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Electrohydraulical synthesis of magnetite nanoparticles for biological application

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In recent years, much attention is paid to study nanoscale magnetic nanoparticles (MNPs), such as Fe_3O_4, γ-Fe_2O_3, $CoFe_2O_4$, $ZnFe_2O_4$, $BaFe_{12}O_{19}$. Among these, superparamagnetic iron oxide nanoparticles (SPIONs) of magnetite (Fe_3O_4) and maghemite (γ-Fe_2O_3) are very popular candidates with their biocompatibility and can be used by encapsulation of the particles with a suitable coating substance for controlled drug delivery of therapeutic agents in "*in-vivo*" applications. Besides, the other applications found in the area of magnetic resonance imaging are tissue repair, immune analysis, biological fluids detoxification, magnetic hyperthermia and cell separation. In fact, although various types of techniques are used for the synthesis of magnetic nanomaterials like chemical precipitation technique, thermal decomposition of organic iron precursors, hydrothermal synthesis, and microemulsion-based technique, etc., unfortunately, at the state-of-the-art, imperfections in the final materials are still usually present. They are due to difficulties in controlling both temperature and mixing process during the synthesis, which result in a procedure-dependent nanoparticle size polydispersion due to the NPs instability towards growing processes. We propose electrohydraulic discharges assisted chemical co-precipitation technique in order to develop a simple, cost-effective, large-scale manufacturing of bio-applicable iron oxide nanoparticles involving plasma arc discharges in base solution. By this method, as preliminary experiments shows, we obtain better dispersing the formed nanoparticles at the initial stage, process their surface (static stabilization, H and OH radical addition for better absorbance) by pulsed discharges and add to the fluid the bactericidal properties. After that, the covering (stabilizing) of the monodisperse nanoparticles with surfactant is relatively easy to follow, with bioactive molecules (dextran, polyvinyl alcohol, polyethylene glycol, etc.), followed by washing from chemical reaction residuals, additional ultrasound homogenization and centrifugation. Transition electron microscopy, vibrating sample magnetometer, VIS spectrophotometry and bactericidal research was used to characterize obtaining samples.

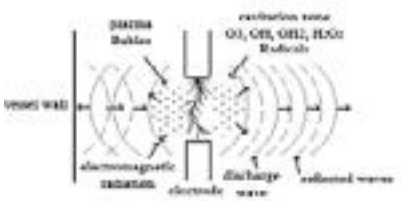

Fig 1. Processes during electro discharges into fluids

Biography

Vladimer T Mikelashvili, PhD, Physicist has his expertise in evaluation and technology of magnetite particles containing nanofluids. He has participated in several (14) international scientific conferences, published 7 scientific articles and is a member of Georgian Scientific Group. The research objective of scientific group of Magnetic Nanofluids of Biomedical Use at Vladimir Chavchanidze Institute of Cybernetics of the Georgian Technical University is synthesis of magnetic nano suspensions, their subsequent modifications and study of the physical and chemical properties.

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