Title: Structural and magnetic properties analysis of trivalent Al3+ ions substituted Ni-Zn-Co nano-spinel ferrites

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Abstract: This study explored the structural, morphological, optical, and magnetic properties of Ni0.4Zn0.35Co0.25Fe2−*x*Al*x*O4 (0 ≤ *x* ≤ 0.12) nano-spinel ferrites. Nanocrystalline cubic structure formation and weight loss percentage were determined by thermogravimetric analysis and differential scanning calorimetry (TGA - DSC). Single-phase cubic spinel structures with Fd3m space group of synthesized samples were confirmed by Rietveld refinement X-ray diffraction (XRD) data. The particle sizes were found to be in the range of 6.7 nm–5.25 nm, and agglomeration occurs inside the ferrite samples. The atomic planes and strong crystallinity were detected through SAED images. The characteristic peaks of the Raman spectra identified the bonding between the cations and anions in the sub-lattices. The optical bandgaps (*Eg*) were found to be in the range of 2.1 eV–2.52 eV. *S*-shape hysteresis (*M*-*H*) loops identified the superparamagnetic nature of the nano-samples. The studies' outcomes indicated the applicability for biomedical applications of these nano samples.