

SYNTHESIS, CHARACTERIZATION AND THIRD-ORDER NONLINEAR OPTICAL PROPERTIES OF SCHIFF BASE DIMER

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ABSTRACT

The Schiff base dimer (SHBD) [2,2'-(4,4'-methylene bis(4,1-phenylene) bis (azan-1-yl-1-ylidene) bis (methane-1-yl-1-ylidene) diphenol] was prepared characterized and studied. Several techniques have been used to characterize the new dimer such as FTIR spectroscopy and CHN analysis. The SHBD polymer film was prepared by the repeat-spray method. The third order nonlinear optical properties were investigated by Z-scan measurements using cw laser. The experimentally determined values of nonlinear absorption β and nonlinear refractive index n_2 are 2.79×10^{-2} cm/W and 6.12×10^{-7} cm²/W respectively. Optical limiting characteristics of the SHBD polymer film was studied. The experimental results indicated that the SHBD polymer film was a promising candidate in the applications of third order nonlinear optical materials.

KEYWORDS: Polymer, Nonlinear Materials, Z-Scan, Optical Limiting

INTRODUCTION

Nonlinear optical materials are attracting much attention because of their potential applications in optical communication, data storage, optical computing, dynamic holography, harmonic generators, frequency mixing, optical switching and optical limiting [1–18]. In order to utilize nonlinear optical (NLO) materials in photonic devices, such materials should possess a high NLO chromophore density so as to display large optical nonlinearity, low optical losses and ultrafast response time. Because there exists no symmetry requirement for third-order nonlinear optical effect this allows studies on a variety of organic molecules and polymers. A large number of organic dyes, fullerenes, charge transfer complexes, p-conjugated polymers, organometallic compounds, nano-composites and liquid crystals have been extensively investigated for third-order nonlinear optics. The third-order optical nonlinearity includes optical bleaching (i.e., saturation) or reverse saturation in the absorption aspect, whereas self-focusing or self-defocusing occurs in the refraction aspect. Of the various techniques available, Z-scan method [19,20] is a simple and effective tool for determining nonlinear properties and is used widely in material characterization because, it provides not only the magnitudes of the real and imaginary parts of the nonlinear susceptibility, but also the sign of the real part. Optical limiting is a nonlinear optical process in which the transmittance of a material decreases with increased incident light intensity. It has been demonstrated that optical limiting can be used for pulse shaping, smoothing and pulse compression [21]. The potential applications of optical limiting devices are sensor and eye protection.

Here, we report on the synthesis of Schiff base dimer (SHBD) [2,2'-(4,4'-methylene bis (4,1-phenylene) bis(azan-1-yl-1-ylidene))bis(methane-1-yl-1-ylidene) diphenol] polymer and investigation of their spectral characteristics. The nonlinear optical properties of Schiff base dimer (SHBD) polymer film were studied using the Z-scan method in order to determine both the nonlinear refractive index n_2 and the nonlinear absorption coefficient β . The experiments was