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Molecular Motion and Macroscopic Actuation in Liquid Crystal Elastomers. J.R. Deschamps^{1*}, J. Konnert¹, C. Spillmann², J. Naciri², B. Ratna², ¹Code 6030, Naval Research Laboratory, 4555 Overlook Ave., Washington, DC 20375, deschamps@nrl.navy.mil; ²Code 6930, Naval Research Laboratory, 4555 Overlook Ave., Washington, DC 20375.

The use of liquid crystals is well known in electrooptics, yet their potential use in other areas of technology is ever increasing. For example, liquid crystals in the nematic phase have been incorporated into cross-linked polymer networks to form materials capable of reversible, uniaxial contraction for use as mechanical actuators^{1,2}. It has been shown that when an electric field is applied to chiral smectic A liquid crystals in the layer plane, the transverse dipole of the molecules couple to the electric field and tilt the molecules in a plane perpendicular to the electric field direction³. Therefore, it is possible to produce reversible, macroscopic dimension changes in a smectic elastomer by applying an electric field to cause molecular tilting of the liquid crystal molecules. In this study, we observe the molecular response, via x-ray scattering, of a smectic A elastomer while subjected to electric field. We examine the diffraction patterns in order to develop an understanding of the relation between changes at the molecular level and the accompanying macroscopic changes in the LC elastomer.

¹ Gleim, W. & Finkelmann, H. Thermoelastic and Photoelastic Properties of Cross-Linked Liquid-Crystalline Side-Chain Polymers. *Makromolekulare Chemie-Macromolecular Chemistry and Physics* 188, 1489-1500 (1987).

² Thomsen, D. L., Keller, P., Naciri, J., Pink, R., Jeon, H., Shenoy, D. & Ratna, B. R. Liquid crystal elastomers with mechanical properties of a muscle. *Macromolecules* 34, 5868-5875 (2001).

³ Garoff, S. & Meyer, R. B. Electroclinic Effect at the Ac Phase-Change in a Chiral Smectic Liquid-Crystal. *Physical Review A* 19, 338-347 (1979).