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Spectroscopic and thermal nonlinearity study of a Schiff base compound

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ABSTRACT

Schiff base compound 2, 4 hydroxy-4- carboxy benzylidene aniline ($C_{14}H_{11}NO_4$) was successfully synthesized by condensation reaction of 4-amino benzoic acid and 2, 4-hydroxy benzaldehyde. The functional groups have been confirmed via Fourier-transform infrared spectroscopy (FTIR) analysis. The Nuclear magnetic resonance (NMR) spectroscopy was used to identify the placement of protons in the obtained compound. UV–visible absorption spectrum was obtained at room temperature for the compound. Diffraction ring patterns were observed when the Schiff base compound was irradiated with a continuous wave laser beam of wavelength 473 nm. The type of the obtained patterns depends on the type of the laser beam wave front. Based on the number of rings the total change in the compound refractive index and the nonlinear refractive index were obtained. The experimental diffraction ring patterns were successfully simulated using the Fresnel-Kirchhoff diffraction theory with good qualitative and reasonable quantitative agreements between experimental and theoretical findings. Both the open and closed aperture Z-scans were performed to measure the nonlinear absorption coefficient and nonlinear refractive index of the Schiff base compound, respectively. The optical limiting behavior of the Schiff base compound was tested too.

1. Introduction

Schiff bases are compounds represent an interesting group and play vital roles in different areas of chemistry due to their promising properties. Schiff bases have imine or azomethine nitrogen (C=N) groups. Schiff base compounds can bear multi-substituents with several electrons donor/acceptor groups which leads to the modification of the hyperpolarizabilities of conjugated systems in these molecules and giving its Schiff bases a potential nonlinear properties [1].

Since its discovery Schiff base received enormous interest and find endless applications due to its variety of properties viz., biological, antibacterial, antifungal, biocidal, antiviral, antimalarial and anticancer. Schiff bases finds applications in medicine, in modern technologies, and in synthesis and chemical analysis and their biological activities were studied by many researchers [2–7]. Schiff bases medical, anticancer, antibacterial, antifungal and pharmacological activities were studied [8–16], together with their optoelectronic properties [17–25]. Last but not least Schiff bases were studied for number of reasons [26–40].

Due to their potential uses in applications such as phase conjugation, optical switching, optical limiting, image processing, optical data storage etc. [41–57], organic materials have attracted intense activities to explore their nonlinear properties such as its nonlinear refractive indexes, nonlinear absorptions, etc., [48–60].

When a continuous wave, CW, laser beam with fundamental, TEM_{00}, Gaussian extent propagates through an absorbing medium small part of the incident beam energy is absorbed by the medium. As a result of absorption local heating of the medium occurs in the shape of bell. Heating leads to change in the local temperature of the medium. Since the medium refractive index is temperature dependent the absorption leads to non-uniform distribution of the refractive index of the medium. Since the absorption occurs at the central part of the laser beam more than the wings of the Gaussian beam so does the change in refractive index. Such medium can be considered as lens like and since heating leads to a reduction in the medium density so that a negative lens usually created at the direction of propagation of the laser beam. The passage of the Gaussian laser beam in the medium subsequently leads to number of phenomena or effects in the transverse direction with respect to the laser beam viz., self-focusing, self-defocusing, self-phase modulation, etc., [61–66]. As a result of passing through the nonlinear medium the laser

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