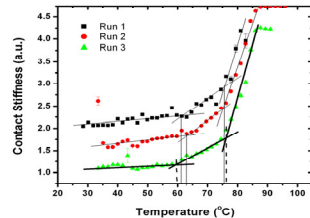
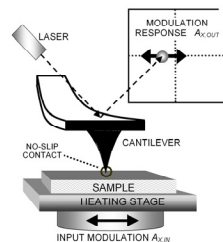
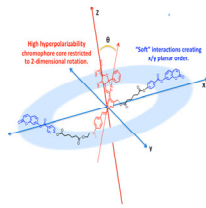




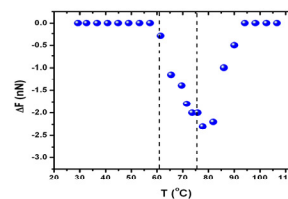
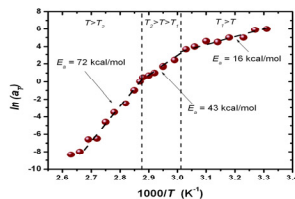
## Thrust on Organic Electro-Optic and All-Optical Materials and Devices



**ACHIEVEMENT:** Force Modulation Scanning Probe (FM-SP) and Intrinsic Friction Analysis (IFA) have been used to define intermolecular electrostatic interactions important in defining poling induced order.



FM-SP and IFA, together with Dielectric Relaxation Spectroscopy (DRS), permit definition of the activation entropy and relaxation length scale associated with the intermolecular cooperativity induced by specific spatially-anisotropic interactions.



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**Goals:** One of the goals of the Thrust on Organic Electro-Optic and All-Optical Materials and Devices is to develop transformative electro-optic materials and device concepts. This goal requires development of an understanding of the role played by various spatially-anisotropic inter/intramolecular interactions in defining poling-induced acentric order of chromophores necessary for electro-optic activity.

**Achievements:** Nanoscopic viscoelastic measurement techniques (FM-SP and IFA) have been developed that permit measurement of the enthalpies and entropies associated with specific spatially-anisotropic interactions that impact poling-induced order of organic electro-optic material. Combination with dielectric relaxation spectroscopy permits cooperativity length scales to be defined. When combined with the techniques discussed in the previous slide, a picture of the order operative in soft matter materials and the energetics of specific interactions that influence poling-induced order is achieved. This is a critical step forward toward the systematic nano-engineering of functional soft matter materials.

**Impact:** Theoretical and experimental advances are transforming the development of electro-optic materials. Electro-optic activity in the range 400-500 pm/V has been achieved together with low optical loss. Materials have been used by Lumera Corporation to fabricate Mach Zehnder modulators with 20 GHz bandwidth and operating with drive voltages of 0.25 V. Boeing has used hybrid organic EO/silicon photonic ring microresonator devices from the STC to demonstrate high data rate reconfigurable optical add/drop multiplexers (ROADMs) for chipscale information management on airborne platforms.

**Future Work:** Electro-optic activity will be further increased to meet requirements of many defense applications. Photo- and thermal stability will be improved to satisfy the requirements of a broader range of applications. An effort will be made to improve the total insertion optical loss of silicon photonic devices. Research will be continued to improve soft and nanoimprint lithography processing of complicated photonic circuitry with the objective of broadening applications and reducing cost.

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