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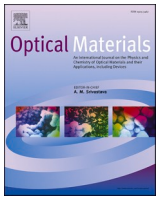

Research Article

Synthesis and investigation of nonlinear optical properties of Azo-SR8 compound using visible laser beams

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ABSTRACT

The main objective of this study is to explore the properties of a chemical compound called Azo-SR8, with a focus on its synthesis, characterization, and nonlinear optical (NLO) properties. To achieve this, several methods are utilized, including ^{1}H and ^{13}C NMR, mass and absorption spectra, differential scanning calorimetry (DSC) thermogram, optimized structure, and investigation of frontier molecular orbitals. NLO properties of Azo-SR8 are analyzed by subjecting it to a cw 473 nm laser beam and using diffraction patterns (DPs) and Z-scan techniques to estimate the nonlinear index of refraction (NLIR) value. The compound's all-optical switching (AOS) capability is investigated using static and dynamics techniques with two cw laser beams. The obtained results provide valuable information on the potential uses of Azo-SR8 in the field of optics.

1. Introduction

The investigation of the nonlinear optical (NLO) characteristics of numerous materials has recently garnered significant attention, as they hold promising potentials for applications in optoelectronic devices such as second harmonic generation, optical switching, electro-optical modulation, and high-density data storage.

Spatial self-phase modulation (SSPM) is a coherent NLO effect was intensively investigated in so many materials during the last four decades [1–10]. This effect, SSPM, leads to generation of diffraction patterns (DPs), an effect discovered by Callen et al. [11], and make used to calculate the change of NL medium refractive index (RI), Δn, and the nonlinear index of refraction (NLIR), n_2, via their total rings number appears in DPs at the highest power input [12].

Sheik Bahae et al. introduced another technique known as Z-scan [13,14]. This technique exploits the spatial distortion of a laser beam wavefront as it propagates through a NL medium, this behavior results from the self-phase modulation of the beam. It is noticed that Z-scan is highly sensitive and can be utilized to ascertain the NLIR, n_2, and the nonlinear absorption coefficient (NLAC) of the nonlinear medium.

Liquid crystals (LCs) occupy important and unique part of research and development effort since 1980 when Zolot'ko et al., published number of articles concerning their various properties [15–17]. The term "LC" refers to an aggregation state that lies somewhere between a crystalline solid and an amorphous liquid. In 1888, F. Reinitzer discovered liquid crystals (LCs), who observed their properties [18,19]. The physical properties of LCs are basically determined via the degree of orientation order in their anisotropic molecules. LCs possess significant nonlinearity owing to their high degree of anisotropy in their RI and optically induced molecular reorientation, rendering them useful for diverse optical applications. LCs possess light-scattering abilities, linear or nonlinear. Many LCs compounds have distinct mesophases based on the molecule arrangement viz., nematic and smectic phases LCs have been used in variety of many applications such as in display, optical cells, in drugs delivery, photoresponsive shape memory etc., [20,21]. The nonlinear properties of number of LCs were studied via different ways such as Z-scan, moiré deflectometry, diffraction ring pattern [22–24]. We have recently studied the NLO properties of couple of LCs [25,26].

The simplest structure of linear LCs contains aromatic rings at least two of which are linked by connecting groups and replaced in para positions by terminal groups such as methyl methoxy halogens, thio alkyl and long flexible chains. These compounds in general show different phases that strongly depends on the molecular structure, the mesogenic core length, number of aromatic rings, type of the connecting groups and the terminal chains nature play important role on mesophase

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