187f Terahertz Dynamics of Polymer Crystallization

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Crystallization of poly(trimethylene terephthalate) (PTT) is studied by confocal Raman spectroscopy, low frequency IR and a unique pump and probe experiment. Quasi-dynamic crystallization studies on PTT fibers by confocal Raman spectroscopy indicated that PTT crystallization is accompanied by the flow of Terahertz (THz) energy into the crystalline "destination" mode at 141 cm^{-1}. The "source" mode from which the THz energy flows is determined by the pump and probe experiment, in which an intense monochromatic far-IR free electron laser (FEL) is used to irradiate PTT films. Crystallization is induced by the irradiation of FEL with a wavelength of 71 cm^{-1}. This experiment suggests that there is an energy flow from the source mode at 71 cm^{-1} to the destination mode at 141 cm^{-1}. The wavenumber relationship between the source and the destination mode suggest a mode-coupling mechanism, similar to Fermi resonance, governs the flow of THz energy during crystallization.

The flow of THz energy during crystallization and the mode-coupling mechanism can be used as a starting point to interpret many crystallization phenomena and formulate a dynamic theory of polymer crystallization.