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Synthesis and Characterization of Superparamagnetic Colloidal Nanoparticles for Theranostics in Oncology

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Nowadays one of the most important research field is the application of magnetic nanoparticles for theranostics in oncology (contrast agent for MRI (Magnetic Resonance Imaging) and active material for Magnetic Hyperthermia treatment). Development of novel advanced nanomaterials for biomedical applications is limited to a great extent by the lack of cutting-edge characterization techniques of both nanoparticles themselves and their spatial distribution in biological tissues after administration. A possibility of fine tuning of these nanoparticles characteristics in size, shape and specific magnetic characteristics should be realized. For the manufacture of colloidal magnetic nanoparticles having tuneable magnetic and biochemical properties advanced micro-wave synthesis technique was used, thus preparing a bases for future personalized nanomedicine platform. To get detailed insight into the relationships between parameters of colloidal magnetic nanoparticles (size, morphology, stoichiometry, type of surfactant covering the nanoparticles) and their magnetic and biochemical properties advanced *in-situ* x-ray spectroscopic methods were applied. Iron oxide based colloidal magnetic nanoparticles for theranostics in oncology are promising candidates for nanomedical applications as one could use them both for diagnostics (as a contrast agent in MRI) and simultaneously for therapy (as active agent for magnetic hyperthermia of tumour tissues). In the present study advanced synchrotron radiation x-ray spectroscopic methods were used for *in-situ* study of colloidal magnetic nanoparticles in solution, reproducing their “natural” conditions in biological tissues. High-energy-resolution XANES and non-resonant XES obtained at ESRF ID26 beamline were applied to study the atomic and electronic structures of the colloidal nanoparticles in both occupied and unoccupied electronic states regions. High energy resolution XAFS, obtained through selective fluorescence detection was treated by using of advanced FitIt theoretical approach to obtain the 3D local structure parameters exploiting the improved full-potential FDMNES code.

Biography

Elena Kuchma graduated from Faculty of Physics at Southern Federal University of Russia. She is a Master student at Southern Federal University and assistant for director of Smart Materials International Research Center.

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