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Laser-induced nonlinearities in a polymer solution

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ARTICLE INFO

Keywords:

Far-field DPs
Z-scan
Optical limiting
All-optical switching

PACS:

42.70.-a
42.65-k
42.65.An

ABSTRACT

Objective: The aim of the present work is to find a material that has high nonlinear optical properties and can be used as an optical limiter.

Methods: A (Aniline, Anisidine and Toluidine) polymer is prepared. The nonlinear optical (NLO) properties of the prepared polymer solution are studied under irradiation with continuous wave (cw), low power, visible laser beams.

Results: The polymer index of nonlinear refraction (INR) is determined via two techniques viz., the far-field diffraction patterns (DPs) and the Z-scan. Optical limiting (OLg) and all-optical switching (AOS) properties of the prepared polymer are tested. The far-field (DPs) are theoretically calculated using the Fresnel-Kirchhoff (F.K) integral.

1. Introduction

Nonlinear optical (NLO) materials have attracted, in recent years, research activities due to their possible applications such as high all-optical speed switching devices. Based on this, materials having high third-order NLO index of refraction are always of continuous interests. Owe to their possible applications in many NLO devices, viz., optical data storage [1–4], optical switching [5], spatial dark soliton transmission [6], optical phase conjugation [7], beam flattening [8], weak absorption measurement [9], and so on. We in the last ten years have used many available materials, developed new materials, and improved the properties of available materials, in the study of their NLO properties viz., index of nonlinear refraction (INR), coefficient of nonlinear absorption (CNA), optical limiting (OLg), change of their index of refraction, etc., using linear and nonlinear approaches, diffraction patterns (DPs) and Z-scan techniques [10–26].

Aniline ($C_6H_5NH_2$) an organic base, used to make plastics, drugs, dyes, etc., was first synthesized in 1826. It is prepared by catalytic hydrogenation of nitrobenzene. When it is heated with organic acid it gives amides such as acetanilide. Aniline in number of materials such as u-bromo-4 chloro benzylidene, 4-chloro 2-nitro-aniline crystals have been studied [27–30].

O anisidine (C_7H_9NO) is an organic compound, a colorless liquid. It is one of three isomers of the methoxy containing aniline derivative. O anisidine received no attention to study its nonlinear properties.

O toluidine (C_7H_9N) is used in the manufacturing of dyes, it is toxic to the human when it is inhaled as vapor, absorbed through skin and swallowed. O toluidine have received no attention to study its nonlinear properties.

In this work a (Aniline-O-Anisidine- O-Toluidine) polymer was synthesized by the mixing of aniline, O-anisidine and O toluidine. The resulting polymer absorbance was studied against wavelength in the UV–vis. range at room temperature. The INR and CNA of the polymer were calculated using a visible, low power, TEM₀₀ mode, 473 nm laser beam via the far-field DPs and the Z-scan. The OLg property of the studied polymer was tested at the same wavelength. All-optical switching (AOS) property of the prepared polymer was

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<https://doi.org/10.1016/j.ijleo.2022.170111>

Received 10 June 2022; Received in revised form 27 September 2022; Accepted 15 October 2022

Available online 18 October 2022

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