

Orientation correlations trapped into liquid crystalline elastomers

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We address the physical properties of a system of liquid crystalline polymers in the isotropic state, which are then subjected to cross-linking so as to form a liquid crystalline elastomer. The approach we take is to extend the replica theory of vulcanized flexible macromolecules to the case of liquid-crystal-forming polymers, thus allowing for the possibility of liquid crystalline order. Our main focus is on the liquid crystalline correlations that are spontaneously present at the time of cross-linking, and the extent to which they are permanently trapped in by the cross-linking process. We discuss the structure of the associated “glassy” liquid crystalline correlations in the following two regimes: (i) When the localization length is shorter than the thermal liquid crystalline correlation length, in which case the correlations are well captured as glassy correlations; and (ii) the opposite regime, in which fluctuations in the positions of the localized polymers partially wash out the glassy correlations.