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The magnetic and oxidation behavior of bare and silica-coated iron oxide nanoparticles synthesized by reverse co-precipitation of ferrous ion (Fe^{2+}) in ambient atmosphere

Abstract

The synthesis of iron oxide nanoparticles, i.e., magnetite was attempted by using only ferrous ion (Fe^{2+}) as a magnetite precursor, under an ambient atmosphere. The room temperature reverse co-precipitation method was used, by applying two synthesis protocols. The freshly prepared iron oxide was also immediately coated with Stöber silica (SiO_2) layer, forming the coreshell structure. The phase, stoichiometry, crystallite and the particle size of the synthesized powders were determined by using X-ray diffraction (XRD) and transmission electron microscope (TEM), while the magnetic and oxidation behaviors were studied by using the vibrating sample magnetometer (VSM) and Mössbauer spectroscopy. Based on the results, the bare iron oxide nanoparticles are in the stoichiometry between the magnetite and the maghemite stoichiometry, i.e., oxidation occurs. This oxidation is depending on the synthesis protocols used. With the silica coating, the oxidation can be prevented, as suggested by the fits of Mössbauer spectra and low temperature magnetic measurement.

Keywords; Reverse co-precipitation, Ferrous ion, Magnetite, Mössbauer, Silica