SYNTHESIS OF NICKEL-ZINC FERRITE NANOPARTICLES IN POLYOLS : MORPHOLOGICAL AND MAGNETIC STUDIES

Z. Beji[1,2], T. Ben Chaabane[1], L. S. Smiri[1], S. Ammar[2], F. Fiévet[2]
[1]*Unité de Recherche 99/UR12-30, Faculté des Sciences de Bizerte, 7021 Jarzouna, Tunisia*
[2]*ITODYS, UMR-CNRS 7086, Université Paris 7, 2 place Jussieu 75251 Paris, France.*
ammarmer@ccr.jussieu.fr

Nickel–zinc ferrites are some of the most interesting soft magnetic materials. They have been extensively used in a number of electronic devices because of their low magnetic coercivity, low eddy current related to their high electrical resistivity, and they are especially suitable for high–frequency applications (large permeability). New low-temperature synthesis methods have been developed to obtain these materials; for example, reverse micelle technique [1], hydrothermal technique [2], citrate precursor method [3]. These methods do not allow simultaneous control of the morphology and the crystalline quality of the particles. A new *chimie douce* route was developed in our laboratory: forced hydrolysis of metallic salts dissolved and heated in a polyol. Polyols are crystal growth media of particular interest for the synthesis of fine particles with a narrow size distribution and high crystallinity [4-7].

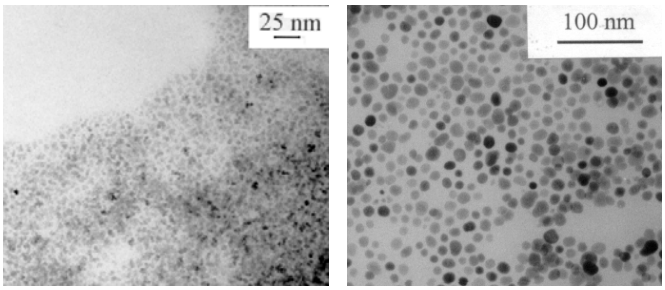
All samples are characterized by X ray diffraction and are found to have the spinel structure. Chemical analysis (EDX) shows that these oxides correspond to a mixed Ni-Zn ferrite with a formula close to $Ni_{1-x}Zn_xFe_2O_4$, with x varying over the whole composition range. Particle morphology and particle size are estimated by transmission electron microscopy (TEM). The TEM images show that the Ni-Zn ferrite nanoparticles are isotropic, with a very uniform size, and are highly crystalline. The mean particle size increases with the Zn proportion.

Magnetic measurements show that all nanoparticles are superparamagnetic at room temperature and present a higher saturation magnetization at low temperature (M_{sat} varies from 51 for x = 0 to 41 emu.g^{-1} for x = 1) than similar particles prepared by other chemical [1;8;9] or mechanical routes [10]. These magnetic characteristics can be related to the high crystalline quality of these nanoparticles.

References:

[1] Gubbala, S.; Nathani, H.; Koizol, K.; Misra, R. D. K., Physica B, **348** (2004) 317.
[2] Upadhyay, C.; Mishara, D.; Verma, H. C.; Anand, S.; Das, R. P., J. Magn. Magn. Mater., **260** (2003) 188.
[3] Singh, A. K.; Goel, T. C.; Mendiratta, R. G., Phys. State Sol. A, **201** (2004) 1453.
[4] Chkaoundali, S.; Ammar, S.; Jouini, N.; Fiévet, F.; Richard, M.; Villain, F.; Greneche, J. M.; Danot, M.; Molinié, P., J. Physics : Condens. Mater., **16** (2004) 4357.
[5] Ammar, S.; Helfen, A.; Jouini, N.; Fiévet, F.; Villain, F.; Rosenman, I.; Danot, M.; Molinié, P., J. Mater. Chem, **10** (2001) 186.
[6] Curuntu, D.; Remond, Y.; Chou, N. H.; Jun, M. J.; Carunti, G.; He, J.; Goloverda, G.; O'Connor, C.; Kolesnichenko, V., Inorg. Chem., **41** (2002) 6137.
[7] Palchik, O.; Zhu, J.; Gedanken, A., J. Mater. Chem, **10** (2000) 1251.
(8] Rajendran, M.; Bhattacharya, A. K.; Das, D.; Chintalapudi, S. N.; Majumdar, C. K., Int. J. Modern Phys. B., **15** (2001) 305.
[9] Alburquerque, A. S.; Ardison, J. D.; Macedo, W. A. A., J. Magn. Magn. Mater., **192** (1999) 277.
[10] Chinnasamy, C. N.; Narayanasamy, A.; Ponpandian, N.; Chattopadhyay, K.; Shinoda, K.; Jeyadevan, B.; Tohji, K.; Nakatsuka, K.; Furubayashi, T.; Nakatani, I., Phys. Rev. B, **63** (2001) 184108.

Figures:



(a) (b)

Fig. 1 TEM images of $Ni_{1-x}Zn_xFe_2O_4$ particles prepared in polyol medium : a) x = 0 and b) x = 1.