

(54) Title of the invention : RADIATIVE PROPERTIES AND APPLIED AS HIGH GAIN IN LASER OPERATION

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(57) Abstract :  
 The presents invention relates to the synthesis of ZnO:Nd<sup>3+</sup> nanoparticles using an eco-friendly and cost-effective chemical method. The nanoparticles were characterized using XRD, FTIR, UV, PL, TEM, and SEM techniques, confirming their hexagonal wurtzite structure. The optical properties were analyzed using Judd-Ofelt (J-O) theory, enabling the calculation of radiative parameters such as transition probabilities, branching ratios, stimulated emission cross-sections, and optical gain. Four fluorescence bands corresponding to 4F3/2 ? 4I9/2, 4F3/2 ? 4I11/2, 4F3/2 ? 4I13/2, and 4F3/2 ? 4I15/2 transitions were observed at room temperature. The large stimulated emission cross-section of the nanoparticles highlights their potential for laser applications, ensuring low operational thresholds and high optical gain. This work demonstrates the suitability of ZnO:Nd<sup>3+</sup> nanoparticles for advanced photonic and laser technologies, emphasizing their efficient energy extraction capabilities.

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