory of nematic elastomers. In the relaxed state the relaxation rate is independent of the scattering vector due to the internal stress, frozen in the sample at the time of preparation. When stretching the elastomer perpendicular to the director, the relaxation rate linearly decreases with the applied strain. At the threshold strain, where soft director rotation begins, the restoring torque for director rotations is no longer governed by internal elastic field. Measurements now show dependence of the scattering vector due to the nematic elasticity. The measurements at larger strains, in the semi-soft deformation regime show a very characteristic behavior, in agreement with the theory of semi-soft elasticity.