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## Nonlinear optical properties and diffraction ring patterns of benzo congo red

**Ketamm Abd AL-Adel and Hussain A. Badran**

*Department of Physics, College of Education, University of Basrah , Basrah , Iraq*

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### ABSTRACT

*The nonlinear optical properties of Benzo congo red in Dimethyl sulfoxide (DMSO) solvent and polymer were studied using single beam Z-scan technique with a continuous-wave radiation at 532 nm of an output power of 40 mW. All the solution samples and polymer showed large nonlinear refractive index and absorption coefficient of the order of  $10^{-8} \text{ cm}^2/\text{W}$  and  $10^{-3} \text{ cm/W}$ , respectively. The concentration-dependent nonlinear refractive index was also investigated. We presents experimental evidences of observing diffraction pattern in congo red dye: DMSO solvent with the calculation of the refractive index change,  $\Delta n$ , the relative phase shift,  $\Delta\Phi$ , and effective nonlinear refractive index,  $n_2$ . The solvent of spectroscopic grade and was used without further purification. All the solutions used for the study were freshly prepared.*

**Keywords:** nonlinear refraction index , Z-scan, azo dye, cw laser.

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### INTRODUCTION

Azo dyes have many advantages over other nonlinear optics (NO) materials. Photoisomerization of azo molecules enables modifies their linear and nonlinear polarizability of them as well as optical nonlinear refraction. Since the optical properties of azo molecules can be controlled optically, it has intrigued considerable interest of people [1,2]. The nonlinear optical phenomena of azo dyes can result from electronic response and/or nonelectronic one. The electronic nonlinearity is induced by either population redistribution or distortion of electronic clouds. A molecule undergoes a transition from its ground state to its excitation state after absorbing a photon. The dipole moment of the molecule changes during such a transition. The change in the dipole moment will give birth to electronic nonlinearity. A nonelectronic response is a non-radiative interaction such as cis-trans isomerism, the changes in density and temperature [3–5]. It has been well known that the nonlinear optical behavior of materials can vary greatly by changing different laser duration or different laser wavelengths. Thus, studies about the mechanism of their nonlinear optical response with different laser duration or different laser wavelengths are expected to be more interesting and important. If the nonlinear mechanism is understood for certain laser pulses, the NLO properties optimization can be well accomplished. Z-scan technique is a simple and effective tool to determine the nonlinear properties [6]. It has been widely used in material characterization because it provides not only the magnitudes of the real part and imaginary part of the nonlinear susceptibility, but also the sign of the real part. Both nonlinear refraction and nonlinear absorption in solid and liquid samples can be measured easily by Z-scan technique, which use the change of transmittance of nonlinear materials [5].

In this work, we demonstrate the optical nonlinearities of a Benzo congo red at different concentration in Dimethyl sulfoxide (DMSO) and thin film through Z-scan technique under laser excitation at 532 nm cw solid state laser with an output power of 40 mW and presents experimental evidences of observing diffraction pattern in Benzo congo red: