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Determination of nonlinear refractive index of paprika oil and pepper oil under cw visible laser illumination

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Abstract:
We report the observation of multiple diffraction rings patterns in paprika and pepper oils using continuous wave laser beams .The patterns occur at relatively low intensities . The number of rings together with outermost ring diameter of each pattern increases monotonically with increasing input power . The total changes in refractive index , Δn ,and nonlinear refractive index,n_2 ,are determined using the number of rings observed in both samples and 473 nm and 532 nm laser beams . We obtained good values of $\Delta n = 0.01$ and $n_2 = 10^{-6}$ cm^2/w . These large values are attributed to thermal effects .

Keywords: Diffraction rings, visible laser beams, nonlinear refractive index, vegetable oils.

Introduction

Changes in refractive index induced by optical fields give rise to variety of nonlinear phenomena in photoresponsive materials [1,2]. When a light beam passes through an absorbing medium whose refractive index decreases as a function of temperature , the medium behaves as a negative lens [3]. In the spatial domain , the interplay between divergence of the propagating beam and the nonlinear response of the medium can leads to a diverse range of self – action behavior such as optical self – trapping, soliton formation and spontaneous pattern formation due to modulation instability [4,5] . A related phenomena is the formation of spatial rings which is understood to be induced by spatial self-phase modulation arising from the laser induced refractive index . The multiple diffraction rings have been demonstrated for the first time back in 1967 by Callen et al ., [6]. A pump laser beam with Gaussian intensity extent can induced such diffraction rings due to the induced of phase shift with a bell – shaped transverse profile (Gaussian) [7]. The interference between light from two distinct points on the Gaussian