International Association of Scientific Innovation and Research (IASIR)
(An Association Unifying the Sciences, Engineering, and Applied Research)

ISSN (Print): 2279-0047
ISSN (Online): 2279-0055

International Journal of Emerging Technologies in Computational and Applied Sciences (IJETCAS)

www.iasir.net

$\chi^{(3)}$ measurements and optical limiting in Bismarck Brown Y dye

Ketamm Abd AL-Adel and *Hussain A. Badran
College of Dentistry, Misan University, Basrah , Iraq
College of Education for pure sciences
University of Basrah, Basrah , Iraq

Abstract: *We investigated the third order nonlinear optical properties of Bismarck Brown Y dye. The nonlinear measurements were performed by using single beam Z-scan technique with cw solid state laser at 473 nm. The nonlinear absorption coefficient is calculated using the open aperture Z-scan data, while it's 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 $10^{-7}cm^2/Watt$, 10^{-3} cm/Watt, respectively. The third order nonlinearity $\chi^{(3)}$ is measured using Z-scan data. The optical limiting behavior is investigated by measuring the transmission of the sample. The results indicate that Bismarck Brown Y is a potential candidate for low-power optical limiting application.*

Keywords: *Optical limiting; nonlinear refraction index; Z-scan; cw laser.*

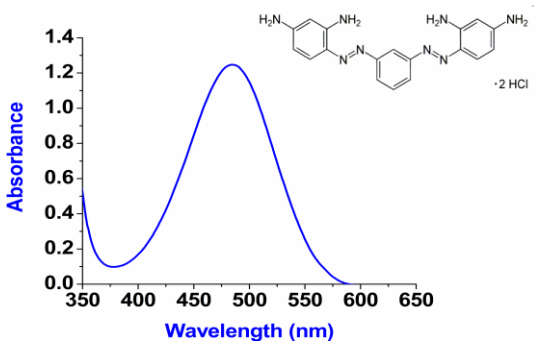
I. Introduction

The nonlinear optical properties of materials can be used to control the phase, the state of polarization, or the frequency of light beams. With the emergence of photonic technologies in areas such as telecommunications where information is coded, transported, and routed optically, there is a strong technological demand for high-performance NLO materials. Organic molecules are promising candidates for these nonlinear optical applications [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 third-order optical nonlinearity includes optical bleaching (i.e.,saturation) or reverse saturation in the absorption aspect, whereas self-focusing or self-defocusing occurs in the refraction aspect. Of the various techniques available, Z-scan method [6,7] is a simple and effective tool for determining nonlinear properties and is used widely in material characterization because, it provides not only the magnitudes of the real and imaginary parts of the nonlinear susceptibility, but also the sign of the real part.
In this paper, we report on our experimental investigation of the third order nonlinear optical susceptibility $\chi^{(3)}$ in Bismarck Brown Y the optical nonlinearity induced in dye Bismarck Brown Y by cw diode laser with an output power of 4.5 mW at 473 nm was studied using Z-scan technique, based on the sample-induced changes in beam profile at the far field. The optical limiting behavior of the dye has been studied.

II. Experimental

The molecular structure of the Bismarck Brown Y dye and the linear absorption spectrum of the dye dissolved in double distilled water at 3mM concentrations is shown in Fig. 1, which was acquired using a UV–VIS spectrophotometer (Type: CECEL 3500) .

Figure 1 UV–Vis absorption spectrum of Bismarck Brown Y dye. Inset shows the chemical structure of dye



The schematic diagram of Z-scan technique is as shown in Fig. 2. By properly monitoring the transmittance change through a small aperture at the far field position (closed aperture), one is able to determine the amplitude of the phase shift. By moving the sample through the focus without placing an aperture at the detector (open aperture) one can measure the intensity dependent absorption of the sample. When both the methods (open and closed) are used in measurements of the ratio of signals determines the nonlinear refraction of the sample.