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Linear and nonlinear optical properties of erbium doped zinc borotellurite glass system

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Abstract:

A glass series of erbium doped zinc borotellurite glass system was prepared by using melt-quenching method. The absorption spectra revealed several bands at visible range which correspond to the following transitions (from the ground state); $^4G_{11/2} + ^2H_{9/2} + ^4F_{5/2} + ^4F_{7/2} + ^2H_{11/2} + ^4S_{3/2} + ^4F_{9/2} + ^4I_{9/2} + ^4I_{11/2}$. From the Judd-Ofelt analysis, it is found that the trend of Ω_2 values is a non-linear variation along with erbium concentrations. Meanwhile, the value of Ω_6 decreases as the erbium concentration increases. The photoluminescence analysis shows green emission which are attributed to the $^4S_{3/2}$ level to the ground state at $^4I_{15/2}$. Meanwhile, the upconversion analysis revealed several emission bands at 376 nm, 424 nm, 470 nm and 558 nm which correspond to $^4G_{11/2} \rightarrow ^4I_{15/2}$, $^4F_{3/2} \rightarrow ^4I_{15/2}$, $^4F_{7/2} \rightarrow ^4I_{15/2}$ and $^4S_{3/2} \rightarrow ^4I_{15/2}$ transitions respectively. The non-linear refractive index spectra show self-defocusing behavior and negative nonlinear refraction ($\eta_2 < 0$) under laser excitation at 532 nm of wavelength. The obtained values of nonlinear absorption and nonlinear susceptibility revealed nonlinear variations.

Keywords: Borotellurite glass, luminescence, upconversion, nonlinear optical properties

Introduction

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