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# Surface morphology and optical limiting properties of azure B doped PMMA film



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Keywords: Dye Polymer Polymethyl methacrylate Film Surface morphology Optical limiting	Surface morphology of azure B doped polymethyl methacrylate (PMMA) film is studied by using optical microscopy and Origin 2017 software program. The optical limiting properties for solution of azure B in the solvent chloroform and azure B doped polymethyl methacrylate (PMMA) film are reported. Measurements were performed using two continuous wave (CW) laser beams. The effects of both concentration of the sample and the wavelength of the laser used on the optical limiting properties have been investigated. The optical limiting properties of the dye solution and dye doped PMMA film are compared. A mechanism for the optical limiting is given.

#### 1. Introduction

With the extensive use of lasers in various applications such as military and civil and so on, it becomes necessary to find a new materials to use as an optical limiter (OL). The optical limiter is a device used to protect the human eye, optical sensor, electronic devices and other optical devices against the high intensity of the laser light. OL is designed to have a linear transmission below threshold for low level light inputs, and a constant transmission above threshold for high power, thus it becomes safe to the eye, optical sensors and to the electronic devices. The material must possess special characteristics to show the optical limiter action such as high optical damage threshold, high linear transmittance at low input power and a low threshold value [1].

Over the past three decades, the optical limiting properties of many materials such as organic, inorganic and semiconductors materials have been studied. Among these materials, organic materials have been given special attention due to the properties they possess, such as high optical nonlinearity, fast response time, high damage threshold and easy molecular design [2]. Many of these materials have proven to be effective as optical limiter [3–25]. This attention given to organic materials is not only due to their applications as optical limiter, but due to its utilized in optical phase conjugation [26], high density optical data storage [27–30], optical bi-stability [31–34] and all-optical switching [35,36].

The aim of the present work is to improve the optical limiting properties for dye to obtain better optical limiting properties as compared to conventional materials. To achieve this purpose, the dye should be doped with polymer, because most of previous research in this filed have shown that the dye doped with polymer has better optical limiting properties than dye alone [37–40]. In the current study, polymethyl methacrylate (PMMA) was chosen as the host of the dye due to its optical stability, resistance to laser damage, and high optical transparency in the visible spectral range [41–43]. The results on the optical limiting properties of an organic dye, namely azure B (colour index number 52010), dissolved in chloroform and azure B doped PMMA film using a continuous wave (CW) laser are reported. The threshold values for both samples are determined. The dependence of threshold value on various parameters is also investigated. Comparison between sample solution and solid film is given too.

#### 2. Experimental

#### 2.1. Sample preparation

Fig. 1a and b shows the chemical structure and molecular formula for azure B dye and polymethyl methacrylate (PMMA) respectively. Two types of samples are used in this study: sample solution and solid film. The first one was prepared by dissolving the azure B in the chloroform solvent. The concentrations prepared were 0.05, 0.06, 0.07 and 0.08 mM. The second sample was prepared using a casting method, which includes dissolving a certain weight of the dye in the chloroform solvent with a concentration of 0.5 mM and a volume 5 ml. The host was prepared by dissolving 5 gm of PMMA with 45 ml of chloroform,

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