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Abstracts presented in the original edition

EFFECT OF THE SILICA PRECURSOR CONCENTRATION ON THE CONTINUITY OF THE CORE-SHELL COATING OF Fe_3O_4/SiO_2 NANOPARTICLES AND THE MAGNETIC CHARACTERISTICS OF THE COMPOSITE

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In recent years, significant attention has been focused on deeper understanding of the magnetic nanoparticles nature, their behavior, and the search for new areas of their applicability. For pharmaceutical and biomedical purposes, magnetic nanoparticles must have a size that lies in the nanometer range, which provides superparamagnetic properties along with high magnetization, as well as a narrow size distribution. The layer covering the magnetic nanoparticles surface should provide aggregate stability and biocompatibility. As a rule, to produce magnetic nanoobjects, synthesis in nanoreactors or synthesis of "core-shell" particles is used [1]. However, when creating magnetic materials, two main problems arise: the development of the synthesis of nanoparticles of reproducible shape and size, as well as the effective nanoparticles stabilization with the preservation of the characteristic nanoscale state properties.

The aim of this work is to study the effect of the silica precursor concentration on the continuity of the core-shell Fe_3O_4/SiO_2 coating and the magnetic characteristics of the composite.

Fe_3O_4 nanoparticles were obtained by co-precipitation of iron (II) and (III) chlorides solutions with ammonia. Fe_3O_4/SiO_2 nanoparticles were synthesized by the Stober method. Totally 3 samples were synthesized with different mass ratio magnetite-tetraethoxysilane (a precursor of silica): 2:1 (sample 1), 1:1 (sample 2), and 1:2 (sample 3). The effect of the silica precursor concentration in the reaction mixture on the continuity of the silica shell was studied (Table 1).

Table 1. Physical and chemical parameters of synthesized samples

Sample	d_{Av} (SEM), nm	d_{Av} (DLS), nm	pH_{IEP}	M_{max}, Am^2/kg
Fe_3O_4	6	4.70 ± 0.09	7.90 ± 0.16	75.0 ± 1.5
Fe_3O_4@SiO_2 No.1	9	7.50 ± 0.15	3.40 ± 0.07	60.0 ± 1.2
Fe_3O_4@SiO_2 No.2	14	15.6 ± 0.3	2.90 ± 0.06	48.0 ± 1.0
Fe_3O_4@SiO_2 Np.3	30	28.7 ± 0.6	2.10 ± 0.04	38.0 ± 0.8
SiO_2	-	-	1.80 ± 0.04	-

d_{Av} (SEM), nm – average particle size according to SEM; d_{Av} (DLS), nm – average particle size according to dynamic light scattering; pH_{IEP} – experimental pH of the isoelectric point; M_{max}, Am^2/kg – maximum magnetization of samples

With an increase in the silica precursor to magnetite mass ratio, we can confirm the complete core particles coating with a shell. Also, with an increase in the silica precursor concentration in the reaction mixture, there is a decrease in the maximum magnetization, due to an increase in the amount of the silica phase in the material, and the shape of the magnetization curves indicates the superparamagnetic state of the obtained materials.

References

[1] Reddy, L.H., Arias, J.L., and Couvreur, J.N., *Chem. Rev.*, **2012**, vol. 112, p. 5818. doi 10.1021/cr300068p

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