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Synthesis, Structural, Magnetic, Optical, and Dielectric Characterization of Nickel-Substituted Cobalt Ferrite Nanoparticles and Potential Antibacterial Applications

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Abstract : Nanoparticle technology is fast progressing and is being employed in innumerable medical applications. At this time, the public's health is seriously threatened by the rise of bacterial strains resistant to several medications. Metal nanoparticles are a potential alternate approach for tackling this global concern, and this is the main focus of this study. The citrate precursor sol-gel synthesis method was used to synthesize the $Ni_x\ Co_{1-x}\ Fe_2\ O_4$, (where x = 0.0:0.2:1.0) nanoparticle. XRD identified the development of the cubic crystal structure to have a preferential orientation along (311), and the average particle size was found to be 29-38 nm. The average crystallizes assessed with ImageJ software and origin 22 of the SEM are nearly identical to the XRD results. In the created NCF NPs, the FT-IR spectroscopy reveals structural examinations and the redistribution of cations between octahedral (505-428 cm^{-1}) and tetrahedral (653-603 cm^{-1}) locales. As the Co^{2+} cation is substituted with Ni^{2+}, the coercive fields HC decrease from 2384 Oe to 241.93 Oe. Band gap energy rises as Ni concentration increases, which may be attributed to the fact that the ionic radii of Ni^{2+} ions are smaller than that of Co^{2+} ions, which results in a strong electrostatic interaction. On the contrary, except at x = 0.4, the dielectric constant decreases as the nickel concentration increases. According to the findings of this research work, nanoparticles are composed of $Ni_{0.4}\ Co_{0.6}\ Fe_2\ O_4$ have demonstrated a promising value against S. aureus and E. coli, and it suggests a proposed model for their potential use as a source of antibacterial agent.

Keywords : antimicrobial, band gap, citrate precursor, dielectric, nanoparticle
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