使用熱化學氣相沉積在矽奈米絲上合成奈米碳管

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摘 要

本實驗利用熱化學氣相沉積法在矽奈米絲上面成長奈米碳管，主要的碳原子來源為甲烷，並以氬氣當載氣將甲烷導入爐管，再利用觸媒熱分解效應將甲烷分解成碳原子並成長出碳管。本研究中，我們針對催化劑厚度與成長溫度二種因素對於所成長SiNW-CNT的結構性質及場發射特性的影響來進行深入研究。

我們使用拉曼光譜(RAMAN)、電子顯微鏡(SEM)、穿透式電子顯微鏡(TEM)、能量散佈分析儀(EDS)來分析奈米碳管的結構性質，奈米碳管的場發射特性則是在高真空狀況下施加電場所量測得到。從拉曼光譜及電子顯微鏡的分析我們發現，鎳膜厚度越厚所需要的能量越高，因此所需要的成長溫度也因此需要增高，若鎳膜厚度增厚而成長溫度卻沒有增高，由於所需要的能量不足，因此會造成碳管數量變少，而碳管的直徑卻會逐漸增大。當成長溫度增高，而鎳膜厚度沒有增厚，其鎳膜厚度不足以使矽奈米絲表面成長出奈米碳管。

由Fowler-Nordheim(F-N)圖我們發現，鎳膜厚度增加的確會使功函數?祤W大，場發射電流會因為所成長的碳管數量減少、碳管曲率半徑變小、及碳管管徑增大三個因素同時作用而降低。這種場發射電流的改變不僅是因為所成長的碳管數量及直徑的改變所造成的，在這種其況下所成長碳管的結晶結構及功函數也會改變，造成電子發射難易程度的改變也是一個非常重要的因素。而成長溫度增高會使SiNW-CNT的管徑變大、曲率半徑變小也同樣會造成電子發射難易程度的改變的重要因素之ㄧ。

關鍵詞 : 奈米碳管、矽奈米線、場發射、熱化學氣相沉積

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