多晶氮化鎵之氣相成長及其光電特性之研究

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摘 要

本篇論文是藉由有機金屬化學器相沉積法在多晶矽基材上成長多晶氮化鎵薄膜，經由實驗及量測所得之結果，探討多晶氮化鎵薄膜之光電特性及整理並歸納多晶氮化鎵材料完整的成長機制，並建立最佳化之成長參數，繼而進行金半金紫外光感測器(MSM UV DETECTOR)之研製與特性量測，探討多晶氮化（鋁）鎵在大面積與低成本光電元件應用之潛力及可行性。 經由我們從實驗所得到的結果中獲知，在多晶矽基材上所成長的氮化鎵薄膜其光學品質雖然不及在單晶藍寶石基材上所成長出的氮化鎵磊晶膜，但相較於成長在單晶矽或單晶砷化鎵之氮化鎵薄膜卻毫不遜色，我們在多晶矽晶片上成長的氮化鎵薄膜（約4 μM微米厚）所得到的室溫光激發光光譜（3.387 EV）其半高寬低於 130 MEV，晶粒大小約為3 ~ 4 μM，經由霍爾量測得知所成長的自然N型氮化鎵薄膜的電子濃度約為2 ~ 7 ×1019 CM-3，電子遷移率約為70 ~140 CM2/V*S。 由於以GAN為緩衝層的二階段式成長的機制中，所得到的自然N型多晶氮化鎵膜的電子濃度均偏高，而如此般的沉積膜無法適用於蕭特基接觸金半金紫外光感測器的製作。所以我們改以ALN作為緩衝層及在高溫調變ALGAN層，之後便成長GAN主層，如此一來，在光特性影響不大之下，在電特性方面，電子濃度可降至2 ~ 7 ×1017 CM-3。 經由POLY-GAN/ALGAN/ALN/POLY-SI所製作完成的金半金紫外光感測器元件的電壓電流特性量測中得知，(1 MM × 1 MM , FINGER 長 = 200 mM, FINGER寬 = 30 mM, SPACE = 30 mM)元件之暗電流為10-10A (逆偏壓為5伏特)，而在HE-CD雷射(光譜在325 NM位置，最大輸出功率為200MW)的照射下，得到元件光電流的變化約為二千多倍。 紫外光感測器是火燄偵測器（必須能在烈日背景下正常工作）之關鍵元件，除需具有250 ~ 280 NM 之感測波段外，高感度 (1NW/CM2)與大尺寸面積亦十分重要，由多晶氮化（鋁）鎵研製之金半金紫外光感測器較傳統光電管、SI 感測器或是以磷化鎵為主的光感測器配合濾光片、鑽石薄膜感測元件等將更具優點。因此希望能藉本論文主題之研究，進行多晶氮化鎵/多晶矽新型光電材料之開發與元件應用，開闢多晶氮化鎵之創新研究領域。

關鍵詞 : 無

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