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Nonlinear characterization of orcein solution and dye doped polymer film for application in optical limiting

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Abstract

The single beam Z-scan technique was used to determine the nonlinear optical properties of the orcein dye in the solvent chloroform and a dye doped polymer film. The experiments were performed using cw SDL laser with a wavelength of 532 nm. This material exhibits negative optical nonlinearity. The dye exhibited a nonlinear refractive index (n_2 = 0.22 x $10^{-7}$and 2.32 x 10^{-7} cm^2/W in dye solution and polymer film, respectively) and nonlinear absorption coefficient (β = 1.44 x 10^{-3} and 18.61 x 10^{-3} cm/W in dye solution and polymer film, respectively). Optical limiting characteristics of the dye solution and polymer film were studied. The result reveals that orcein dye can be a promising material for optical limiting applications.

Key words: Nonlinear optics, Nonlinear refractive index, Z-scan technique, Optical limiting, Dye

1- Introduction

The field of nonlinear optics (NLO) has been developing for a few decades as a promising field with important applications in the domain of photoelectronics and photonics [1,2]. NLO materials can be used to manipulate optical signals in telecommunication systems and other optical signal processing applications [3,4]. Organic materials are considered as one of the important classes of third-order NLO materials because they exhibit large and fast nonlinearities and are, in general, easy to process and integrated into optical devices [5-7]. Moreover, a fine-tuning of the NLO properties of organic compounds can be achieved by rational modification of the chemical structure[8]. Various types of organic compounds have been studied to obtain materials with large third-order nonlinearity. On the other hand a wide range of techniques has been used to measure third-order nonlinearity: e.g. Z-scan [9,10], nonlinear interferometry [11], degenerate four-wave mixing [12], nearly degenerate three-wave mixing[13], ellipse rotation [14], beam