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Enhanced Optical Nonlinearity in Bismuth Borate Glass: Effect of Size of Nanoparticles

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Abstract : Metallic nanoparticle doped glasses has lead to rapid development in the field of optics. Large third order non-linearity, ultrafast time response, and a wide range of resonant absorption frequencies make these metallic nanoparticles more important in comparison to their bulk material. All these properties are highly dependent upon the size, shape, and surrounding environment of the nanoparticles. In a quest to find a suitable material for optical applications, several efforts have been devoted to improve the properties of such glasses in the past. In the present study, bismuth borate glass doped with different size gold nanoparticles (AuNPs) has been prepared using the conventional melt-quench technique. Synthesized glasses are characterized by X-ray diffraction (XRD) and Fourier Transformation Infrared spectroscopy (FTIR) to observe the structural modification in the glassy matrix with the variation in the size of the AuNPs. Glasses remain purely amorphous in nature even after the addition of AuNPs, whereas FTIR proposes that the main structure contains BO_3 and BO_4 units. Field emission scanning electron microscopy (FESEM) confirms the existence and variation in the size of AuNPs. Differential thermal analysis (DTA) depicts that prepared glasses are thermally stable and are highly suitable for the fabrication of optical fibers. The nonlinear optical parameters (nonlinear absorption coefficient and nonlinear refractive index) are calculated out by using the Z-scan technique with a Ti: sapphire laser at 800 nm. It has been concluded that the size of the nanoparticles highly influences the structural thermal and optical properties system.

Keywords : bismuth borate glass, different size, gold nanoparticles, nonlinearity
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