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Finite element studies of the soft elastic response in liquid crystal elastomers[1] BADEL MBANGA, JONATHAN SELINGER, ROBIN SELINGER, Liquid Crystal Institute, Kent State Univ. — When a liquid crystal elastomer film is stretched in a direction transverse to the nematic director, the resulting stress-strain curve typically displays a plateau region, showing a characteristic soft elastic response. Using 3-d nonlinear finite element simulation, we model the formation of orientational domains controlling this mechanical behavior. We investigate the force-displacement response as a function of strain rate, and explore geometric frustration arising from boundary conditions imposed by clamps. We also model mechanical response of polydomain films aligned under external strain. Our 3-d finite element algorithm is based on a Hamiltonian with terms representing elastic potential energy, kinetic energy, and coupling between elastic strain and nematic order. We assume that orientational order of the material relaxes quickly and remains in local quasistatic equilibrium with the instantaneous local strain. Internal dissipation is also included. We intend through this model to further our understanding of the basic physics governing the dynamic mechanical response of nematic elastomers and also provide a useful computational tool for design and testing of potential engineering device applications.

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