Abstract of “rigorous” work

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Name: **Selected systems of nano-particles and their physico-chemical properties**

Presented work belongs to the topic of solid-state chemistry, which focuses mainly on the preparation and characterization of nano-particles and nano-composites.

The introduction describes current knowledge of classical magnetism and magnetism of small particles. Next paragraphs describe the sol-gel technique, which uses alkoxides of transition elements for preparation of gels, xerogels and nano-composites. The introduction ends by the overview and explanation of experimental techniques that were employed for final sample characterization.

The experimental work is divided in three thematic parts: i) Preparation and characterization of $CoFe_2O_4/SiO_2$ composite in the form of spheres of few microns in diameter ; ii) Preparation and characterization of Fe_3O_4/SiO_2 composite in the form of spheres with core-shell morphology with diameter of several tens of nanometers ; iii) Preparation and characterization of Fe_2O_3/TiO_2 composite with photo-catalytic properties.

In the first part, the SiO_2 micro-spheres of average 11 micrometers in diameter, doped by super-paramagnetic $CoFe_2O_4$ nano-crystals, were synthetized. Final products were characterized by X-Ray powder diffraction, electron microscopy. The magnetic properties were studied by hysteresis loop and alternating susceptibility measurements.

The second thematic part was focused on the study of reaction conditions in earlier published preparation route, when magnetic nano-particles were covered by a layer of amorphous silicon dioxide using sol-gel technique in micro-emulsion. The X-ray powder diffraction and mainly high resolution transmission electron microscopy were employed for the final product characterization.

The last part contained the preparation of the magnetically separable photo-catalyst Fe_2O_3/TiO_2. The maghemite particles were synthetized using the co-precipitation method and covered by citric acid. Later, a layer of titania was precipited on the surface of these nano-crystals. The final photocatalytic properties were studied by decomposition of 4-chlorphenol in the colloidal dispersion irradiated by UV radiation.