Synthesis and Size Dependent Properties of Magnesium Ferrites

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$MgFe_2O_4$ samples were prepared by high-temperature thermal decomposition (HTTD), sol-gel, and solid-state reaction methods. The samples (a) prepared by HTTD, (b) annealed at 800 °C prepared by sol-gel method under Ar atmosphere, and (c) annealed at 1100 °C prepared by a solid-state reaction method have the inverse cubic spinel structure ($(Fe)_A[MgFe]_BO_4$) with a space group of $Fd3m$. The saturation magnetization (M_s) and coercivity (H_c) at room temperature are found to be 42.2, 44.2, and 53.3 emu/g and 1.2, 81.6, and 94.1 Oe, respectively. The Mössbauer spectra of all samples have been obtained at room temperature and the sample prepared by the HTTD method was measured at various temperatures ranging from 4.2 K to 300 K. The Mössbauer spectrum of the sample prepared by the HTTD method shows superparamagnetic behavior at room temperature and the Mössbauer spectra of the other samples show ferrimagnetic state of six-line shapes having the hyperfine field (H_f) values of 432 $\sim$ 452 kOe for the A sites and 466 $\sim$ 483 kOe for the B sites. The linewidth and the hyperfine field of Mössbauer spectra is broadened and reduced, respectively, which is reduced the particle sizes.

***Index Terms*—High-temperature thermal decomposition (HTTD), Magnesium ferrites, Mössbauer spectroscopy, superparamagnetism.**