Magnetic behaviour of novel polymeric nanocomposites

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The challenge to synthesize and characterise novel materials exhibiting outstanding properties requires the involvement of interdisciplinary groups with complementary expertise. This is the case of polymeric films and gels with incorporated magnetic components. Particularly, PVC composite matrix where magnetic nanoparticles are embedded represents one of the most attractive and emerging type of novel nanocomposite materials for basic and technological research [1].

In the present work, we introduce most recent results concerning the synthesis and characterization from topological and magnetic viewpoints of magnetic nanocomposites consisting on CoNi nanoparticles embedded in a polymeric PVC matrix.

The CoNi nanoparticles have been prepared by polyol method, with particle sizes of 33 nm and 13 nm. These nanoparticles are present in the PVC matrix having different concentrations. The matrix presents 3 different states: liquid, gel and film, depending of the used dissolvent (tethrahidrofurane and diethyloxalate), and the temperature. The topological characterization (for film and gel samples) has been performed by SEM, AFM techniques. The depth profile obtained by SEM images analysis allows us to determine the spatial distribution of nanoparticles inside the films, while surface distribution is analysed by SEM and AFM imaging.

The magnetic properties of the bulk samples have been measured by VSM and SQUID magnetometers, while MFM imaging allows us to determine the surface magnetic characteristics. The hysteresis loops presents similar values of coercitivity at room temperature for nanocomposites having 33 nm (326 Oe) and 13 nm (372 Oe) nanoparticles for all analysed concentrations analysed (0.1 to 10% in weigth) while the remanence monotonically increases with nanoparticles concentration. These magnetic properties are compared with the results obtained for powders of nanoparticles, and analysed in view of the magnetic interactions among them.

Finally, the potential technological applications of these polymeric nanocomposites are discussed considering their combined magnetic properties with chemical and mechanical behaviour of PVC.

[1] J. Chatterjee et al. Colloid. Polym. Sc. 281 (2003) 892
[2] Luna et al. Nanotechnology 15 (2004) 293-297