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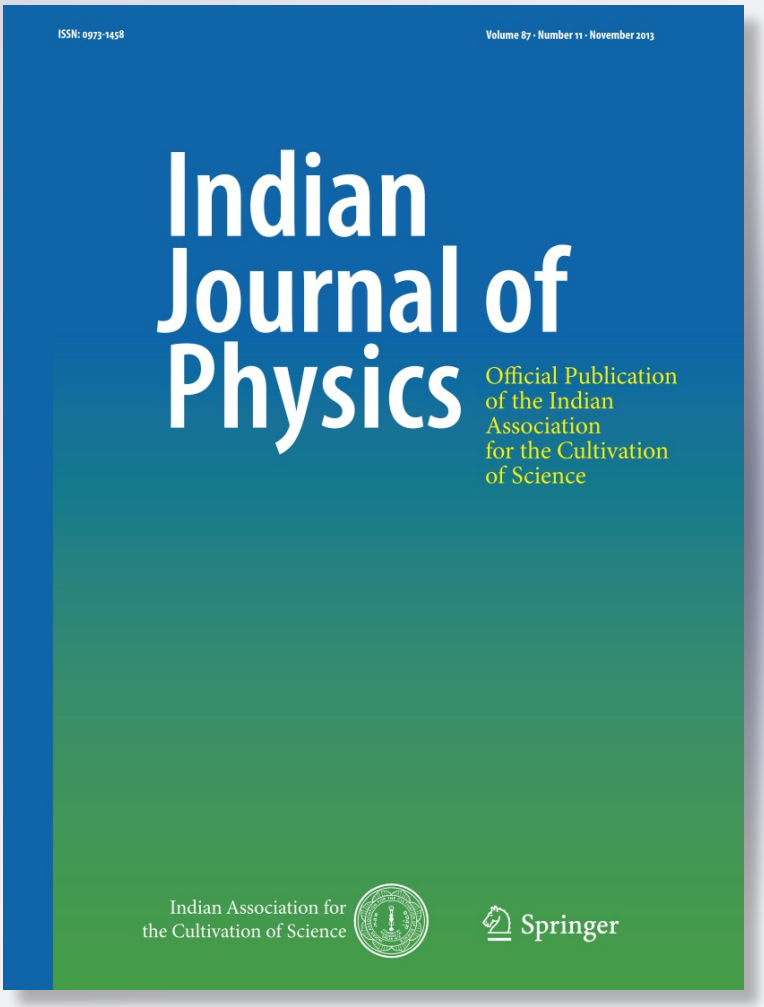

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ORIGINAL PAPER

Time dependent diffraction ring patterns in bromothymol blue dye doped PMMA film under irradiation with continuous wave green laser light

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Abstract: Diffraction ring patterns are generated in bromothymol blue (BTB) doped poly methyl methacrylate (PMMA) film with the aid of visible light from a solid state laser of Gaussian distribution. Temporal evolution of patterns i.e. the number of rings increases as time elapse is observed. Based on the experimental findings, change in refractive index (Δn) effective nonlinear refractive index (n_2) and variation of refractive index with temperature (dn/dT) have been obtained as 0.0025, 1.45×10^{-6} cm^2 W^{-1}, 1.69×10^{-5} K^{-1} respectively. Obtained results suggest the possibility of using BTB doped PMMA in data storage, recording and holography.

Keywords: Nonlinear refractive index; Thermo-optic coefficient; Self-phase modulation; Nonlinear optics

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1. Introduction

Owing to theirs special characteristics, poly methyl methacrylate (PMMA) films doped with various materials have attracted research activities in different directions: to improve the quality of all-optical switching [1–4], in all optical devices [5–7], to study the behavior of chromophores in different aging stages of hosts [8], in three dimensional multi-layered optical memory [9], etc.

There are a few reports on the use of materials doped in PMMA for data recording using lasers, data storage and holography [10–13]. The present article represents a study of the ring patterns that occur in bromothymol blue (BTB) doped PMMA film with aid of visible, 532 nm, continuous wave (cw) green light beam. It is to be mentioned that the behavior of ring patterns have been observed by Callen et al. [14] as back as in 1967.

2. Experimental details

The chemical structure of BTB (3′,3″-dibromothymolsulfonphthalein) dye is shown in Fig. 1. The BTB dye-doped PMMA film is prepared as follows: BTB dye and PMMA are dissolved separately in chloroform and then the solution of BTB dye and that of PMMA are mixed completely. After stirring for an hour, the mixed solution spread on a clean glass slide uniformly and dried at room temperature for 24 h. The concentration of BTB dye and PMMA in chloroform is 0.37 mmol. The film sample has a good purity and uniform thickness. The thickness of the film is approximately 45 μm.

UV–Vis spectroscopy has been used to characterize the BTB doped PMMA sample in the spectral range 300–750 nm. Measurements of absorbance (A) of the sample has been carried out using a reflectance spectrometer (Cecil Reflectascan CE 3055). This measurement has been performed at room temperature. The optical absorption of BTB doped PMMA film is presented in Fig. 1. The absorption peak is located at 423.5 nm.

The apparatus consists of a diode laser (0–50 mW output, beam radius 1.5 mm at 1/e^2), 532 nm, a positive glass lens of +100 mm focal length, a slab of glass with the film of 45 μm thickness, a semitransparent screen 30 cm × 30 cm, a digital CCD camera and a detector to measure input power. A stop watch is used to measure time development of rings system. Output of the CCD camera has been fed into a computer for further analysis. A schematic diagram of the experimental set up is shown in Fig. 2.

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