Abstract

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Spectroscopic and optical investigations on Er3+ ions doped alkali cadmium phosphate glasses for laser applications

Alkali cadmium phosphate glasses doped with erbium ions were prepared by traditional melt-quenching technique. The FTIR and Raman spectroscopies were performed and employed to investigate the structural changes of the glass network doped with different concentrations of Er3+ ions. The UV–Vis–NIR spectroscopy was used to investigate the optical absorption spectra, optical bandgaps, refractive indices, and related parameters. The Judd–Ofelt (J–O) theory was used to explain the structural changes and to determine the bond nature in the studied glasses by calculating the intensity parameters \( \Omega_2, \Omega_4, \text{ and } \Omega_6 \). The J–O intensity parameters followed the trend of \( \Omega_2 > \Omega_6 > \Omega_4 \) and were used to evaluate some radiative parameters such as electric and magnetic radiative transition probabilities, branching ratios, and radiative lifetimes for the excited levels of the Er3+ ions. The absorption and emission cross-sections for the 4I13/2 \( \rightarrow \) 4I15/2 transition of Er3+ ions were studied, and the gain coefficient was calculated. The higher values of the branching ratios (\( >0.5 \)) and lifetimes of the present glasses indicate their good suitability for lasers and amplifiers applications.