World Academy of Science, Engineering and Technology
International Journal of Physical and Mathematical Sciences
Vol:8, No:09, 2014

Nonlinear Absorption and Scattering in Wide Band Gap Silver Sulfide Nanoparticles Colloid and Their Effects on the Optical Limiting

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Abstract : In this paper, we study the optical nonlinearities of Silver sulfide (Ag2S) nanostructures dispersed in the Dimethyl sulfoxide (DMSO) under exposure to 532 nm, 15 nanosecond (ns) pulsed laser irradiation. Ultraviolet–visible absorption spectrometry (UV-Vis), X-ray diffraction (XRD), and transmission electron microscopy (TEM) are used to characterize the obtained nanocrystal samples. The band gap energy of colloid is determined by analyzing the UV–Vis absorption spectra of the Ag2S NPs using the band theory of semiconductors. Z-scan technique is used to characterize the optical nonlinear properties of the Ag2S nanoparticles (NPs). Large enhancement of two photon absorption effect is observed with increase in concentration of the Ag2S nanoparticles using open Z-scan measurements in the ns laser regime. The values of the nonlinear absorption coefficients are determined based on the local nonlinear responses including two photon absorption. The observed aperture dependence of the Ag2S NP limiting performance indicates that the nonlinear scattering plays an important role in the limiting action of the sample.The concentration dependence of the optical liming is also investigated. Our results demonstrate that the optical limiting threshold decreases with increasing the silver sulfide NPs in DMSO.

Keywords : nanoscale materials, silver sulfide nanoparticles, nonlinear absorption, nonlinear scattering, optical limiting
Conference Title : ICAAPMS 2014 : International Conference on Advances in Applied Physics and Materials Science
Conference Location : Berlin, Germany
Conference Dates : September 15-16, 2014