P型氧化鋅薄膜之製作與光電特性研究

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摘 要

在本研究裡利用RF濺鍍成長ZnO:(Al, N)薄膜，探討ZnO:(Al, N)薄膜的結構、表面形貌、摻雜比例對於導電性(conductivity)、載子濃度(carrier concentraction)、遷移率(mobility)、光穿透率 (transmission)以及光激發螢光發光(Photoluminescence)之影響，本研究透過射頻功率的調變、降低本質缺陷、活化受體，實現可控制生長 n型與 p型的氧化鋅薄膜。進而獲得具良好光電特性ZnO:(Al, N)薄膜之最佳製程條件。

實驗結果顯示最佳製程條件為 ZnO:Al靶材射頻功率230 W、工作壓力10 mTorr、工作溫度室溫環境下，薄膜厚度維持在400 nm。ZnO:(Al, N)薄膜其電阻率1.6？cm、載子濃度 2.32x1016cm-3、載子遷移率 165 cm2/V-s，在可見光範圍之穿透率平均可以達到 80 %。我們發現ZnO：(Al, N)薄膜摻雜原子的比率在Al/Zn為 10~20 %與 N/Al為 1~1.3時，是適合成長出p型 ZnO: (N, Al)薄膜的條件，此結果非常接近理論值 N/Al=2:1。分析發現p 型 ZnO:(Al, N)薄膜，主要以氧空缺與鋅空缺存在。同時也提供氮原子取代氧空缺與鋁原子取代鋅空缺的機會，製程p型ZnO:(Al, N)薄膜機會也大幅增加。

關鍵詞 : 氧化鋅、射頻磁控濺鍍法、電阻率、摻雜

目錄

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