Glassy correlations in nematic elastomers

BING LU, PAUL GOLD-BART, University of Illinois at Urbana-Champaign, XIAOMING MAO, University of Pennsylvania — We address the physical properties of an isotropic melt or solution of nematogenic polymers that is then cross-linked beyond the vulcanization point. To do this, we construct a replica Landau theory involving a coupled pair of order-parameter fields: one describing vulcanization, the other describing local nematic order. Thermal nematic fluctuations, present at the time of cross-linking, are trapped by cross-linking into the vulcanized network. The resulting glassy nematic fluctuations are analyzed in the Gaussian approximation in two regimes. When the localization length is shorter than the thermal nematic correlation length, the nematic correlations are well captured as glassy correlations. In the opposite regime, fluctuations in the positions of the localized polymers partially wash out the glassy nematic correlations.