11th International Conference on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

ICAM2009

Magnetic nanofilms of maghemite nanoparticles hosted in polyaniline

L. G. Paterno(1)*, M. A. G. Soler(1), F. J. Fonseca(2), J. P. Sinnecker(3), E. C. D. Lima(4) and P. C. Morais(1)

(1) Instituto de Física, Universidade de Brasília, DF 70910-900, Brazil, e-mail: lpaterno@lme.usp.br
(2) Depto de Engenharia de Sistemas Eletrônicos, EPUSP, SP 05508-900, Brazil
(3) Instituto de Física, Universidade Federal do Rio de Janeiro, RJ 21945-970, Brazil
(4) Instituto de Quimica, Universidade Federal de Goiás, GO 74001-970, Brazil
* Corresponding author.

Abstract – Magnetic nanofilms of maghemite nanoparticles hosted in polyaniline are prepared under the layer-by-layer technique. The adjustment of deposition conditions such as magnetic fluid concentration and number of bilayers allowed precise control of the film thickness, morphology and properties. At room temperature, all films presented electrical conductivity and superparamagnetic behavior regardless the film´s deposition conditions.

Molecular devices are based on organized systems of molecular components which together perform specific tasks upon application of an external stimulus, for example optical, electric, and/or magnetic [1]. Among different classes of components, multifunctional materials have gained considerable attention. In this regard, we have employed the layer-by-layer (LbL) technique to produce bi-functional nanocomposite films consisting of citrate coated maghemite nanoparticle (γ-Fe_2O_3,cit-MAG, ∅~ 7 nm) hosted in polyaniline (PANI). At room temperature the nanocomposite films exhibit simultaneously superparamagnetism and electrical conductivity [2,3]. Moreover, we have found that the end properties can be easily and precisely modulated by varying the concentration of the magnetic fluid used for film deposition and/or controlling the nominal number of nanoparticle/polymer bilayers in the nanocomposite. Nanocomposite preparation is based on the alternated and successive immersion of a glass or silicon substrate into a solution of the conducting polymer and a diluted suspension of nanoparticles, respectively. The deposition process of multilayered nanocomposites based on cit-MAG and PANI is well-regulated with a linear correlation between the nominal number of adsorbed cit-MAG/PANI bilayers (Fig 1), the material content, and the film thickness, even for the smallest number of adsorbed bilayers. Magnetization curves measured with a 50-bilayer nanocomposite film show no hysteresis at room temperature which indicates the superparamagnetic behavior (Fig. 2). Values of the blocking temperature obtained from ZFC/FC curves recorded for the nanofilm produced using the highest γ-Fe_2O_3 concentrated suspension (2×10^{-3} g L^{-1}) monotonically increase from 30 to 40 K as the number of cit-MAG/PANI bilayers increases from 5 to 50 bilayers. Values of electrical conductivity (film thickness) found for the 10-bilayered cit-MAG/PANI nanocomposite films were in the range of 10^{-2}-10^{-4} Scm^{-1} (25-63 nm) for γ-Fe_2O_3 concentration within the employed magnetic fluid suspension in the range of 10^{-4}-10^{-3} g L^{-1}.

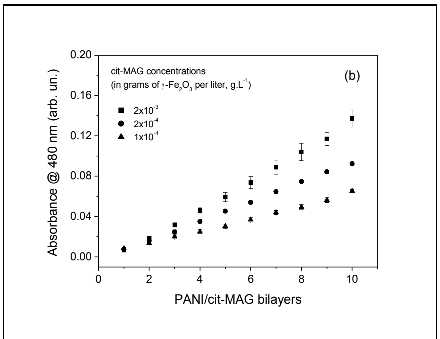

Figure 1: Build-up of cit-MAG/PANI films.

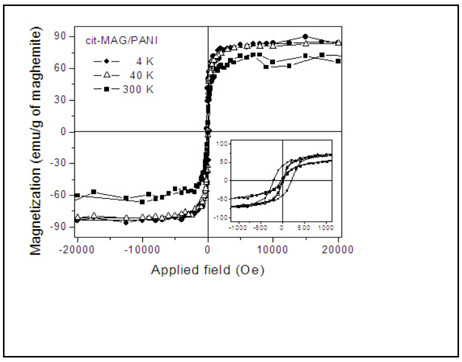

Figure 2: MxH curves for a 50 bilayer cit/MAG/PANI film.

References

[1] V. Balzani, A. Credi, M. Venturi, Molecular devices and machines, Nanotoday 2 (2007) 18-25.
[2] L.G. Paterno, F.J. Fonseca, G.B. Alcantara, M.A.G. Soler, P.C. de Morais, J.P. Sinnecker, M.A. Novak, E.C.D. de Lima, F.L. Leite, L.H.C. Mattoso, Thin Solid Films 517 (2009) 1753-1758.
[3] L.G. Paterno, M.A.G. Soler, F.J. Fonseca, J.P. Sinnecker, E.H.C.P. Sinnecker, E.C.O. de Lima, M.A. Novak, P.C. de Morais, J. Phys. Chem. C 113 (2009) 5087–5095.