Abstract of Master diploma thesis

Michal Kačenka, Prague 2009

The aim if this thesis is preparation of novel fluorescent magnetic nanoparticles. Such particles are promising materials for biomedical research as dual labeling agents. Silica-coated particles of perovskite phase $La_{0.75}Sr_{0.25}MnO_3$ (LSMO@SiO_2) were previously described as a promising material for magnetically induced hyperthermia. Besides, the relaxometric studies of LSMO@SiO_2 suspension revealed high values of relaxivity r_2, related to the contrast quality in MRI, significantly exceeding that of widely used iron oxide nanoparticles. Binding fluorescent dye into silica layer of LSMO@SiO_2 could provide dual probe with the possibility of fluorescence and magnetic resonance detection, suitable for bimodal cellular labeling.

The nanoparticles were coated by two-step procedure including the use of mixture of *N*-1-(3-triethoxysilylpropyl)-*N'*-fluoresceinylthiourea and tetraethoxysilane in the first step leading to the fluorescent silica shell. The resulting particles exhibit low colloidal stability in water and, therefore, they were subsequently coated by secondary pure silica layer in the next step employing only tetraethoxysilane. The final product exhibits sufficient colloidal stability in water.

The morphology and size were investigated by means of DLS and TEM, that evidenced also the increase of the shell thickness after the second step. The overall thickness of silica shell was ~16 nm, average particle size was ~90 nm. Luminescence spectroscopy proved the presence of fluorescein moiety, IR spectra proved presence of aminopropyl moiety present in silica layer. No fluorescein leaching was observed even after long storage.

Cellular labeling experiments with HeLa cells and human fibroblasts revealed significant uptake of the nanoparticles in both cases and good viability of labeled cells. According to the fluorescence microscopy numerous endosomes containing nanoparticles were formed. *In vitro* labeling of stem cells revealed good viability of tested cells. Islets of Langerhans exhibited reasonable vitality and insulin releasing ability after *in vitro* labelling. Although the presence of particles in the islets determined by fluorescence microscopy was low, labeled islets provided sufficient signal for MR imaging.

Prepared nanoparticles showed both magnetic and fluorescent features. Performed biological experiments proved no significant negative interference of final product with the vital functions of tested cells. Therefore, prepared nanoparticles are suitable for further biomedical experiments as dual labeling agents.