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Research Article

An efficient ultrasound-assisted CH_3COONa catalyzed synthesis of thiazolidinone molecule: Theoretical and nonlinear optical evaluations of thiazolidinone-Schiff base derivative

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ABSTRACT

Chemical synthesis, structural analysis, theoretical calculations and optical properties exploration of (*E*)-2-((*E*)-(4-nitrobenzylidene)hydrazono)-3-phenyl-4-thiazolidinone **7** ($C_{16}H_{12}N_4O_3S$) are introduced. The synthesis method involves three steps. The applying of ^1H and ^{13}C NMR, infrared radiation (IR), mass and UV–visible spectroscopies and melting point (m.p) confirmed the expected compound structure. Optimization of the compound geometrical structure is carried out via the theoretical calculation and evaluation of its nonlinear optical (NLO) properties. The NLO properties of the synthesized 4-thiazolidinone derivative **7** are studied under the irradiation with visible and single transverse mode laser beam, through the determination of the nonlinear refractive index (NRI) via the diffraction ring patterns (DRPs) and the Z-scan together with optical limiting. Using two visible laser beams, the all-optical switching (AOS) in 4-thiazolidinone derivative **7** is studied too.

1. Introduction

During the many years post the birth of the first laser device there has been continuous demands of new materials that respond fast enough and having nonlinear optical (NLO) properties for the possible use in applications such as optical information processing, all-optical switching (AOS), refractive index modulation, optical limiting, light controlled phase, data storage, phase conjugate [1–19], etc.

The study of the NLO properties of materials such as the nonlinear refractive index (NRI), nonlinear absorption coefficient (NAC), NLO susceptibility, etc., are based on new developed methods viz., diffraction ring patterns (DRPs) [20], thermal lens [21], and the single beam Z-scan [22]. These techniques are simple, accurate and required small number of apparatus. The first technique is based on the generation of DRPs while the third one is based on the deformation of the laser beam wave front, due to the propagation through a nonlinear medium. Both techniques were performed using single mode, continuous wave and low power laser beams.

Thiazolidinone and its derivatives are chemical heterocyclic structures that was discovered with a broad spectrum of biological activities [23]. Thiazolidinone moiety is a saturated structure of thiazole that consists a five-membered ring with a sulfur atom (S) at position 1, a nitrogen atom (N) at position 3, as well as a carbonyl group (C═O) on its 2, 4, or 5 carbons. Examples of common analogues of thiazolidinone core-structure including thiazolidin-2-one **I**, thiazolidin-4-one **II**, thiazolidin-5-one **III**, 2-thioxothiazolidin-4-one **IV**, and thiazolidine-2, 4-dione **V** are shown in Fig. 1 [24].

Thiazolidin-4-one derivatives as sulfur organic compounds in which a carbonyl group is located at fourth position, have attracted much interest by medicinal and organic chemists due to their various applications in modern pharmaceutical chemistry and affinity for different biotargets [25]. The above assemblage expresses ongoing physical chemistry investigations to discover novel thiazolidin-4-one derivatives which can offer many physiochemical applications. The chemical materials that have NLO properties can be employed in diverse applications, such as the optical coupling process between fibers and laser light production that is considered as an important factor for photonic computation and logic operations [26]. In general, thiazolidinone derivatives does not associated with physiochemical and photochemical applications so far, however, some works that have been recently

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