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Enhancement of non-linear optical laser power-depend properties of ZnO Nanoparticle synthesized by green method

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Abstract

This study explores the green synthesis of zinc oxide nanoparticles (ZnO NPs) using mint plant extracts, emphasizing their applicability in photonic technologies. Verified by Scanning Electron Microscopy (SEM), the nanoparticles, approximately 80 nm in size, exhibited enhanced nonlinear optical properties suitable for optical limiting applications. Employing open and closed aperture Z-scan techniques at wavelengths of 532 nm and 635 nm, the nanoparticles demonstrated nonlinear absorption coefficients ranging from 0.5 cm/GW to 187 cm/GW and refractive indices between 2.51×10-13 and 5.81×10-13 cm2/W, underscoring their potential for advanced optical applications. The involvement of plant-derived functional groups, confirmed by Fourier Transform Infrared Spectroscopy (FTIR) and Energy-dispersive X-ray Spectroscopy (EDX), was critical in acting as reducing, capping, and stabilizing agents. These agents contributed significantly to the structural and compositional integrity of the ZnO nanoparticles. The study highlights the effectiveness of using plant-based synthesis methods, not only in enhancing the nanoparticles' optical properties but also in promoting sustainable material development in the field of photonics.

Keywords

ZnO NPs ; Optical properties ; Structural properties ; Z-Scan ; Green synthesis