MAGNETITE-GOLD NANOPARTICLES: SYNTHESIS, PHYSICAL-CHEMICAL INVESTIGATION AND BIOMEDICAL APPLICATION

EFREMOVA Mariia, TCAREVA Iana, RUDAKOVSKAYA Polina, GREBENNIKOV Ivan, GARANINA Anastasia, ABAKUMOV Maxim, BLOHINA Anastasia, SCHETININ Igor, SAVCHENKO Alexander, GOLOVIN Yuriy, MAJOUGA Alexander, KLYACHKO Nataliya

Lomonosov Moscow State University, Moscow, Russian Federation

National University of Science and Technology «MISiS»; Pirogov Russian National Research Medical University; Tambov State University, Russian Federation

Abstract

Magnetic nanoparticles (MNP) of magnetite become widespread in biomedical researches and practice during the last decade. Coating of MNP with gold shell reduces their aggregation in colloid solution, decreases their toxicity for living organisms and facilitates functionalization.

Herein, we present the synthesis, purification, functionalization processes and characterization of magnetite-gold nanoparticles with target properties for biomedical application. Magnetite nanoparticles were obtained by co-precipitation and then covered with gold shell by reduction of HAuCl4 with Na citrate or NH2OH*HCl. Obtained nanoparticles were functionalized with sulphur-containing ligands (mercapto-PEG-acid, lipoic acid etc.). As an enzyme for modification a chymotrypsin was chosen.

Magnetite and magnetite-gold nanoparticles were characterized by TEM, XRD, VSM. The formation of «core-shell» structure was proved by HRTEM combined with EDX-analysis. Transverse relaxation rate (R2) was determined to be 250-300 mM-1s-1 for magnetite and 150-300 mM-1s-1 for magnetite-gold that exceeds R2 of commercial MRI-contrasting agents. The effect of alternating magnetic field on catalytic properties of chymotrypsin immobilized on magnetite nanoparticles, notably the slowdown of catalyzed reaction at the level of 30-35 % was found. The most probable reason for it is the change of active centers topology on the enzyme surface as a result of its deformation.

Thereby, obtained systems have promising application in MRI as contrasting agents and also in targeted drug delivery for remote control of enzyme catalytic activity.

Keywords: Magnetic nanoparticles, core-shell structures, MRI agents, enzyme functionalization

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