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Experimental and Theoretical Study of the Laser Induced Diffraction Pattern in the Acid Orange 10 Dye: Polyacrylamide Gel

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Abstract:

We observed and studied diffraction rings generated in an Acid Orange 10 dye doped Polyacrylamide gel (AO10: PAA gel) using cw visible laser beam. The number of rings increases almost exponentially with increasing input power and concentration of the samples. The refractive index change, Δn, effective nonlinear refractive index, n_2, variation of thermo-optic coefficient ,dn/dT, figure of merit ,W, and thermal figure of merit ,H, are found to be 0.004788 , 10^{-5} cm^2/Watt, 1.01×10^{-4} 1/°C, 13.7 and 0.45×10^{-4} respectively. The effective nonlinear refractive index, n_2, was determined based on the observed number of rings. This large nonlinearity is attributed to a thermal effect. Theoretical diffraction patterns that agree well with experimental one are generated using a wave theory.

Keywords: Nonlinearity; Thermal effect; Wave theory.

1. *Introduction*

Self-induced index changes in optical media have been investigated extensively in the past in connection with Q- switching and mode locking of lasers and self-focusing or defocusing of laser beams. The mechanisms behind self- induced changes fall into two categories. In the first category, there are several non-resonant mechanisms which have been studied quite extensively in the past in connection with self-focusing. In the second category, we have near-resonant effects, the most important of which is associated with the saturation of a more-or-less homogenously broadened absorption line [1]. A Frédericksz transition caused by the electric field of wave was first observed by Zolot'ko and colleagues [1]. He and his colleagues published series of articles concerning the appearance of aberration