氮化鎵薄膜表面V型缺陷(V-defect)結構之微拉曼光譜(Micro-Raman)研究

研究生：沈承勳　　　　　　　　　　指導教授：李明知博士

中文摘要

在本論文中，我們利用原子力顯微鏡(AFM)、微拉曼光譜(micro-Raman)等方法研究利用金屬有機化學氣相磊晶系統(MOCVD)所成長的氮化鎵薄膜表面上的V型缺陷。在微拉曼光譜分析中，發現在不同摻雜濃度n型氮化鎵薄膜上直徑3.3微米的V型缺陷內，其LO相關的模態相對於平坦處都有明顯的藍移情形。而在同樣摻雜濃度下、不同大小的V型缺陷中，隨著V型缺陷的直徑增加，禁止模態(forbidden modes) A_1(TO)、E_1(TO)強度增加，而LO相關的模態則有明顯的藍移行為。我們將禁止模態的出現歸因於表面形貌的改變而提供了側向散射，而LO相關模態的藍移則是由於V型缺陷下方較高的線差排密度(dislocation density)提供了許多的電子。經由LO聲子-電漿的耦合模型(LO phonon-plasmon coupling)以及有效電子濃度(effective electron density)計算，我們推測在V型缺陷中心下方的線差排密度數量級在$10^{10}cm^{-2}$以上。

Studies of V-Defects on GaN Films by Micro Raman Spectroscopy

Student：Chern-Hsun Shen Advisor：Dr. Ming-Chih Lee

Institute of Electrophysics

National Chiao Tung University

Abstract

The optical properties of V-defects on GaN films were characterized by using atomic force microscopy and micro-Raman spectroscopy. Raman LO related modes of 3.3μm V-defects show noticeable blue shifts from different doping concentration samples. For V-defects of different size, the appearance of forbidden Raman modes A_1(TO) and E_1(TO) inside V-defects is due to the right angle scattering from morphology variation. Distinct blue shift of LO related modes was also observed inside V-defects compare to the plain region, especially in large V-defects. Simulation results obtained from the phonon-plasmon interaction model suggest a higher carrier density inside V-defects than that on the plain region. Thus, we deduced a higher dislocation density (~10^{10}cm^{-2}) inside V-defects than that (10^8~10^9cm^{-2}) on the plain by considering effective electron density.