Abstract

Magnetic materials are widely used in different technological applications like, power generation, communication, data storage and retrieval, sensors etc. Continuous efforts by many researchers during the past many decades have led to the discovery of many novel magnetic materials and properties like high-T_C oxide superconductors, giant and colossal magnetoresistive materials, high magneto-dielectric material, giant magnetostrictive materials, etc. Here we report the synthesis of Molybdenum substituted Cobalt-Zinc inverse spinel ferrites and their characterization with structural, dielectric, complex impedance, electric modulus, electrical conductivity and magnetic properties.

All the polycrystalline Mo doped Co-Zn ferrite samples was prepared with the help of conventional ceramic technique. The XRD pattern affirms the formation of exact cubic inverse spinel structure with having *Fd3m* space group. The calculated lattice constant and grain size was observed to be increased with Mo concentration. The temperature variation of dielectric constant recommend that the origin of dielectric constant in ferrite is four types of polarization. Also the temperature reliance of dielectric constant can be clarified based on thermally assisted relaxation mechanism. The dielectric dispersion of all the sample can be best illuminated in light of Maxwell-Wagner type of interfacial polarization in agreement with Koop's phenomenological theory. The variation of dielectric loss tangent with temperature and frequency reveals very low value of *tanδ* at room temperature and high frequency.

Abstract

Both the real and imaginary part of impedance decreased with frequency due to decrease in space charge polarization. The Z'' vs. f curves have some broad Debye peaks at a hopping frequency and peaks are shifted to higher temperature at high frequency due to increase in rate of electron hopping at higher temperature. The Cole-Cole plot suggest that there is a contribution of only grain boundary in the conduction process and also existance of non-Debye type relaxation in the materials was verified. All the curves of electric modulus were well fitted according to modified Kohlrausch-Williums-Watts (KWW) function proposed by Bergman. The scaling behavior gives the concrete evidence for existence of non-Debye type relaxation in the present samples. The activation energy of all the samples was calculated from both the impedance and modulus spectra.

The variation of ac conductivity with frequency predict that the conduction is because of the correlated barrier hopping mechanism. Also all the curves were well fitted according to Jonscher's single power law. The temperature dependence of ac conductivity displayed the semiconducting nature of the sample. The activation energy of all the samples in both paramagnetic and ferrimagnetic region was estimated using the Arrhenius relation. It has been seen that the value of activation energy in ferrimagnetic state is lower than that in paramagnetic state due to the fact that ferrimagnetic state is ordered than the paramagnetic state. The variation of magnetic moment with temperature showed the increase of both maturation magnetization and Curie temperature due to Mo substitution. The low value of T_C might be because of the disordered cation distribution in the material under study. Also the variation of real permeability with temperature have the similar trend as M-T plot.