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Synthesis And Characterization Of Samarium Doped Nickel Cobalt Ferrite For Photocatalysis Application

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Abstract

Back ground: Spinel ferrite nanomaterials - $NiFe_2O_4$, $CoFe_2O_4$, Cu–Ni ferrite, and Ni–Zn–Co ferrite - were successfully doped with Sm^{3+} using a co-precipitation route, followed by calcination to achieve the desired phase and properties. The main objective of this research was to investigate the structural, morphological, and photocatalytic properties of ferrite nanomaterials with samarium doping

Methods: The synthesis and characterization of samarium-doped spinel ferrite nanomaterials were carried out using a systematic experimental approach designed to evaluate both their structural properties and photocatalytic performance.Spinel ferrite nanomaterials including $NiFe_2O_4$, $CoFe_2O_4$, Cu–Ni ferrite, and Ni–Zn–Co ferrite were prepared via the co-precipitation method. Co-precipitation was selected for its ability to produce homogeneous, nanoscale particles with controlled stoichiometry. Stoichiometric amounts of metal nitrates corresponding to the desired ferrite composition were dissolved in deionized water. An aqueous solution of Sm^{3+} was then introduced to achieve samarium doping. The mixed metal solution was subjected to controlled precipitation by dropwise addition of a precipitating agent under continuous stirring and maintained pH conditions. The resulting precipitate was collected, thoroughly washed to remove residual ions, dried, and subsequently subjected to calcination at an optimized temperature. Calcination was performed to enhance crystallinity, promote phase formation, and stabilize the spinel structure, thereby ensuring the desired magnetic and photocatalytic properties.The synthesized ferrite nanomaterials were subjected to multiple analytical techniques to confirm phase purity, chemical bonding, morphology, optical properties, and particle size distribution of these composites were verified by Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), UV-Visible spectroscopy, Scanning Electron Microscopy (SEM),zeta sizer.

Results: SEM analysis revealed agglomerated nanostructured particles with almost uniform morphology. The degradation percentage of Rhodamine B increased significantly after samarium incorporation, attributed to better charge separation and enhanced surface activity of the nanomaterials. Comparative study of graphs, spectra, and calculated values showed that Sm-Fe ferrite exhibited higher photocatalytic activity compared to undoped ferrite. Samarium-doped spinel ferrites can be considered potential multifunctional materials for environmental remediation and wastewater treatment processes.

Keywords: *Samarium-doped spinel ferrites; Ferrite nanomaterials; Photocatalytic degradation; Rhodamine B; Wastewater treatment*