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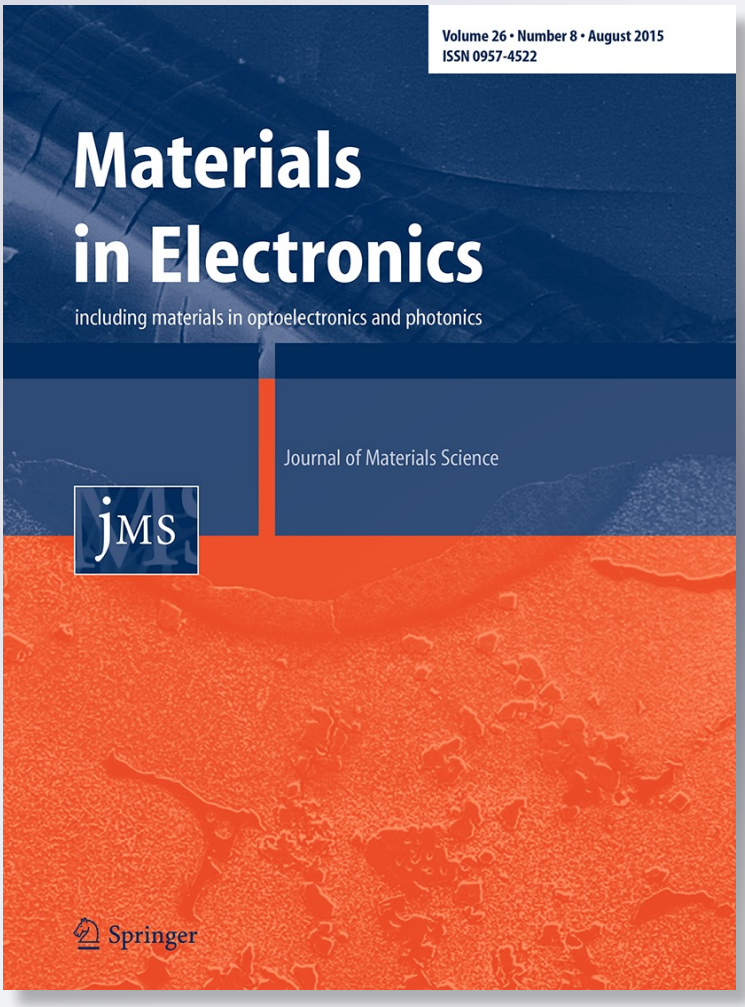

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Large third order optical nonlinearity and optical limiting properties of a 3,4-diaminopyridine

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Abstract Third-order nonlinear optical properties of aqueous solution of 3,4-diaminopyridine with different $MgCl_2$ and NaCl concentrations are investigated by the use of the Z-scan technique at wavelength of 473 nm with a continues wave (CW) laser. The results showed that the samples exhibited self-defocusing optical nonlinearity. All the samples showed large nonlinear refractive indices and nonlinear absorption coefficients of the order of 10^{-8} cm^2/W and 10^{-4} cm/W, respectively. Also the samples exhibits good optical power limiting properties under CW excitation. The nonlinear refractive index, nonlinear absorption coefficient and efficiency of limiting are found to increase with increases in the concentration $MgCl_2$. Therefore, the organic compound investigated here are promising candidates for optical power limiting devices.

1 Introduction

Materials processing optical nonlinearities have widely been investigated because of their potential in applications such as optical phase conjugation, high-speed all optical switches, optical bistability, transmission, amplification, optical storage, optical limiting devices, electro-optic modulators, and so on [1–9]. The optical limiting is considered as a promising application of nonlinear optical-power limiting activity [10]. It is a device used to protect eyes and sensors against damage by exposure to sudden high-intensity light. Optical limiting results from irradiance-dependent nonlinear optical (NLO) properties of materials. The incoming intense light alters the refractive and absorptive properties of the materials resulting in a greatly reduced transmitted intensity and therefore it is important to determine the magnitude of the nonlinearity of materials to select suitable materials as optical limiting media [11, 12]. Many materials have shown optical limiting features such as organics materials [13–16], fullerenes [17, 18], porphphyrins [19], nanomaterials [20, 21] semiconductors [22] and metal clusters [23, 24].

In this Letter, we presented our studies of nonlinear optical properties and optical limiting of aqueous solution of an organic dye, namely 3,4-diaminopyridine. We investigated the nonlinear refraction, nonlinear absorption and optical limiting threshold of sample using a continuous wave (CW) from solid state laser (SDL) at 473 nm wavelength. Also we investigated the effect of salt concentration in 3,4-diaminopyridine solution on the nonlinear optical and optical limiting properties.

2 Experiment

2.1 Preparation of the sample

The 3,4-diaminopyridine, $MgCl_2$ and NaCl were purchased from Aldrich and used without any purification. The sample was prepared as follows: 0.0436 g of 3,4-diaminopyridine powder and 0.2 g of $MgCl_2$ were dissolved in distilled water separately and stirred well to form uniform solution, later both the solutions were mixed together and stirred for 2 h using a magnetic stirrer. The concentration of yield is 0.3 M. The other samples for aqueous solution of 3,4-diaminopyridine and $MgCl_2$ with 0.5 and 1 M concentration and for aqueous solution of 3,4-diaminopyridine and NaCl with 0.3, 0.5 and 1 M were also prepared in a

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