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# Investigating the nonlinear behavior of cobalt (II) phthalocyanine using visible CW laser beam

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ABSTRACT

Experimental and theoretical results of the diffraction ring patterns in cobalt (II) phthalocyanine (PcCo(II)) in dimethyl formamide solution using visible low power continuous wave CW laser beam are reported. The wave-front curvature of the used laser beam seem to modify the spatial phase modulation of the beam. The upward convection modify each pattern by reducing the vertical diameter of each ring in comparison with horizontal one. At low input power the effect of convection is minimized. Simulation results given are based on the Fresnel-Kirchhoff diffraction integral. The nonlinear refractive index of the solution of PcCo(II) was measured using Z-scan technique, by exciting with CW laser at 473 nm wavelength. The effect of concentration of the sample on nonlinear refractive index has been investigated.



## 1. Introduction

Organic molecules with nonlinear optical process continue to attract attention because of their potential applications in a wide variety of optoelectronic and photonic devices [1–3].The nonlinear response of these organic molecules at low intensity lasers results in a large third order nonlinear optical (NLO) susceptibilities. Extensive work has been carried out and the reports have been published for the organic molecules in liquid solutions [4,5].

When a laser beam propagates in an absorbing medium a spatial distribution of temperature is generated according to the light beam irradiance spatial profile. Since the local refraction index values of the absorbing medium depend on the temperature, a spatial distribution of the refraction index or thermal lens (TL) [6] is induced. As a direct consequence of (TL) effect and the change of phase of the propagating laser beam diffracting ring patterns (DRPs) [7] resulted. Based on the (DRP) the nonlinear refractive index, $n_2$, of the nonlinear medium can be evaluated. The Z-scan technique, developed by Sheik Bahae et al. [8] is another simple and effective tool that can be used to measure the nonlinear refractive index, $n_2$.

During the last fifteen years, extensive works have been directed towards the study of nonlinear properties of phthalocyanine, viz., bis- phthalocyanine [9], alkyl phthalocyanine [10], Lu(111) phthalocyanine [11], alkoxy phthalocyanine [12], 4-tetra and oct-substituted lead phthalocyanine [13], copper phthalocyanine [14], zinc phthalocyanine [15–17], Lanthanide

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