



Study of the thermal and nonlinear optical properties of alizarin gelb R solution

Amir Hussein Ali¹ · H. A. Sultan¹ · Qusay M. A. Hassan¹ · C. A. Emshary¹

Received: 10 May 2024 / Accepted: 14 August 2024

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2024

Abstract

The thermal and nonlinear optical (NLO) properties of alizarin gelb R solution are investigated experimentally and numerically. The thermal conductivity, K , of alizarin gelb R solution is calculated by constructing a device and found to decrease with the increase in absolute temperature. The change in refractive index, Δn , of alizarin gelb R solution and its nonlinear index of refraction (NLIR), n_2 , are estimated via diffraction patterns (DPs) under irradiation with a 473 nm cw laser beam. As high as 4.73×10^{-3} and $4.81 \times 10^{-11} \text{ m}^2/\text{W}$ of Δn and n_2 are determined. The collapse of DPs phenomenon through the deformation of the resulted DPs seen to occur. The resulted DPs are numerically calculated via the use of a mathematical model that is solved using the diffraction integral.

Keywords Alizarin gelb R · Thermal properties · Nonlinear optical properties · Diffraction patterns

1 Introduction

Owing to the wide spread use of nonlinear materials, i.e., materials that respond nonlinearly against high intensity, Gaussian, cw, laser beams has triggered a race among researchers, so that many materials have been studied (Sadr et al. 2016; Zidan et al. 2016; Kumara et al. 2019; Maidur et al. 2019; Zidan et al. 2020; Rashidian et al. 2009; Nadafan et al. 2017; Faraji et al. 2014; Koushki et al. 2018; Sindhu et al. 2006; Sindhu et al. 2005; Dehghani et al. 2011; Ghaleh et al. 2007; Nadjari et al. 2012; Jeyaram 2021; Jayaram et al. 2020; Pramodini et al. 2014). Many materials properties has been improved using, for example, γ rays (Fleifil et al. 2023; Jebur et al. 2020; Santhosha et al. 2018; Madi et al. 1994; Dutsyak et al. 1996) and many novel materials has been synthesized for the first time (Neela et al. 2023; Kabilan et al. 2022; Dehghani et al. 2021; Gao et al. 2023; Thomas et al. 2024; Yaseen et al. 2024; Lakshmi et al. 2024; Mao et al. 2023; Qiao et al. 2023; Caddirci et al. 2023).

✉ Qusay M. A. Hassan
qusayali64@yahoo.co.in

¹ Department of Physics, College of Education for Pure Sciences, University of Basrah, Basrah 61001, Iraq