Tuning Polymer Crystallinity

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Addition of nanosized inorganic materials in a polymeric matrix results to nanohybrids with optimized properties with respect to the initial components. On the other hand, the behaviour of polymers when they are restricted in space or when they are close to surfaces can be very different from that in the bulk.
In this work, we investigate the morphology and crystallization of a hydrophilic, semi-crystalline polymer, poly(ethylene oxide), PEO, when mixed with different silica, SiO_2, nanoparticles in a broad range of compositions. The initial components were characterized with Dynamic Light Scattering (DLS) which verified that the two kinds of nanoparticles vary by an order of magnitude in radius. The good dispersion of the nanoparticles was verified by Transmission Electron Microscopy (TEM), whereas the morphology and crystallization behaviour of the hybrids were investigated with X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR) and Differential Scanning Calorimetry (DSC). A gradual decrease of polymer crystallinity with increasing nanoparticles content is observed; nevertheless, polymer crystallization exists for most of silica loadings. Moreover, DSC showed two melting and crystallization transitions in hybrids with polymer content lower than 50wt%, indicating that the polymer crystallizes differently than the bulk when it is in a thin interfacial layer near the silica surface (Figure 1). [1] The existence of the two transitions are also evident in the IR and Raman spectra.

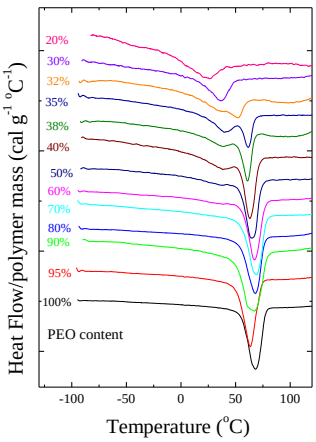

Figure 1: DSC thermograms of PEO/SiO_2 nanohybrids with different polymer compositions.

Three component systems, in hybrids composed with the two silica nanoparticles having largely different sizes were prepared in order to increase the level of confinement. It is evident that the behaviour in these systems is defined, and the polymer crystallinity can be tuned by varying the ratio of the large vs small nanoparticles. [1]

References

[1] H. Papananou, E. Perivolari, K. Chrissopoulou and S. H. Anastasiadis, in preparation (2016)

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