熱化學氣相沉積奈米碳管之場發射特性

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摘 要

本實驗利用熱化學氣相沉積法來成長奈米碳管，主要的碳原子來源為甲烷，並以氬氣當載氣，將甲烷帶入爐管中反應，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以及不同的催化劑三種因素對於所成長奈米碳管的的結構性質及場發射特性的影響來進行深入研究。 我們使用拉曼光譜及SEM來分析的奈米碳管的結構性質，而奈米碳管的場發射特性則是在高真空狀況下施加很大的電場所量測得到。從拉曼光譜及SEM的分析我們發現，當催化劑鎳膜成長厚度愈厚時，催化劑鎳膜在成核時期所形成鎳催化顆粒會愈大，造成碳管數量變少，而碳管的直徑卻會逐漸增大。當溫度較低時，所提供的熱能可能並不足以將原子填補至適當的結晶位置，所以在奈米碳管中會形成較多的結晶缺陷。而當溫度被提高時，碳原子的表面遷移速率增大，因此可以幫助碳管的成長，石墨結晶化程度也較好。而且從不同催化劑(Fe,Co,Ni)比較當中，以鎳膜成長的奈米碳管的性質最佳。 由F-N圖我們發現，鎳膜厚度增加的確會使功函數φ增大，場發射電流會因為所成長的碳管數量減少、碳管尖端電場增強效應減低、及碳管功函數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，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。

關鍵詞 : 奈米碳管 ; 場發射 ; 熱化學氣相沉積

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