

论文

强激光条件下5CB液晶中的激光诱导衍射环现象

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摘要:

强激光经5CB液晶传播时会产生非线性自相位调制现象,利用532 nm和1 064 nm CW激光研究了强激光条件下5CB液晶中的激光诱导衍射环现象,并对强激光在5CB液晶中产生自相位调制的现象和机理进行了讨论.当532 nm激光和1 064 nm激光功率密度分别大于10 kW/cm²和300 W/cm²时,接收白屏上有较明显的衍射环现象|当激光分别持续作用数十毫秒和数百毫秒量级时间时,接收屏上的衍射环现象消失.分别利用基尔霍夫衍射积分公式的菲涅耳近似和夫朗和费近似形式对5CB中激光自相位调制和激光诱导衍射环进行了数值模拟,数值结果与实验结果符合的较好.基于热传导理论定性分析了5CB液晶在不同波长和入射条件下的三阶非线性系数.结果表明:在强激光入射条件下,热效应是自相位调制的主要原因,这种三阶非线性系数除了与液晶的吸收系数和作用时间相关,还与激光作用面积甚至激光诱导指向矢转动过程相关.

关键词: 强激光 衍射环 向列相液晶 基尔霍夫衍射积分

Research on High Power Laser Induced Diffraction Ring in 5CB Liquid Crystal

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Abstract:

Self-phase modulation phenomena was found in 5CB liquid crystal,which accounted for the far field diffraction ring phenomena induced by high power laser traversing thin liquid crystal cell.Experimental and numerical methods were employed to study the mechanism of the self-phase modulation in 5CB.Experimental results indicate that diffraction ring phenomena can be found when the incident laser intensity rise to 10 kW/cm² and 60 W/cm² for 532 nm and 1 064 nm laser separately,but will disappear when the effect of laser interaction with liquid crystal sustained hundreds of milli-second.Numerical results applying Kirhoff diffraction integral formula were in good agreement with experimental results.Based on thermal conductivity theory,the relationship of the third order nonlinearity with the incident laser spot and wavelength in 5CB liquid crystal was discussed qualitatively.It was indicated that thermal effects take the main role in the nonlinear self-phase modulation phenomena which is greatly associated with the absorption coefficient and the laser spot diameter.

Keywords: High power laser Diffraction ring Nematic liquid crystal Thermal effect Kirhoff diffraction integral

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