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Atif, M., Idrees, M., Nadeem, M., Siddique, M., Ashraf, M.W.

Investigation on the structural, dielectric and impedance analysis of manganese substituted cobalt ferrite i.e., Co 1-x Mn x Fe 2 O 4 (0.0 ≤ x ≤ 0.4)
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Abstract
Manganese substituted cobalt ferrites, i.e., Co 1-x Mn x Fe 2 O 4 (0.0 ≤ x ≤ 0.4) were prepared by a solid state reaction method. XRD analysis confirmed the formation of a single-phase cubic spinel structure for all of the synthesized compositions, whereas an SEM study revealed that Mn substitution changes the microstructure. 57 Fe Mössbauer spectroscopy measurements suggested that Fe 3+ cations progressively migrate with Mn addition from tetrahedral (A) sites to octahedral (B) sites which have a relatively smaller covalency. Therefore, the distribution of cations between the A- and B-sites changed with increasing x. Moreover, interestingly, the Fe 2+ /Fe 3+ cation ratio remains zero and high spin Fe 3+ is the only oxidation state observed at both sites for all of the synthesized compositions. In order to explore the effects of observed variations in the microstructure and cation distribution on the dielectric and resistive properties, the prepared samples were subjected to impedance spectroscopic experiments in a wide frequency range at room temperature. Mn substitution is found to improve the resistive properties by about two orders of magnitude. This increase in the resistive properties is explained in terms of the variations in the microstructure and decrease in the mobility of the charge carriers associated with the cations redistribution. Similarly, the variation in the dielectric permittivity is also conferred in terms of the change in microstructure and cation redistribution. © The Royal Society of Chemistry 2016.

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