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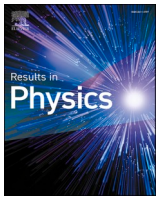

Studies of third order nonlinearity and thermal diffusivity of C3OC dye using thermal lens technique

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ABSTRACT

An FT-IR spectrometer and a UV–Visible spectrometer were utilised in order to characterise the Cyanidin-3-O-glucoside chloride (C3OC) dye. The dye's thermally induced optical nonlinearity was measured in a dimethylformamide solvent using an adjustable diode-pumped solid-state (DPSS) laser at 473 nm. The optical response was measured using the Z-scan technique. The dye showed negative and large nonlinear refractive index) NRX) values, with high nonlinear absorption coefficients (NBO). Because of its ability to change with concentration, the NRX is a viable candidate for applications in the field of nonlinear optics. Thermal lens (THS) technique was used to investigate thermo-optical properties and the NRX. The optical limiter capabilities of the C3OC dye are being investigated as a potential use.

Introduction

Significant nonlinear optical (NLO) features have attracted a lot of attention recently and hold promise for applications in optoelectronics and photonics, including time-reversed optical wave, photonics-based computing, light wave communication, and optical limiting [1–7]. Researchers are excited about exploring organic and inorganic substances for nonlinear optical applications like optical limiting, optical switching, and optical communication thanks to their remarkable properties [8–14]. Despite their appealing NLO properties, the high cost and energy requirements of most inorganic materials limit their practical applications. To overcome the current constraints, researchers are constantly searching for new optical materials that are accessible, possess superior NLO capabilities, and respond to easily available low-power lasers. Owing to their distinct chemical characteristics, natural pigments such as flavonoids, anthocyanins, and carotenoids, are a viable and eco-friendly alternative to inorganic and synthetic materials.The simplicity, environmental protection, affordability, and non-toxicity are associated with the using of plant-based pigment. The exploration of novel NLO materials with sub-picosecond response times and large third-order NLO susceptibility values for photonics and optoelectronics applications remains an active research area. Recent studies using advanced techniques have demonstrated the presence of nonlinear optical properties in natural dyes extracted from flower petals, leaves, bark, seed, and other organic substances, suggesting potential applications in various fields [15–20]. Zongo et al. revealed the potential of Bixa Orellana pigments for light manipulation by demonstrating their nonlinear optical properties through a spin-coating technique [21]. Bouchouit et al. employed four-wave mixing in a degenerate system to characterize the NLO properties of carotenoids extracted from spinach leaves. A number of researchers have reported the widespread potential of various natural plants, including green wattle bark, Marigold flowers, Cocks Comb flowers [22], Curcuma longa, trigonella foenum graecum [23], egonia malabarica Lam, Melastoma malabathricum, Punica granatum L [24,25], grape pomace [26], and blue pea flower [27], as readily accessible sources for the extraction of natural dyes. This contribution will confirm that the C3OC dye, which is the subject of this discussion, has NLO characteristics caused by a high population of delocalized p-electrons within their anthocyanin squeleton. This leads to a large generation of third harmonics and the phenomena of two-photon absorption, such as the attractive intensity-dependent refractive index and optical limiting. This research used a Fourier transform infrared spectrometer and a UV–visible spectrometer to characterize a natural dye compound containing the anthocyanin group (Cyanidin-3-O-glucoside

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