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Anisotropic Thermal Conduction in Polymers and its Molecular Origins DAVID NIETO SIMAVILLA, DAVID VENERUS, JAY SCHIEBER, Illinois Institute of Technology, UCOSM TEAM — Anisotropy in thermal conductivity has a significant impact on both processing and final properties of materials. Simple molecular arguments suggest that Fourier?s law must be generalized to allow for anisotropic thermal conductivity. We present two complementary experimental methods to obtain quantitative measurements of the thermal diffusivity (conductivity) tensor. We report anisotropic thermal diffusivity and stress in molten, cross-linked and solid polymers under several types of flows. Our results support the validity of a linear relationship between stress and anisotropy in thermal conductivity. When the proportionality constant, the stress-thermal coefficient, is made dimensionless by the plateau modulus of the polymer melt, a universal value of approximately 0.03 is observed for all chemistries. Such a universality is surprising, since phonon transport mechanisms are sensitive to chemical structure. For instance, the analogous stress-optic coefficient depends strongly on chemistry, and can even change sign. Connecting these measurements with current theories for thermal transport in amorphous materials, such as Minimum Thermal Conductivity (MTC) model, is crucial to understand the molecular origins of anisotropic thermal conduction in polymers.

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