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Surface-protective assistance of ultrasound in synthesis of superparamagnetic magnetite nanoparticles and in preparation of mono-core magnetite-silica nanocomposites

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ABSTRACT

Ultrasound was throughout employed to enhance co-precipitation method in synthesis of magnetite nanoparticles (Fe_3O_4) and Stöber approach in preparation of magnetite-silica nanocomposites (Fe_3O_4/SiO_2). The synthesised magnetite nanoparticles exhibited as single-domain nanocrystallites with uniform spherical morphology, narrow size distribution (ca. 10 nm), and negligible magnetic resistance (5 Oe for coercivity). The prepared magnetite-silica nanocomposites possess monocore-shell structure with spherical morphology, biologically coherent size (ca. 100 nm), and discrete mono-domain behaviour (3.2 $emu \cdot g^{-1}$ for magnetisation). The crystalline structure-magnetic behaviour relationships of the nanomaterials were investigated to imply the presence of a surface protection at nanoscale. The speculation indicated that shock-waves took place as the surface-protective role rather than original mechanical interaction of ultrasound with larger scope of impact.

KEYWORDS

Fe_3O_4 nanoparticles, $Fe_3O_4@SiO_2$ nanocomposites, shock-wave, ultrasonic assistance, co-precipitation, Stöber method, crystalline structure-magnetic behaviour relationships

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