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**Making them Faster and Better:
Flow-Induced Crystallization of Polymers**

Reminiscent of teeth, bone and sea shells, semicrystalline polymers combine strength with toughness by forming a nano-scale composite with platelet-like crystals stacked with noncrystalline material between them. The morphology and orientation distribution of the nanostructure dictate macroscopic material properties. Ultrastrong fibers, impact resistant plastics and elastomers can all be achieved by controlling the morphology of crystallization. Effects of flow are central to controlling polymer crystallization. Flow can accelerate polymer crystallization by orders of magnitude and induce highly oriented crystal morphologies. On a molecular level, small concentrations (<2%) of long chains dramatically change the rate and morphology of flow-induced crystallization. In situ rheo-optical and rheo-WAXD techniques in combination with ex situ optical microscopy and electron microscopy provide evidence that shish grow in length at a velocity on the order of 10 microns per second. On the length scale of a single chain, this is a remarkably fast process: adding approximately 10nm per ms, under conditions in which ordering events are very rare in the surrounding melt. Binary blends of well-defined, long chains in a matrix of much shorter---but still highly entangled---short chains have provided key tests of existing ideas. The results, however, run counter to models that relate oriented precursors to the specific work imposed on the melt; instead, they inspire a new model that account for the dynamics of the longest chains and their interactions with growing precursors and with neighboring chains. Above all, the results suggest that further expansion of the property envelope can be achieved by using small concentrations of ultra-long chains as “stealth additives” that are chemically indistinguishable from the bulk of the material, yet dramatically change processing behavior and ultimate material properties.

SEMINAR
Friday, April 27th
Livermore Center
Room 101
3:00 – 4:00 pm