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Finite-Size effects in the Optical and Magnetic Properties of $MnCo_2O_4$ Nanostructures SOBHIT SINGH, M. S. SEEHRA, West Virginia University, P. PRAMANIK, S. THOTA, Indian Institute of Technology Guwahati — $MnCo_2O_4$ nanoparticles (NPs) find extensive applications in energy sectors such as in fuel cells, Li-ion batteries, supercapacitors, etc. Here we present a detailed study of the surface and finite size effects on the optical and magnetic properties of $MnCo_2O_4$ NPs synthesized by the sol-gel method. $MnCo_2O_4$ particles of various sizes (5.4 nm $\leq$ d $\leq$ 112 nm) were prepared by varying the heat treatment conditions of the oxalate precursor. The optical absorption spectra of these samples were recorded using a diffuse reflectance accessory. The optical bandgap (E_g) values, determined using the Kubelka-Munk analysis, reveal a strong confinement induced blue shift, increasing E_g from 1.73 to 2.4 eV with decreasing size from 112 to 5.4 nm. Also, the role of crystallite size on the crystal field transitions e.g. ligand-to-metal (p-d at 3.10 eV) and intra-band metal-to-metal charge transfer transition (2.6 eV) within d-states has been analyzed. The ferrimagnetic ordering temperature (T_C) determined from temperature dependence of dc-magnetic susceptibility $\chi(T)$ measurements decreases to 140 K from the bulk value of 185 K with decreasing the crystallite size to 5.4 nm. Such size dependent variation of T_C follows the finite-size scaling relation $T_C(d) = T_C(\infty)[1\text{-}(\xi_o/d)^\lambda$, with shift exponent $\lambda = 0.81$ and microscopic correlation length $\xi_o = 1.48$ nm that is almost twice the lattice parameter (8.27 Å), confirming its microscopic nature.

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