MAGNETOLIPOSOMES BASED ON NICKEL/SILICA CORE/SHELL NANOPARTICLES

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Abstract

Liposomes entrapping magnetic nanoparticles (magnetoliposomes) are of large importance in drug delivery, as they can be guided and localized to the therapeutic site of interest by external magnetic field gradients and used in cancer treatment by hyperthermia [1,2].

In this work, magnetic nanoparticles of nickel core with silica shell were prepared by soft chemical methods, using tetraethyl orthosilicate (TEOS) and different surfactants as templating media.

These nanoparticles were either covered with a lipid bilayer, forming dry magnetoliposomes, or entrapped in liposomes - aqueous magnetoliposomes. The systems were characterized by DLS and SEM and the magnetic properties of the nanoparticles were evaluated. It was possible to obtain Ni nanoparticles with silica shell with diameters lower than 100 nm (from DLS measurements) for [TEOS]/[Ni] ratios of 2:1 and 5:1, using CTAB (cetyl trimethylammonium bromide) or AOT (bis(2-ethylhexyl) sulfosuccinate) as templating media.

SEM images of the dry magnetoliposomes prepared (Figure 1) show that they are approximately uniform in size (diameter between 58 nm and 76 nm).

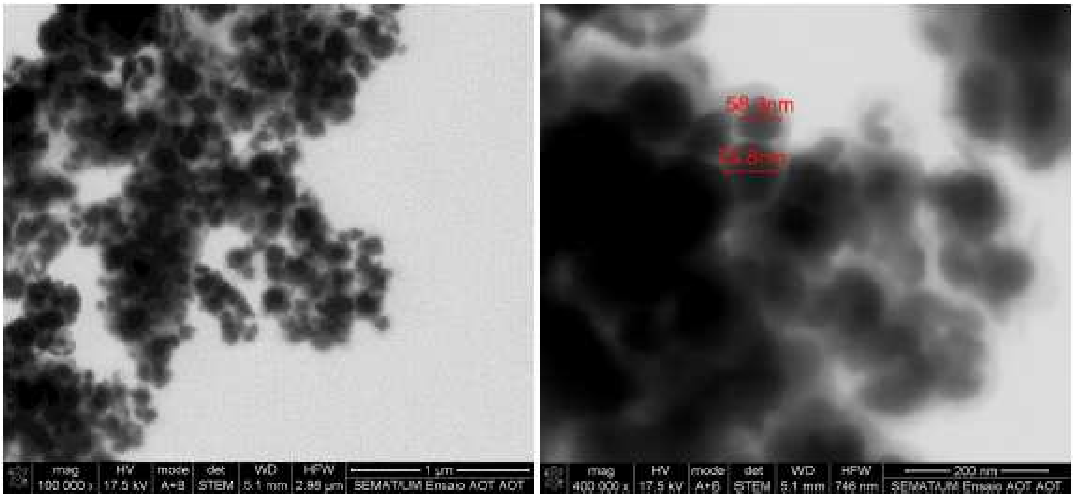

Figure 1. SEM images of dry magnetoliposomes of nickel nanoparticles with silica shell covered by the double chain surfactant AOT.

The hysteresis loop obtained by SQUID measurements (Figure 2) show typical ferromagnetic properties of the Ni nanoparticles at room temperature. The magnetic measurements allow estimating a coercive field of 80 Oe that compares well with the value previously obtained for nickel nanoparticles prepared by similar methods [3].

Preliminary assays of the non-specific interactions of both dry and aqueous magnetoliposomes with biological membranes (modeled by giant unilamellar vesicles, GUVs) were performed. FRET (Förster Resonance Energy Transfer) assays between GUVs containing phospholipids labeled with fluorescence probes and other dyes (e.g. Nile Red) incorporated in the magnetoliposomes have revealed the occurrence of fusion between the magnetoliposomes and the GUVs.

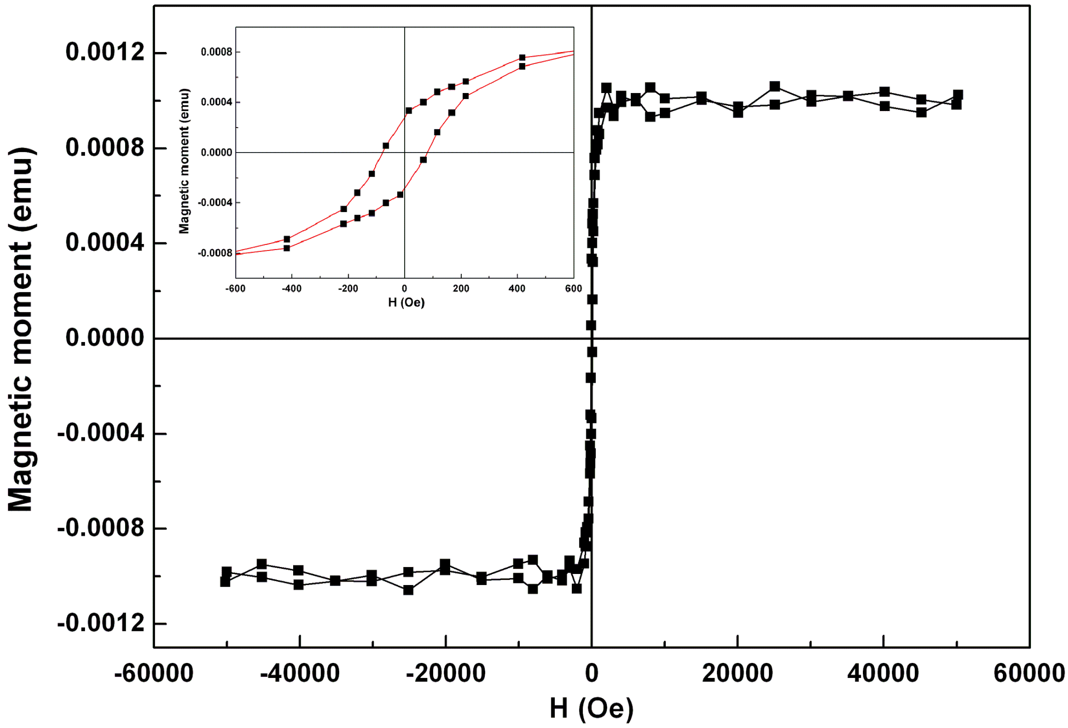

Figure 2. Hysteresis loop of Ni nanoparticles at room temperature obtained by SQUID.

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