INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

The present Ph.D. thesis focus on the nature of ferromagnetic behavior of few complex inverse-spinels such as Co_2SnO_4 (CSO), Co_2TiO_4 (CTO) and the magnetodielectric response of tetragonal spinel Mn_3O_4. The electronic structure evaluated form the X-ray photo electron spectroscopy revels the following configuration $[Co^{2+}][Co^{2+}Sn^{4+}]O_4$ and $[Co^{2+}][Co^{3+}Ti^{3+}]O_4$ for CSO and CTO, respectively. The temperature dependence of dc- and ac-magnetic susceptibilities $\chi'(T)$ and $\chi''(T)$ reveals that both Co_2SnO_4 and Co_2TiO_4 ferrimagnetic ordering due to the unequal magnetic moments of Co^{2+} on the 'A' sites and 'B' sites of spinel lattice with ferrimagnetic Néel temperature T_{FN} ~ 41 K and 47.8 K for CSO and CTO, respectively. Below the T_{FN}, CSO exhibits spin-glass (SG) phase for $T < T_{SG}$ =39.1 K in which only the transverse spin components are frozen below T_{SG}. This co-existence of longitudinal ferrimagnetic order below T_{FN} = 41 K and transverse SG state below T_{SG} =39.1 K is suggested to result from the presence of non-magnetic Sn^{4+} ions on the 'B' sites. It is interesting to note that CTO exhibits a dramatic magnetic compensation effect across 32K due to the complete balance of the magnetization of both the sublattices, which is an unusual scenario for the CSO system. Due to a very high magnetocrystalline-anisotropy both the systems CSO and CTO exhibits giant sign reversible exchange bias effect, cervicitis, and pseudo first-order discontinuous magnetic phase transition in the low-temperature regime $5K \leq T \leq 32$ K. In the case of tetragonally distorted Mn_3O_4 a sequence of transitions at T_N ~ 42.75 K, T_1 ~ 39 K, and T_2 ~ 34 K are observed together with a new anomaly at 38 K (T^*) which was successfully probed by $\chi_{ac}(T)$ and $\varepsilon_r(T)$ measurements. A clear hysteresis of about 5.15 K was observed in the temperature dependence of dielectric $\varepsilon_r(T)$ for bulk Mn_3O_4 which is consistent with the previously reported first-order transition across this temperature. Whereas, the magneto-dielectric $\Delta\varepsilon_r/\varepsilon_r(T,H)$ studies in zero-field $\varepsilon_r(T)$ across the incommensurate-to-commensurate transition T_2 ~ 34 K which provides dominant role of magneto-crystalline anisotropy in Hausmannite Mn_3O_4.