

CARBON MATERIALS CONTAINING IRON OXIDE NANOPARTICLES. A SYNTHETIC APPROACH

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Carbons containing iron oxide nanoparticles are attractive materials with applications in many fields where special magnetic properties are required. This is because the carbon matrix prevents iron oxide from oxidising and also because iron oxide in the form of discrete particles exhibits magnetic properties which are not observed at micro and macroscale.

Below we show the preliminary results of the preparation of a carbon matrix containing iron oxide nanoparticles obtained by different procedures.

An anthracene oil-based pitch, supplied by Industrial Química del Nalón, S.A was used as carbon matrix precursor (softening point of 112°C; elemental analysis: C: 93.6 %, H: 4.4 %, N, 1.0 %, S, 0.5% and O, 0.5%). The iron oxide nanoparticles were obtained following different procedures: (i) toluene reflux of $\text{Fe}(\text{CO})_5$ with Pluronic P127 in the presence of H_2 [1]; (ii) treatment of a mixture of $\text{FeCl}_3 \cdot \text{H}_2\text{O}$ and $\text{FeCl}_2 \cdot 4 \text{H}_2\text{O}$ with concentrated aqueous ammonia, precipitation and stabilization with lauric acid [2]; and (iii) a sol-gel procedure using tetraethoxysilane (TEOS) and an iron nitrate aqueous solution [3].

The pitch and the iron oxide nanoparticles were thoroughly mixed to the desired concentration by ball-milling. Afterwards, the mixtures were carbonized in a horizontal tube furnace by heating at 3°C min^{-1} to the desired temperature, under a nitrogen flow of 25 L h^{-1} . The resulting materials were characterized from a structural, electrical and magnetic point of view. According to these results, a relationship was established between the properties obtained and the procedure used for the preparation of the nanoparticles.

References:

- [1] J. Lai, K. Shafi, A. Ulman, K. Loos, Y : Lee, T. Vogt, W. Lee, N. Ong, *The Journal of Physical Chemistry Letters B*, **109** (2005) 15.
- [2] JR. Moore, S. Evans, T. Shen, C. Hodson, *Physica E*, **9** (2001) 253.
- [3] J. Zhang, Y. Zhang, X. Chen, J. Zhu, *Materials Research Bulletin*, **38** (2003) 261.

Acknowledgements.- The authors would like to thank FICYT (Project PC04-13 CIS) for financial support. Dr. P. Alvarez also thanks the MEC for her Juan de la Cierva grant.