Title: Structural analysis through cations distributions of diamagnetic Al3+ ions substituted Ni-Zn-Co ferrites

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Abstract: In the current study, we explored the influence of structural, morphological, and [magnetic properties](https://www.sciencedirect.com/topics/materials-science/magnetic-property) of diamagnetic [aluminum](https://www.sciencedirect.com/topics/materials-science/aluminum) (Al3+) ions substituted nickel-zinc-cobalt (Ni-Zn-Co) spinel ferrites synthesized by the conventional ceramic technique. Single-phase cubic spinel structures with the Fd3m space group of Ni0.4Zn0.35Co0.25Fe(2‐x)AlxO4 (0 ≤ x ≤ 0.12) ferrites were confirmed by the [Rietveld refinement](https://www.sciencedirect.com/topics/materials-science/rietveld-refinement) of X-ray diffraction (XRD) data. The [lattice constants](https://www.sciencedirect.com/topics/materials-science/lattice-constant) showed a decreasing trend with Al contents. [Field Emission Scanning Electron Microscopy](https://www.sciencedirect.com/topics/materials-science/field-emission-scanning-electron-microscopy) (FE-SEM) was used to observe the [surface morphology](https://www.sciencedirect.com/topics/materials-science/surface-morphology). The average grain size estimated from the FE-SEM microstructures was found to be 0.55–0.38 µm for the studied samples. Fourier transform infrared (FT-IR) spectra identified two prominent absorption bands from 579.82–584.39 cm‐1 and 399.82–405.03 cm‐1 corresponding to the tetrahedral and octahedral voids, respectively. The modes' peak positions were both red-shifted and blue-shifted, as demonstrated in the Raman spectra. Cations distributions were identified by the Mossbauer spectra and from the [Rietveld refinement](https://www.sciencedirect.com/topics/materials-science/rietveld-refinement). The concentrations of iron (Fe3+) [ions in](https://www.sciencedirect.com/topics/materials-science/indium-ion) the sub-lattices were determined using Mossbauer spectra analysis. The maximum saturation magnetization (Ms) was found to be 93.06 emu/g for the sample with x = 0.12. Overall, the obtained results indicate the applicability of the ferrite for high-frequency electronic devices.