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Elucidating The Effects of Neodymium Nanoparticles on Judd-Ofelt and Optical Parameters of Zinctellurite Glass For Fiber Lasers

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ABSTRACT

The Judd-Ofelt analysis of neodymium nanoparticles doped zinctellurite glass were performed to determine their spectral parameters. A glass sample of neodymium nanoparticles doped zinc-tellurite with chemical composition of 0.47TeO2 + 0.2B2O3 + 0.29ZnO + 0.05Nd2O3 was synthesized by using conventional melt quenching method. We select 0.05 mol fraction of neodymium nanoparticles in tellurite glass as it gives the optimum results for glass stability and spectral intensities. The Judd-Ofelt parameters were determined by using least-square fitting method. It was found that the observed that neodymium nanoparticles doped zinctellurite glass exhibit judd-ofelt parameters as follows; Ω2 = 2.623, Ω4 = 0.174, Ω6 = 0.837 and found in the following Ω2 < Ω4 <Ω6 trend. The hypersensitive transition was highly related to the Ω2 parameter. Furthermore, the hypersensitive at 4I9/2 → 4G5/2 transition affect the value of Ω2 which satisfies the selection rule Δs=0, Δl⩽2 andΔJ⩽2. The Ω4 parameter was related mainly to the bulk properties of the host matrix meanwhile the Ω6 parameter was related to the rigidity of the glass matrix. The extinction coefficient and fermi energy of the glass system were determine using least-square fitting method. It was revealed that the studied glass system exhibit reduction in extinction coefficient due to the change of wavelength. It was found that the Fermi energy decreases along with neodymium nanoparticles concentration. The decreasing trend of Fermi energy, EF indicates the enhancement of semiconducting properties. Therefore, the studied glass system have an excellent potential to be utilized in semiconducting materials. Therefore, the investigated glass materials may provide a good material for fiber lasers.

Keywords: Tellurite oxide; Neodymium oxide; Glasses; Optical properties; Judd-ofelt analysis; Extinction coefficient