**Structure-based magnetic, electrical and transport properties of Ni–Zn–Co ferrite by V5+ substitution**

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**Abstract**

This article presents the modification of structure-based magnetic, electronic and transport properties along with the conduction mechanism and its relaxation process in a Ni–Zn–Co ferrite tailored by V5+substitution at B-site replacing Fe3+ions. The composition Ni0.7Zn0.2Co0.1Fe2-*x*V*x*O4 was synthesized by standard solid- state reaction method and all samples were crystallized with a single-phase cubic spinel structure belonging to the Fd3m space group. The lattice constants decreased gradually from to and the average grain sizes (DSEM)are also decreased from 6.92 μm to 1.99 μm due to V5+ ions substitution at Fe3+ of B-site. However, more than 25% of Fe3+ ions migrate to A-site from B-site due to V5+ substitution at Fe3+of B-site. In all samples θD does not strictly follow the Anderson’s prediction, rather it monotonically decreases to a low value until x= 0.12. Magnetic phase transition temperature shifted to the lower temperature and the net magnetization decreases due to V5+ substitution in Ni–Zn–Co ferrite. Apart this, during conduction charge carriers should require more energy to jump from one cationic site to other for V5+ substitution in the Ni–Zn–Co ferrite and the activation energy (Ea) is much more higher in V5+ substituted sample. Moreover, long-range interaction with localized relaxation mechanism is observed in V5+ doped samples. The resistance at the grain (Rg) is maximum (243.09 Ω) for the sample x=0.10 while grain boundary resistance (Rgb) is maximum (5.98×105 Ω) for the sample x=0.07. However, the higher value of for x=0.12 sample ensures to be suitable for electromagnets, transformers, electronic inductors, and at high-frequency applications. Moreover, x=0.07 sample displays high value of TCR ( 8.6 %/K at 418 K) which may be utilized as an infrared detector for night vision bolometer material.

**Keywords:** Cation distribution, Thermo-magnetization, Debye temperature, Phase angle, Relaxation mechanism and Transport properties.