低溫奈米碳管在鍍銀電極玻璃基材上之成長與特性研究

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摘要

本論文之研究是利用微波電漿化學氣相沈積法（Microwave plasma enhanced chemical vapor deposition），低溫成長奈米碳管於鈉玻璃（Soda-lime glass）基板上之厚膜銀極，並比較兩種不同觸媒沈積方式，所成長出的奈米碳管性質及場發射的應用特性。

第一種觸媒沈積方法是以溶液沈積法（Solution deposition method）於 Ag 顆粒上沈積奈米級 Ni 顆粒，並將其混合製作成銀膠，再經由網版印刷（Screen printing）技術塗佈於玻璃基板上。第二種觸媒沈積方法方法是以溶膠-凝膠法（Sol-gel method），形成含鎳的溶膠，再以旋轉塗佈法（Spin-on glass, SOG）上於以網印形成的 Ag 電極上。

含 Ni 觸媒的試片再利用微波電漿化學氣相沈積法，以 H_2 和 CH_4 為反應氣體，在低溫下（550 ℃~600 ℃）成長奈米碳管。實驗中藉著改變不同成長參數來瞭解碳管的低溫成長機制。而兩種方法製作的試片成長後在分佈上，皆擁有極佳的均勻性。在電子顯微鏡觀察下，可知兩種方式所成長出的奈米碳管為有過多缺陷的多層奈米碳管。

在場發射的性質量測上，F-N 曲線可證明低溫碳管試片具有場發射的性質，第一種方法製作的試片最佳的起始電場是 3.2 V/μm，而第二種製作的試片起始電場為 5.4 V/μm，較目前其它文獻上所提出的低溫碳管具有更佳的場發射特性，未來將可以運用於奈米碳管場發射顯示器。

Growth and characteristics of low temperature carbon nanotubes on silver coated glass substrates for field emitters

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Abstract

In this study, we prepared the thick films with catalysts on the soda lime glass substrates using solution deposition method and sol-gel methods, respectively. These two methods were commonly used to prepare films in the optoelectronic techniques for low cost. Then, the CNTs were grown on the substrates by microwave plasma enhanced chemical vapor deposition (MPCVD) at low temperature.

The first method prepared catalysts was solution deposition method. The Ni particles were prepared by solution deposition method. Then the Ni particles were coated on the surfaced of Ag powders as the pastes of Ni/Ag. The pastes of Ni/Ag were coated on the glass substrates. The other method was sol-gel method. The gel of Ni catalysts was synthesized by sol-gel method. Next the Ni gel was coated by spin-on glass technology (SOG) on Ag film using screen printing method.

The as-deposited samples with Ni nanoparticles were synthesized by MPCVD at low temperature with H_2/CH_4 gas. Various parameters were introduced to understand the growth mechanism of CNTs. The characterization, using scanning electron microscopy and transition electron microscopy showed great uniformity and distribution and the CNTs were curved with many defective edges.

The field emission measurement showed a low turn-on voltage of 3.2 V/μm in the solution deposition method and an optimal turn-on voltage of 5.4 V/μm in the sol-gel methods, respectively. The CNTs grown at low temperature showed potential for nano-manipulation.