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New Insights Regarding the Polydomain-to-Monodomain Transition in Smectic Elastomers[1] RONALD HEDDEN, HARSHAD PATIL, DANIEL LENTZ, Penn State University — Smectic elastomers are rubber-like networks characterized by lamellar mesophases. Crosslinking a smectic polymer in the absence of an aligning field produces a polydomain elastomer containing numerous randomly oriented microdomains. Under uniaxial tension, polydomain smectic elastomers undergo a transition to a globally oriented "monodomain" state, which may proceed by rotation and/or transient disordering of microdomains. New studies of smectic main-chain elastomers suggest that disordering of microdomains via unfolding of hairpin structures is the dominant mechanism for elongation at intermediate strains. A "plateau stress" is found in plots of the nominal stress vs. strain, which correlates with the average domain size. At very high strains, elastic chains approach the finite extensibility limit, and layer buckling becomes the predominant mechanism for elongation. The elongation mechanism differs significantly from that in mesomorphic poly(diethylsiloxane) elastomers, which also exhibit a "plateau" in the nominal stress vs. strain curve due to spontaneous random coil-to-helix transition. Because of chain-folding in main-chain smectics, the P-M transition may exhibit some similarities with the cold drawing of semicrystalline polymers.

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Ronald Hedden
Penn State University

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