

Azimuthal Angle Scan Distribution, Third Order Response, and Optical Limiting Threshold of the Bismarck Brown Y:PMMA Film

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This paper studies various roughness parameters, besides waviness, texture, and nonlinear parameters of Bismarck brown Y (BBY)-doped Poly(methyl methacrylate) (PMMA) films based on the computed values of optical limiting (OL) threshold power and nonlinear refractive index. The films' morphology, grain size, and absorption spectra were investigated using atomic force microscopy in conjunction with ultraviolet-visible (UV-Vis) spectrophotometer. The particle size of the films ranged between 4.11–4.51 μm and polymer films showed good homogeneity and medium roughness, ranging from 1.11–4.58 μm . A polymer film's third-order nonlinear optical features were carried out using the Z-scan methodology. The measurements were obtained by a continuous wave produced from a solid-state laser with a 532 nm wavelength. According to the results, BBY has a nonlinear refractive index of $10^{-6} \text{ cm}^2/\text{W}$ that is significantly negative and nonlinear. The optical limiting thresholds are roughly 10.29, 13.52, and 18.71 mW, respectively. The shift of nonlinear optical features with the film's concentration was found throughout the experiment. Additionally, we found that the polymer samples have outstanding capabilities for restricting the amount of optical power that may be transmitted through them. We propose that these films have the potential to be used in a wide variety of optoelectronic applications, including optical photodetectors and optical switching.

Keywords : Azo dye, Grain size, Nonlinear materials, Optical limiting, Roughness

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I. INTRODUCTION

In recent years, there has been an increasing need for nonlinear optical materials that are compatible with low-intensity lasers and can be employed in a number of applications. Some examples of these applications include all-optical switching [1–3], optical bistability, phase conjugation, data and image processing [4–7], eye and sensor protection [8–11], nonlinear optical fiber and limiter devices [12–15] and optical switching [16–27]. Organic dyes have a variety of advantages over traditional nonlinear optical materi-

als, which differentiate them from such materials [28, 29]. Organic compounds fall within the category of dyes. They show substantial optical nonlinearities, short response times, and strong absorption in the visible spectrum range, making them particularly attractive materials for the investigation of the impacts of optical nonlinearity. In addition, dye-doped polymer solid films made with these materials are characterized by their flexibility as well as their thermal and chemical durability. Because of these extremely significant benefits, the dyes are good candidates for nonlinear optical research. The capacity of these dyes to capture opti-

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