Nanocomposites and nanomaterials

Thermal stability of magnetite nanoparticles by magnetization measurements

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Magnetite nanoparticles are an important magnetic material than can be used as catalyst, magnetic sensors, ferrofluids. They can also be used in biomedical areas such as drug delivery systems, magnetic resonance imaging, and cancer therapy [1]. The application of magnetite nanoparticles in some areas (e.g. coating with polymers or silica) require a high thermal stability of the iron oxide nanoparticles [2].

The aim of this work is to determine the thermal stability of microscale and nanoscale magnetite by magnetization measurements.

The magnetite nanoparticles were prepared by first precipitating Fe(II) hydroxide which was then crystallized into magnetite in the presence of potassium nitrate as mild oxidizing agent. The microscale magnetite (0.05-0.1 mm) collected from Kryvyi Rih basin.

The magnetization loss was measured by magnetometer with the Hall sensors after thermal treatment of magnetite samples at 300, 400, 500, and 600 °C during 30 min. The thermal treatment leads to magnetization loss from 31 to 69 % for nanoscale magnetite and from 22 to 66 % for microscale magnetite with the temperature increasing from 300 to 600 °C. The surprising stability of magnetization of nanoscale magnetite compared to microscale magnetite is attributed to the different pathway of phase transformation of iron oxide.

Further thermomagnetic analysis showed that thermal treatment of microscale magnetite leads to hematite formation, while the thermal treatment of nanoscale magnetite leads to maghemite formation as well.

Therefore, the maghemite contribution was the reason of a higher saturation magnetization of nanoscale magnetite compared to microscale sample.

1. *Harraz F.* A. Synthesis and surface properties of magnetite (Fe_3O_4) nanoparticles infiltrated into porous silicon template // Applied Surface Science.-2013.-**203**.-P. 210.

2. *Kalska-Szostko B., Wykowska U., Satula D., Nordblad P.* Thermal treatment of magnetite nanoparticles. Beilstein Journal of Nanotechnology.-2015.-**6**, N 1.-P. 1385–1396.