

Z-掃描量測氧化鋅薄膜之非線性光學特性

研究生：陳英仁

指導教授：謝文峰 教授

國立交通大學光電工程研究所

摘要

我們利用高重複率飛秒脈衝鈦藍寶石雷射為光源做 Z-掃描量測，來研究 Laser-MBE 磊晶成長之氧化鋅薄膜的非線性光學特性。本實驗所得之雙光子吸收係數及非線性折射率比之前用 25 皮秒 532nm 波長量測的氧化鋅塊材分別大了二到三個數量級。在接近氧化鋅能隙和激子雙光子共振時，雙光子吸收係數和自由激子呈現出共振行為，不過卻因為自由激子飽和之緣故其共振波長而相對於雙光子吸收係數產生紅移現象。另外我們觀察到氧化鋅缺陷的吸收飽和現象發生在波長 810nm 到 840nm 之間。藉由熱透鏡光學效應的分析，我們推論當激發波長為 420nm 時，所量測到的非線性折射主要由熱所貢獻；而當波長接近紅外光時，非線性折射主要還是由束縛電子及自由激子所產生即使熱透鏡的效應仍然不能被忽略。

Nonlinear optical properties of ZnO thin films measured by Z-scan method

Student: Yin-Jen Chen

Advisor: Dr. Wen-Feng Hsieh

Institute of Electro-Optical Engineering
National Chiao Tung University

Abstract

Optical nonlinearities of ZnO thin film made by the laser MBE have been investigated by Z-scan method from the high repetition rate femtosecond Ti:sapphire laser. The measured positive γ and β near IR shows enormous increasing than the ZnO bulk measured at $532nm$ with $25ps$ pulse duration. The two-photon resonance of the bandedge and exciton is observed by the two photon absorption coefficient β and the free carrier induced nonlinearities with a red shift relative to β due to the free carrier saturation. In addition, the linear absorption saturation by the ZnO defect states is observed while the excitation wavelength between $810nm$ - $840nm$. By the analysis of thermal-optical effect, we suggest that the nonlinear refraction index is mainly dominated by the thermal nonlinearity at $420nm$. Nevertheless, the bound electronic and free carrier effect is main source of the nonlinear refraction in the near IR range even though the thermal-optical effect can not be neglected.

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