Optical Nonlinear Properties and Optical Limiting Effect of Congo red dye under CW Laser

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Abstract

Nonlinear optical properties of congo red dye in tetrahydrofuran (THF) solvent are studied employing different optical techniques. Experiments are performed using the diode laser beam at 532 nm wavelength and 40mW power. The effect of nonlinearity of congo red dye in broadening the laser beam is observed. The optical limiting behavior is investigated by measuring the transmission of the samples. The nonlinear absorption coefficient is calculated using the open aperture Z-scan data, while its nonlinear refractive index is measured using the closed aperture Z-scan data. The nonlinear refractive index and absorption coefficient are found to be in the order of 4.14×10^{-8}cm^2/Watt , 1.99×10^{-3} cm/Watt, respectively. The results indicate that congo red dye is a potential candidate for low-power optical limiting application. The optical limiting behavior of the solvent of azo dye is also demonstrated.

Keyword: Optical limiting , nonlinear refraction index , Z-scan , azo dye

1. Introduction:

Nonlinear optics has received considerable attention due to their variety of applications in optoelectronic and photonic devices. Especially, nonlinear optical materials exhibiting strong two-photon absorption (TPA) are in great demand, due to their applications in three-dimensional fluorescence imaging and multi- photon microscopy, eye and sensor protection, frequency up conversion lasing, optical signal reshaping and stabilizing fast fluctuations of laser power [1–5]. A wide variety of materials have been investigated for third-order nonlinear optics, among which organic materials are attractive because of their optical and electronic properties which can be tuned and tailored by structural modification. The large and ultra fast nonlinear optical response has made organics particularly attractive candidates for high band width applications. There is quest to design and develop the novel nonlinear materials with large molecular two-photon absorption cross-sections to meet the present demand [6]. Optical limiting is a nonlinear optical process in which the transmittance of a material decreases with increased incident light intensity. It has been demonstrated that optical limiting can be used for pulse shaping, smoothing and pulse compression [7]. The potential applications of optical limiting devices are optical sensor and eye protection [8].

ISSN-1994-697X