MFe_2O_4 (M= Mn, Co and Ni) nanoferrites: A simple solvothermal synthesis

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During the past decades, the desing, preparation and characterization of nanometric magnetic materials have been an important area of research that is attracting growing interest because of the potential applications that such materials have in ferrofluids, advanced magnetic materials and medical diagnostic [1].

In particular, the MFe_2O_4 (M= Mn, Fe, Co...) spinel ferrites are among the most important magnetic materials and have been widely used in electronic devices and for information storage [2]. A big variety of methods have been employed in the synthesis of these compounds, such as for example: sol-gel techniques, coprecipitation, mechanochemical processing, reverse micelles and microemulsions procedures, but the most cost-effective routes for large-production ferrite nanocrystals are the chemical precipitation and the solvothermal synthesis.

In this contribution, we report a simple preparation method to obtain MFe_2O_4 (M= Mn, Co and Ni) nanoparticles, that is an adaptation of the synthetic route described by N. Pinna et al. [3] to obtain Fe_3O_4 nanocrystals. This procedure involves a solvothermal reaction that is a valuable alternative to, for example, the known aqueous sol-gel process. And as it will be shown, the proposed method offers the following significant advantages for the preparation of ferrites: its simplicity, the high crystallinity of the obtained products at relatively low temperature (T~180 ºC), the capability to control the crystal growth without the use of surfactants and its adequacy for the preparation of large amount of sample.

By this method, the synthesis of MFe_2O_4 (M= Mn, Co and Ni) is carried out under autogenous pressure inside a stainless-steel autoclave and an alcohol (hexanol or benzyl alcohol) is used both as solvent and ligand, so that it is not necessary to add a surfactant.

We will discuss the influence of the synthetic conditions used in the obtention of the highly crystalline nanoparticles (see Figure), and we will report a morphological, structural and magnetic characterization of the as-obtained nanoparticles.

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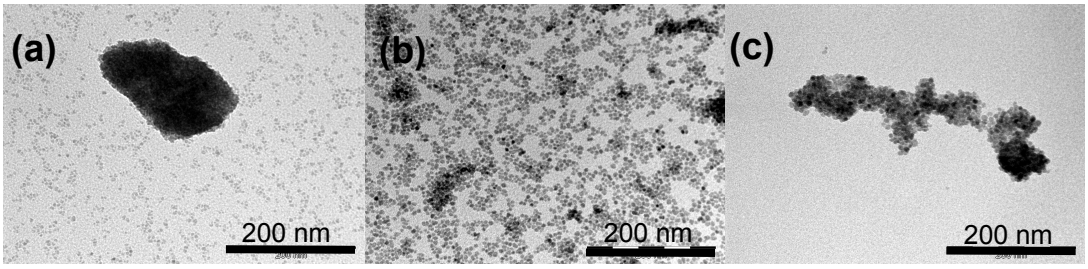

Figure. TEM micrographs of the (a) $MnFe_2O_4$, (b) $CoFe_2O_4$ and (c) $NiFe_2O_4$ nanoparticles synthesized in hexanol at 180 ºC during 24 h.