PREPARATION OF MIXED OXIDE MAGNETIC NANOPARTICLES UNDER MILD CONDITIONS USING THE MICROEMULSION REACTION METHOD

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Conventional methods for the synthesis of nanoparticles, such as co-precipitation, sol-gel and impregnation processes, are often not capable of resulting in the very small and controlled size required in certain applications[1]. Other methods, such as laser evaporation, sputtering, ionized beam deposition, flame spray pyrolysis, chemical vapour deposition, etc. involve the use of complicated and expensive equipment. An interesting and simple alternative is the use of surfactant self-assemblies as templates for the preparation of nanoparticles with controlled size and shape. In this sense, microemulsions have been employed for the synthesis of metallic, metal oxide and other inorganic nanoparticles, after the pioneering research of Boutonnet et al[2]. However most of the investigations reported employ microemulsions with high concentrations of ionic surfactants. Given the interactions between precursor salts and ionic surfactants, the content of precursor inside the water nanodroplets is limited. In addition, complex functional species could be adsorbed at the particle surface and interfere with its growth [3]. Nonionic surfactants have been used in some investigations for the synthesis of mixed oxides, however mostly non-biodegradable nonylphenol ethoxylates were employed [4].

The objective of this work is to prepare mixed oxide nanoparticles based on non-noble metals (Fe, Mn, Zn), using environmentally friendly technical grade n-alkyl fatty alcohol ethoxylated surfactants, and to optimize the formulations in terms of surfactant concentration. The phase behavior of ternary aqueous solution/nonionic surfactant/hydrocarbon systems was investigated in order to identify w/o microemulsions, in the presence of metallic precursors, or precipitant agents. Selected microemulsions with different compositions were used for the synthesis of Mn-Zn ferrite nanoparticles. Characterization of the obtained materials was performed by transmission electron microscopy, X-Ray Diffraction, and magnetization. Nanoparticles in the same size range of the microemulsions (3-10 nm) were obtained, demonstrating the microemulsion template effect. The results suggest that these environmentally friendly microemulsion systems could be useful for the preparation of nanostructured mixed oxides and other magnetic materials, which could have potential applications in biomedical applications such as Magnetic Resonance Imaging, controlled drug delivery and hyperthermia treatment.

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