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Modeling twisted distortions in nematic elastomers[1] VIANNEY GIMENEZ, BADEL MBANGA, FANGFU YE, JONATHAN SELINGER, ROBIN SELINGER, Liquid Crystal Institute, Kent State Univ. — Experimental studies have reported that nematic elastomers with a twisted nematic director–similar to the configuration in a twisted nematic cell–show a well-controlled deformation under change of temperature. Due to the difference in thermal expansion along and perpendicular to the nematic director, the sample twists and curls dramatically under heating and cooling [1]. We model this shape evolution using both analytical calculations and finite element elastodynamics simulations. In analytical calculations, we determine the optimal shape of an initially flat strip by minimizing a free energy functional that takes into account the coupling between orientational order and mechanical strain. We compare which of two final states–a helical or twisted ribbon shape–is lower in free energy, as a function of the sample's aspect ratio and material properties. We then use finite element simulations to model the dynamics of this spontaneous deformation and examine the resulting equilibrium shapes, which may be intermediate between helical and twisted. Results are compared to relevant experiments. We also use our simulation model to explore a wider variety of director configurations and sample geometries, beyond the ideal cases solvable via analytical methods. [1] G. Mol, K. D. Harris, C. W. M. Bastiaansen, and D. J. Broer, Adv. Funct Mater, 15, 1155 (2005).

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