

PEO crystallization kinetics close to SiO₂ surfaces

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Polymer materials are often filled with inorganic compounds in order to improve their properties. The optimization of the properties is mostly achieved when the dimensions of the additive is in the nm range, producing a nanocomposite. The change in the properties occurs because the behavior of polymers when they are restricted in space can be very different from that in the bulk, especially when the molecules are confined to dimensions comparable to their sizes. The inorganic filler's geometry as well as the confining length of the polymer plays a significant role in the crystallization process of the polymer chains.

Polymer crystallization kinetics of a hydrophilic, semi-crystalline polymer, poly(ethylene oxide), PEO, when mixed with silica, SiO₂, nanoparticles, of different sizes in a broad range of compositions are investigated with Isothermal Differential Scanning Calorimetry (DSC) (Figure 1) and Isothermal Polarized Optical Microscopy (POM) (Figure 2). The study through POM shows differences in the spherulite number, radius and growth rate for hybrids with different silica content and different SiO₂ nanoparticles' sizes. The crystallization process exhibits different characteristics in the hybrids compared to that of the neat polymer melt seen both in POM and DSC. An attempt is performed to investigate the crystallization mechanism when the polymer is in close proximity to the silica surfaces utilizing hybrids with high inorganic content.

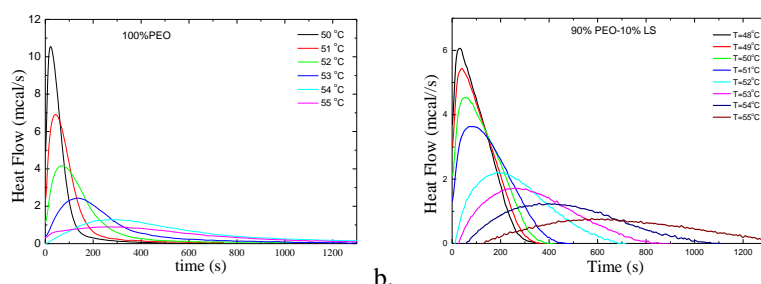


Figure 1: Isothermal DSC cycles of (a) pure PEO and (b) 90%PEO-10%SiO₂ (r~7nm) nanohybrid at different crystallization temperatures

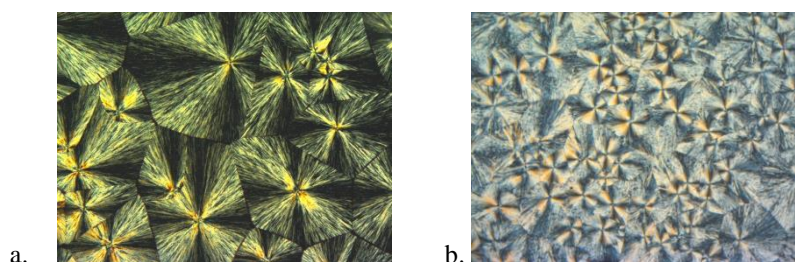


Figure 2: POM images of (a) pure PEO and (b) 80% PEO-20% SiO₂ (r~7nm) at T_c=52°C

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