Fe_2O_3 magnetic nanoparticle modification with PMMA-*b*-PCL copolymer, and nanoparticle dispersion into PS-*b*-PCL block copolymer

Irati Barandiaran[1], Ariel Cappelletti[2], Miriam Strumia[2], Galder Kortaberria[1]

[1] "Materials + Technologies" Group, Basque Country University, Plaza Europa 1, 20018 Donostia, Spain
[2] Facultad de Ciencias Químicas, Universidad de Córdoba, Haya de la Torre Esq. Medina Allende 5000, Córdoba, Argentina

irati.barandiaran@ehu.es

Abstract

Especial interest is focused on Fe_2O_3 nanoparticles due to its magnetic properties. Magnetic nanoparticles have been a subject of extensive research because of their potential applications in many diverse fields, such as magnetic ferrofluids, contrast agents for magnetic resonance imaging, biomedical materials, catalysis, and MN/ligand targeting systems for drug delivery [1].
Organic/inorganic nanomaterials based on polymeric matrices and inorganic nanofillers like nanoparticles have received especial interest due to their unique properties [2]. The main goal is to obtain a good dispersion of the nanoparticles into the organic matrix [3]. A common practice to control nanoparticle dispersion is the growth of polymer brushes into the nanoparticle surface in order to increase compatibility with the matrix. Different methods such as *grafting to*, grafting from or or *grafting through* have been proposed for this purpose.
The aim of this work is to disperse Fe_2O_3 magnetic nanoparticles into a PS-*b*-PCL block copolymer. In order to increase compatibility among nanofiller and block copolymer Fe_2O_3 nanoparticles have been functionalized with PMMA-*b*-PCL copolymer, by *grafting to* method.
Fe_2O_3 nanoparticles present –OH groups on the surface. The first step has been the anchoring of 3-aminopropyltrymethoxysilane to those hydroxyl groups. Once it has been covalently anchored, the PMMA-*b*-PCL copolymer (which has a terminal -Cl) has been grafted to it. FTIR and TGA analysis have been carried out to confirm the functionalization (Fig. 1 and Fig. 2).
Then PS-*b*-PCL/MNP nanocomposites have been prepared. PS-b-PCL/MNP films have been prepared by spin coating from toluene solutions of mixture. Samples were then annealed during 72 h at 120 ºC, for nanostructuring the copolymer. Atomic force microscopy (AFM) probed that nanoparticles have been placed in PCL nanodomains due to the compatibility with the matrix because of the brushes (Fig. 3).

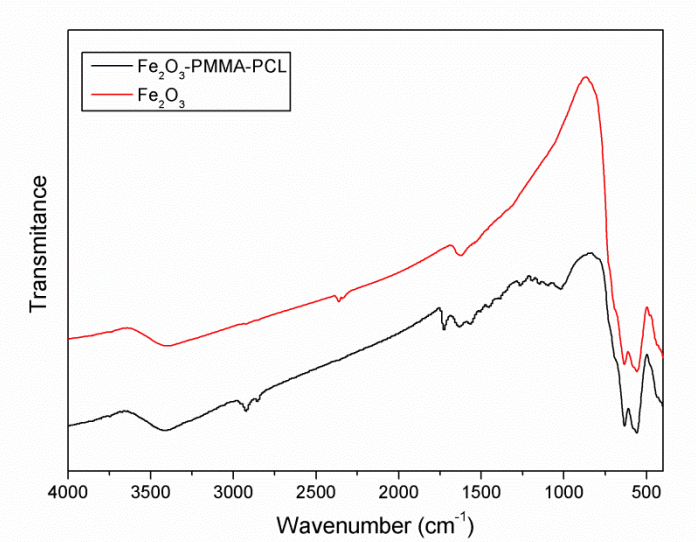

Figure 1. FTIR spectra of Fe_2O_3 nanoparticles before and after functionalization

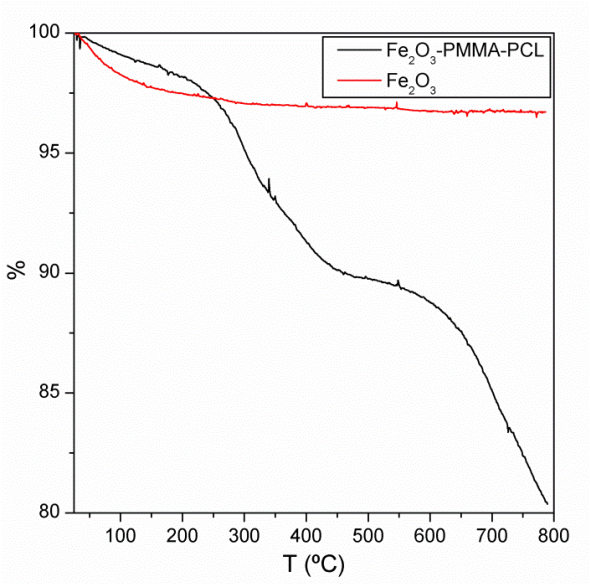

Figure 2. TGA analysis of Fe_2O_3 nanoparticles before and after functionalization

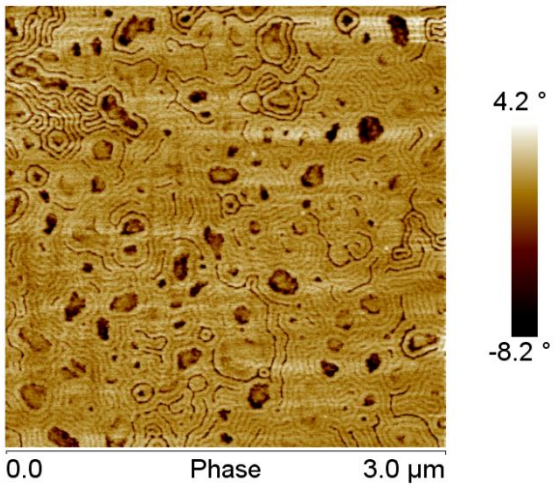

Figure 3. AFM phase image of a PS-b-PCL/MNP film with 2 (wt)% of MNP

References

[1] I Garcia, NF Zafeiropoulos, A Janke, A Tercjak, A Eceiza, M Stamm, I Mondragon, Journal of Polymer Science: Part A: Polymer Chemistry, (2007) 925.
[2] IW Hamley, Nanotechnology, 14 (2003) R39.
[3] L Peponi, A Tercjack, L Torre, JM Kenny, I Mondragon, Composite Science and Technology, 68 (2008), 1631.