**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 $\left(0\leq x\leq 0.12\right)$ 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 $8.3673 Å$ to $8.3602 Å$ 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 $\left(n\_{B}^{e}\right)$ 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 $ρ\_{DC}$ 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.