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Anna V Bychkova

N.M. Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, Russia

Stable plasma protein coatings on magnetite nanoparticles for biomedical applications

Mariia V. Lopukhova, Alexander I. Shalupov, Luybov A. Wasserman, Pavel G. Pronkin, Alexander L. Kovarski and **Mark A. Rosenfeld**
N.M. Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, Russia

Proteins are promising materials for creation of coatings on magnetic nanoparticles (MNPs) due to their biocompatibility, prevention of MNPs agglomeration and chemical reactions in biological liquids [1]. Magnetically targeted nanosystems with protein coatings are considered to be applicable in different areas of biology and medicine including theranostics and biosensing techniques. Proteins represent extremely susceptible targets for oxidants. The protection mechanisms in preventing oxidative damages for proteins within cells are mainly related to a large variety of antioxidant enzymatic systems. In contrast, plasma proteins are scarcely protected by these systems but the highly site-specific oxidation was convincingly demonstrated for some proteins, indicating that protein structure could be adapted to oxidation [2]. The mechanism providing plasma protein functioning in the conditions of generating reactive oxygen species (ROS) is a base for to the development of free radical approach to immobilizing of protein on magnetic nanoparticles (MNPs) in dispersions. Adsorption of a group of blood proteins including serum albumin and immunoglobulin G on MNPs and stability of the coatings was studied with the help of dynamic light scattering (DLS), UV/Vis spectrophotometry, differential scanning calorimetry (DSC), spin label technique [3], ferromagnetic resonance (FMR) [4], and the method of spectral-fluorescent probes [5]. The novel approach lead to the formation of stable cross-linked functional coatings on magnetite (Fe_3O_4) MNPs assembled from protein molecules. The free radical linking of thrombin and immunoglobulin G on the surface of nanoparticles has been shown to almost completely keep native properties of the protein molecules as potential therapeutic products and biovectors. The reported study aimed at obtaining multifunctional coating on magnetic nanoparticles was funded by RFBR and Moscow city Government according to the research project № 15-33-70019 «mol_a_mos», and by the Russian Science Foundation project No. 18-73-00350; protein study on the surface of MNPs was funded by RFBR, according to the research project No. 16-34-60244 mol_a_dk; spectral-fluorescent probes applications were developed according to the research RFBR project No. 16-03-00735 a. The research was carried out within the framework of budget financing under the government task (themes 0084-2014-0001, State registration No 01201253311, and 0084-2014-0005, State registration No 01201253307).

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Biography

Anna V Bychkova has graduated from D. Mendeleyev University of Chemical Technology of Russia in "Materials science and technology of new materials" and completed her PhD in "Physical Chemistry" from N.M. Emanuel Institute of Biochemical Physics, Russian Academy of Sciences (Moscow, Russia) where has been working as a reserch scientist since 2006. She has published more than 50 papers in peer-reviewed journals, 7 chapters in books, 1 Russian patent and awarded the scholarship of the President of the Russian Federation for young scientists and graduate students engaged in research and development in priority areas of the Russian economy modernizing (2013-2018).

anna.v.bychkova@gmail.com

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