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Solvents effect on the optical nonlinear properties of the sudan iv

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ABSTRACT

The optical nonlinear properties of three sudan iv solutions in DMSO, DMF and chloroform solvents are studied under irradiation with low power laser beam work at 473 nm. The diffraction ring patterns and Z-scan experiments were carried out separately to calculate the change in the index of refraction and the nonlinear index of refraction of each solution. The rings number per each pattern, the area of each pattern and the outer most ring diameter in each pattern increased with the increase of input laser beam intensity. Each pattern loses symmetry in the upper part as input intensity increased. The obtained diffraction ring patterns are simulated using Fraunhofer approximation of the Fresnel-Kirchhoff diffraction theory where good theoretical agreements with the experimental findings are obtained. According to both methods it is proved that sudan iv three solutions shows self-defocusing phenomena. Type of solvent appears to control the nonlinearities of sudan iv solutions. Optical limiting property is studied in the three solutions.

1. Introduction

The nonlinear optical properties of different materials were and still examined in the continuous wave (cw) regimes of visible low power laser beams by the three techniques viz., diffraction ring patterns [1,2], thermal lens [3,4] and by Z-scan [5,6]. These three techniques are simple and required little components viz., a laser device, a positive lens, a glass cell, a power meter, a semitransparent screen and a camera. So many materials have been tested for the sake of obtaining their nonlinear refractive indexes [7–21] for the possible use in different applications and devices [22–30]. Sudan dyes are available in various sorts viz., sudan i, sudan ii, sudan iii, sudan iv, sudan red B, sudan red G, sudan red 7B, sudan orange, and sudan black [31]. Generally all sudan dyes can causes potential risk to the health [32]. It received little attention from the point of view of nonlinear behavior. Sudan red G and sudan orange G optical linear and nonlinear properties and quantum parameters were studied by Esme and Sagdine [33], sudan i nonlinear optical response was studied by He and Wang [34]. Properties of optical limiting of sudan red B doped PMMA film, and films of sudan iv doped poly (alkyloxymethacrylate) for optical data storage were investigated by Qusay et al., [35,36]. Sudan iii have received much attention where ring patterns were generated under the effect of electrical field [37], measure of its nonlinear index of refraction [38], its photo-induced dichroism [39], its optical limiting behavior [40], its optical data storage [41] and its nonlinear optical properties were studied too [42]. Sudan iv optical nonlinear response was studied by Majles Ara et al. [43].

Through previous studies, which are mentioned above, it was concluded that sudan dyes have high nonlinear optical properties, so that one of sudan's dyes family, namely sudan iv is chosen, as a sample in this study. In this work the effect of three solvents viz., dimethyl sulfoxide (DMSO), dimethyl formamide (DMF) and chloroform on the optical nonlinear properties of sudan iv are presented

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