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Sensing the Melting Transition of Semicrystalline Polymers via a Novel Fluorescence Technique

-Background

The melting point (Tm) is an important parameter that dictates the physical properties and applications of semicrystalline thermoplastics. Conventional melting transition characterization techniques such as differential scanning calorimetry, ellipsometry, optical microscopy, and X-ray based methods measure Tm by monitoring temperature-dependent thermal properties, morphologies, and microstructures. Although these techniques have been well-developed, they have certain limitations. For example, X-ray based methods require the use of X-ray beams, which can have harmful side effects. Most previous techniques can only measure spatially averaged properties throughout a film cross section or an entire bulk sample.

Invention Description

Researchers at Arizona State University have developed a novel fluorescence technique for probing the melting transitions of semicrystalline thermoplastics. This technique incorporates fluorescent probes into a semicrystalline polymer, either by physical doping or covalent labeling. The temperature-dependent fluorescence intensity data exhibits a stepwise decrease nearby Tm because of the reduced restriction of intramolecular motion when crystals start to melt.

The first derivative of the obtained temperature-dependent fluorescence intensity can reveal more details of the underlying melting transition, including the onset and end point of the melting transition as well as the peak melting temperature. The melting point values determined by fluorescence agree with those characterized by conventional differential scanning calorimetry, confirming the validity of our fluorescence technique for probing melting transitions.

Potential Applications

- Analysis & design of semicrystalline thermoplastics
- Location-specific Tm investigations within multilayer films, blends and composites

Benefits & Advantages

- Can be applied with various types of fluorescent probes and generalized to many semicrystalline thermoplastics
- Excellent sensitivity to melting transitions and crystallization processes
- Simple & contact-free approach

Related Publication: Sensing the melting transition of semicrystalline polymers via

a novel fluorescence technique