

PEO crystallization and dynamics close to SiO₂ surfaces

H. Papananou,^{1,2,*} K. Chrissopoulou,¹ and S. H. Anastasiadis^{1,2}

¹*Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas, Heraklion, Crete, Greece*

²*Dept. of Chemistry, University of Crete, Heraklion Crete, Greece*

K. S. Andrikopoulos,³ G. A. Voyiatzis,³ A. Avgeropoulos,⁴ M. Labardi,⁵ D. Prevosto⁵

³*Institute of Chemical Engineering Sciences, Foundation for Research and Technology-Hellas, Patras, Greece*

⁴*Dept. of Materials Science Engineering, Univ. of Ioannina, Ioannina, Greece*

⁵*CNR-IPCF, Department of Physics, University of Pisa, Pisa, Italy*

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, crystallization and dynamics of a hydrophilic, semi-crystalline polymer, poly(ethylene oxide), PEO, when mixed with silica, SiO₂, nanoparticles in a broad range of compositions. 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). All techniques show a gradual decrease of polymer crystallinity with increasing the amount of nanoparticles; nevertheless, polymer crystallization is observed for all silica loadings. Moreover, DSC measurements showed the existence of two melting and crystallization transitions in hybrids with polymer content lower than 50wt%, indicating that the polymer crystallizes differently than the bulk near the silica surface.

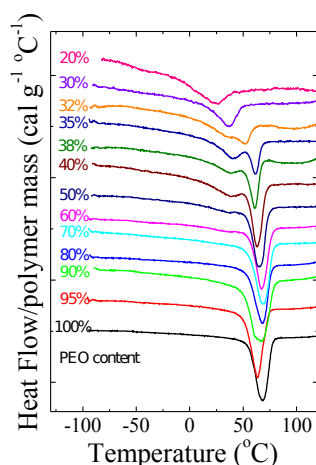


Figure 1: DSC thermograms of PEO/silica nanohybrids with varying polymer content

The effect of the proximity to the silica surface on polymer dynamics was investigated with Broadband Dielectric Spectroscopy, (BDS) as well. The dynamic behaviour of hybrids with different composition is compared with the respective of the bulk polymer and with the one of nanohybrids comprised of a different additive i.e. layered silicates. In the latter case, the effect of the size and geometry of the additive is examined.

This work was performed in the framework of PROENYL research project, Action KRIPIS, project MIS-448305 (2013SE01380034), funded by the General Secretariat for Research and Technology, Ministry of Education, Greece and the European Regional Development Fund (Sectoral Operational Programme: Competitiveness and Entrepreneurship, NSRF 2007-2013)/ European Commission and the COST Action MP0902-COINAPO (STSM-MP0902-14971).