Analysis of beam propagation in a dye-doped nematic liquid crystal

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Nematic liquid crystals are important materials that are applied for electro-optical displays, optical storage devices and nonlinear optics. Their nonlinearity can be influenced by a small amount of dye impurities. [1,2]

Nonlinear optical behavior of dye doped liquid crystals depends on several factors such as dye concentration. Thus, it is interesting to investigate the influence of dyes on nonlinear properties of the liquid crystals.

In this investigation, we propose a numerical method to obtain the distorted Gaussian beam shape transmitted through three nematics liquid crystal sample. Passing the Gaussian beam from a nonlinear optical medium, mainly in TEM00 mode, is well known in many optical devises and configurations such as z-scan and moiré deflectometry method [3]. The importance of this method would appear in many results induced by experimental studies. This numerical method will enable us to reinvestigate many of these experimental results and an extra ability for optical material characterizations too.

These optical properties are conductive to the simulation of the beam profile by utilizing a computer program. In each state, the sample was put at a fixed point. The beam radius has been obtained at a far vertical plane located at z. This plane has been moved to the sample place in finite negligible stages. The mentioned calculations are repeated for each stage. A series of continuous beam radiuses has been obtained that its asymptotic curve is the beam profile. The beam profiles for these materials are drawn.

We have drawn the beam shape of third-order nonlinear optical materials and discussed about the numerical advantages and investigated it for some reported materials. Also, the influence of dyes on the exiting beam after the sample is compared for the Azo-Sudan dyes.

References:
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