Effects of Particle Size on the Magnetic Properties of Maghemite Nanoparticles

KELLY L. PISANE, MOHINDAR S. SEEHRA, Department of Physics and Astronomy, West Virginia University — The effects of particle size on the magnetic properties of oleic-acid-coated maghemite (\(\gamma\)-Fe\(_2\)O\(_3\)) nanoparticles (NPs) with average diameters of 3.2 nm and 7.0 nm are reported. These samples were prepared by identical procedures and characterized by x-ray diffraction, transmission electron microscopy, FTIR spectroscopy and temperature-dependent ac and dc magnetometry. The zero field-cooled and field-cooled magnetization \(M\) vs. \(T\) data under \(H = 100\) Oe yield the blocking temperature \(T_B \approx 21\) K (35 K) for the 3.2 nm (7.0 nm) NPs. Changes in \(T_B\) with changes in the measuring frequency \(f_m\) (10 Hz to 10 kHz) are used to determine the Neel-Brown relaxation time and the strength of inter-particle interaction. Above \(T_B\), the data of \(M\) vs. \(H\) up to \(H = 90\) kOe are used to determine magnetic moment per particle and to understand the effects of size distribution on the measured properties. Below \(T_B\), the plots of \(M\) vs. \(H\) show surprisingly negligible hysteresis with coercivity \(H_C \approx 20\) Oe for both NPs. Interpretation of these results will be presented along with comparison with results obtained from bulk maghemite.

\(^1\)Supported in part by NSF IGERT Grant DGE-1144676.