

摻雜鋁氧化鋅奈米柱與p型矽異質界面之電性

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摘要

本研究使用水溶液法在p型矽基板上製備摻雜鋁氧化鋅(aluminum-doped zinc oxide, Al-doped ZnO)奈米柱並量測不同摻雜硝酸鋁(aluminum nitrate, $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$)濃度之摻雜鋁氧化鋅之表面型態、結構成分與導電性。實驗中,先以無水酒精(ethyl alcohol, $\text{C}_2\text{H}_5\text{OH}$)加入醋酸亞鋅(zinc acetate, $\text{Zn}(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$)調製成0.0075M之溶液,以旋轉塗佈(spin coating)方式於p型矽基板製備種子層(seeding layer)。之後,再以體積濃度0.02M的四氮六甲環(hexamethylenetetramine, $\text{C}_6\text{H}_{12}\text{N}_4$)、0.02M的硝酸鋅(zinc nitrate hexahydrate, $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$)及不同濃度硝酸鋁調製成混和溶液,加熱至90°C並維持兩小時以成長氧化鋅奈米柱。由場發式電子顯微鏡(field-emission scanning electron microscopy, FE-SEM)觀測到氧化鋅為六角柱狀,並且由能量質譜儀(energy diffraction spectroscopy, EDS)分析得知摻雜鋁氧化鋅奈米柱是由鋅、氧及鋁所組成並且摻雜硝酸鋁濃度越多,鋁原子所佔的比例也越高。由霍爾效應(Hall effect)量測證實摻雜鋁氧化鋅奈米柱的確具有n型導電性,並且導電率有因摻雜而上升趨勢,而隨著硝酸鋁濃度愈高,多數載子濃度隨之上升,多數載子遷移率則會下降。另外,實驗也發現摻雜鋁氧化鋅奈米柱之光激發螢光(photoluminescence, PL)峰值大約在376.1nm至379.4nm之間。最後,我們在p型矽基板成長摻雜硝酸鋁氧化鋅奈米柱以構成n-ZnO/p-Si異質界面,此n-ZnO/p-Si異質界面展現整流特性,我們量測此異質界面之電流-電壓特性,並成功決定其逆向飽和電流密度、理想因子等特性參數。

關鍵詞: 摻雜鋁氧化鋅、霍爾效應量測、光激發螢光

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