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Nanoparticles Modification by Grafting Strategies for the Development of Hybrid Nanocomposites

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Abstract : Hybrid inorganic/organic nanostructured materials based on block copolymers are of considerable interest in the field of Nanotechnology, taking into account that these nanocomposites combine the properties of polymer matrix and the unique properties of the added nanoparticles. The use of block copolymers as templates offers the opportunity to control the size and the distribution of inorganic nanoparticles. This research is focused on the surface modification of inorganic nanoparticles to reach a good interface between nanoparticles and polymer matrices which hinders the nanoparticle aggregation. The aim of this work is to obtain a good and selective dispersion of Fe3O4 magnetic nanoparticles into different types of block copolymers such us, poly(styrene-b-methyl methacrylate) (PS-b-PMMA), poly(styrene-b-ε-caprolactone) (PS-b-PCL) poly(isoprene-b-methyl methacrylate) (PI-b-PMMA) or poly(styrene-b-butadiene-b-methyl methacrylate) (SBM) by using different grafting strategies. Fe3O4 magnetic nanoparticles have been surface-modified with polymer or block copolymer brushes following different grafting methods (grafting to, grafting from and grafting through) to achieve a selective location of nanoparticles into desired domains of the block copolymers. Morphology of fabricated hybrid nanocomposites was studied by means of atomic force microscopy (AFM) and with the aim to reach well-ordered nanostructured composites different annealing methods were used. Additionally, nanoparticle amount has been also varied in order to investigate the effect of the nanoparticle content in the morphology of the block copolymer. Nowadays different characterization methods were using in order to investigate magnetic properties of nanometer-scale electronic devices. Particularly, two different techniques have been used with the aim of characterizing synthesized nanocomposites. First, magnetic force microscopy (MFM) was used to investigate qualitatively the magnetic properties taking into account that this technique allows distinguishing magnetic domains on the sample surface. On the other hand, magnetic characterization by vibrating sample magnetometer and superconducting quantum interference device. This technique demonstrated that magnetic properties of nanoparticles have been transferred to the nanocomposites, exhibiting superparamagnetic behavior similar to that of the maghemite nanoparticles at room temperature. Obtained advanced nanostructured materials could found possible applications in the field of dye-sensitized solar cells and electronic nanodevices.

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