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Self diffraction and nonlinear optical properties for 2, 3-Diaminopyridine under cw illumination

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Abstract: **-** The nonlinear absorption and refraction indices for 2,3-Diaminopyridine solution were measured using open-and closed- aperture z-scan techniques, with continuous wave (cw) irradiation. Furthermore, diffraction rings pattern as a result of nonlinear refraction was observed. The effect of concentration, wavelength and laser intensity on the nonlinear absorption, nonlinear refraction and diffraction rings are studied experimentally. It is found that the nonlinear refraction and absorption indexes in order of 10^{-8} cm^2/W and10^{-3} cm/W, respectively. We suggested an opportunity to form a new nonlinear-optical media for nonlinear optical application.

Keywords: **-** *nonlinear refractive index, nonlinear materials, Z-scan, self- diffraction.*

I. INTRODUCTION

Nonlinear optics (NLO) is a branch of optics that is associated with the changes in the optical properties of material when it interacts with light. Nonlinear optical materials have been explored greatly for their various applications in all-optical switches, opto-electronic devices, 3-D optical memory devices, optical modulation, tele-communications, human eyes and optical sensors protection, etc., and future applications in biological and medical sciences [1-6]. Continuous wave lasers ranging from mW to kW are widely used in many applications[7]. Wide range of materials including liquid crystals, porphyrins, dyes, semiconductor nanoparticles, thin films, phthalocyanines and crystals are known to be optically nonlinear under cw laser illumination [8-16].

Several techniques developed to measure the nonlinear optical properties such as nonlinear interferometry, degenerate four-wave mixing, nearly degenerate three-wave mixing, ellipse [17,18]. rotation and beam-distortion are sensitive but usually require complex experimental apparatuses The Z-scan technique is a popular and powerful method for the measurements of the optical nonlinearity because of its sensitivity, simplicity and ability to determinate the signs and magnitudes of optical nonlinearity. This method allows the simultaneous measurement of both nonlinear refractive index and nonlinear absorption coefficient. Basically, the method consists of translating a sample through the focus of a Gaussian beam and monitoring the changes in the far field intensity pattern. Because of the light-induced lens-like effect, the sample has the tendency to recollimating or defocusing the incident beam, depending on its z position with respect to the focal plane. By properly monitoring the transmittance change through a small aperture placed 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 and without placing an aperture at the detector (open aperture), one can measure the intensity dependent absorption as a change of transmittance through the sample.

In this study, we report the experimental investigation of third-order optical nonlinearity of 2,3-Diaminopyridine by using the single beam Z-scan technique. We also investigated the self-diffraction for the sample under cw laser illumination. The experiment is performed for different concentrations, wavelengths and incident beam intensities. The sample is found to exhibit a negative and large optical nonlinearity.

II. EXPERIMENTAL

The sample and DMSO are purchased from Aldrich Chemical Company and were used without any purification. The chemical structure and molecular formula of 2,3-Diaminopyridine are shown in Fig.1. A UV–visible spectroscopy has been used to characterize the 2,3-Diaminopyridine in solvent DMSO in the spectral range (350–900 nm). The absorbance (A) of the sample measured using Cecil Reflected-Scan CE 3055 reflectance spectrometer. These measured were performed at room temperature. Fig.1 shows the spectral distribution of absorbance of samples with different concentrations. We can see from the Fig. 1 that the absorbance of the sample increases with increasing the concentration this due to increase number of molecular per unit volume, so the absorbance will be increased.