**Laser-Induced Nanostructuring and Surface Phonon Behavior in ZnO/MnO Nanocomposites**

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In this study, we investigate the influence of laser power on nanocrystalline ZnO(Mn) samples synthesized via a wet chemical co-precipitation method followed by calcination at 300 °C. The initial mixtures were prepared with varying concentrations of MnO dopant, ranging from 5% to 95%. X-ray diffraction (XRD) analysis confirmed the presence of ZnO and ZnMn₂O₄ phases. At the same time, Raman spectroscopy and scanning electron microscopy (SEM) provided additional insights into the structural and morphological evolution of the samples.

Non-resonant Raman scattering spectra were recorded across the 100–1600 cm⁻¹ range for samples irradiated at multiple laser power densities. The results reveal that laser-induced heating leads to characteristic broadening and red-shifting peaks associated with ZnO and Mn-based phases. These spectral modifications are attributed to nanostructuring effects and partial decomposition processes triggered by localized thermal energy.

As the dopant concentration and laser power increase, significant changes in the behavior of surface optical phonons (SOP) are observed, including a gradual suppression of SOP modes associated with the ZnO matrix. The data suggest the formation of secondary phases such as Zn₁₋ₓMnₓO and ZnyMn₃₋yO₄, resulting from the interplay between laser-induced nanostructuring and dopant-induced modifications of the host lattice.

This comprehensive investigation highlights the complex relationship between laser power, dopant concentration, phase evolution, and optical phonon dynamics in ZnO/MnO nanocomposites. It underscores the utility of laser processing as a tool for fine-tuning the structural and vibrational properties of multifunctional oxide materials.