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Structural, Optical and Antibacterial Properties of neodymium (Nd^{3+}) doped nickel oxide (NiO) Nanoparticles using Sesbania grandiflora Leaf Extract

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Abstract

Objectives: To study the eco-friendly green synthesis of neodymium doped nickel oxide nanoparticles and to study their structural, optical and antibacterial activities. Method: Sesbania grandiflora herb has been used to synthesize NiO nanoparticles. With the materials present in the plant extract, such as sugar, flavonoid, protein, enzyme, polymer, and organic acid, acting as the reducing agent the green approach takes charge in bio induction of metal ions into nanoparticles. Structural and Optical Properties of nanoparticles were studied by following XRD, SEM, EDAX, FTIR and UV-Vis-NIR (DRS). The antibacterial activity of the resultant neodymium (Nd^{3+}) doped nickel oxide (NiO) was tested on Gram negative and Gram positive bacteria with suitable standard. Findings: From the XRD analysis, it is revealed that the size of the particles is in the order of 9.2 to 23.06 nm. JCPDS data confirmed that Nd^{3+} ion-doped NiO nanoparticles exhibit phases of (111), (200), (220), and (311). SEM with EDAX proved that existence of Nd^{3+} ion-doped NiO nanoparticles. Cubical and spherical shapes of the nanoclusters having a size of 20-40 nm are shown by SEM analysis. Most promising peaks at 420 cm^{-1} and 657 cm^{-1} associated to Ni-O vibration bond and Ni-O-H stretching bond were analyzed from FTIR graph of the sample before annealing while for the sample at 500oC shows the Ni-O vibration bond at 411cm^{-1}. The direct band gap of Nd^{3+} ion-doped NiO nanoparticles calculated as 3.08 eV at the concentration of NiONdO3 mol%. By doping with Nd^{3+} ion, energy gap increases with doping concentration proved by UVDRS spectroscopy that confirms Quantum confinement. The eco-friendly synthesized nanoparticles exhibited good antibacterial activity against pathogenic bacterial strain is an indication of antibacterial efficiency of nanoparticles. Novelty: Eco-friendly synthesis of NiO nanoparticles and characterization and doped nanoparticles exhibited good antibacterial activity.

Author Keywords

Green synthesis, NiO particles, Characterization, Cubical, Spherical shapes, Direct band gap semiconductors, NIR laser, Antibacterial activities

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