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Morphological, Thermal, and Magnetic Analysis of Ball-Milled γ-Fe_2O_3 and Fe_3O_4 Nanoparticles for Biomedical Application PHILIP BURNHAM, GEORGIA C. PAPAEFTHYMIOU, ARTHUR VIESCAS, Villanova University, Department of Physics, CALVIN LI, Villanova University, Department of Mechanical Engineering, NORMAN DOLLAHON, Villanova University, Department of Biology — Superparamagnetic iron oxide nanoparticles are promising agents for hyperthermia cancer treatment, because, when exposed to an alternating magnetic field, they impart heat to surrounding tissue. A comparison of γ-Fe_2O_3 and Fe_3O_4 nanoparticles for such application is presented. The particles were obtained via surfactant-assisted high energy ball-milling in a hexane/oleic acid carrier-fluid environment. Particles with diameters of 5 to 16 nm were prepared with mass ratios (oleic acid):(γ-Fe_2O_3) of 0:1, 1:5, 1:10 and 1:20, with milling times of 3, 6, 9, and 12 hours. TEM micrographs revealed spherical morphology and the effect of oleic acid shells. Optimal size distributions were obtained for high oleic acid contents. At room temperature, a reduced internal magnetic field ∼480 kOe) was recorded via Mössbauer spectroscopy compared to bulk γ-Fe_2O_3 ∼500 kOe), due to magnetic relaxation; Fe_3O_4 particles produced similar results. For the γ-Fe_2O_3 and Fe_3O_4 nanoparticles with 20% oleic acid by mass, comparative ZFC/FC magnetization (H_{app} = 200 Oe in temperature range from 2 to 400 K) and hysteresis loops (T = 2 K and 300 K up to H_{app} =6 kOe) were obtained. Thermal transport characteristics were verified by Specific Absorption Rate (SAR) measurements using an AC magnetic field (f =282 kHz). Differences and similarities in behavior will be discussed.

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