

SYNTHESIS AND FUNCTIONALIZATION OF ROD-LIKE IRON OXIDE NANOPARTICLES

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Abstract

Magnetic iron oxide nanoparticles have been recognized for use in various promising biomedical applications, such as detection of biological molecules, contrast agents in magnetic resonance imaging (MRI), vectors in drug delivery and mediators to convert electromagnetic energy to heat (hyperthermia). We reproduce a simple two-step reaction strategy for the synthesis of uniform magnetic iron oxide nanorods with ~50 nm in length and ~5 nm in diameter (Figure 1) and their colloidal stabilization with three different polymers (bisphosphonate polyoxyethylene - Optima 100, polymethacrylate polyoxyethylene - PCP45 and polyacrylic acid sodium salt - PAA) in water. Two-step reaction consists on synthesis of akaganeite followed by its transformation by reduction using hydrazine in microwave to obtain magnetic iron oxide nanorods [1]. The nanorods present the saturation magnetization value of ~64 kA/m and residual magnetization of ~15 kA/m, thus this material has ferro- or ferrimagnetic behavior. To estimate the iron oxide composition we use the technique of Mössbauer spectroscopy and a mixture of maghemite (strongly magnetic phase) with a quasi-amorphous intermediate phase (weakly magnetic phase) was detected, explaining a relatively low magnetization saturation. The suspensions of MNPs were probed by dynamic light scattering (DLS) and the distribution curve provides the Z-average hydrodynamic diameter equal 70±5 nm for Optima 100, 82±8 nm for PCP45 and 99±8 nm for PAA. We also study the effect of the polymer concentration and of the solution pH on the suspension stability.



Figure 1: Transmission electron microscopy image of nanorods stabilized with Optima100

[1] Milosevic, I., Jouni, H., David, C., Warmont, F., Bonnin, D., and Motte, L. Facile microwave process in water for the fabrication of magnetic nanorods. *J. Phys. Chem. C* 115, 18999-19004 (2011).