Growth and characteristics of density-controlled carbon nanotubes

Student : Shih-Yu Chan Advisor : Dr. Chia-Fu Chen

Department of Materials Science and Engineering

National Chiao-Tung Unerversity

Abstract

In this study, a unique morphology of octopus-like nanostructure was produced in an argon-ambient high temperature furnace. Subsequently, carbon nanotubes (CNTs) with various densities could be grown relating to the octopus-like nanostructure in bias assisted microwave plasma chemical vapor deposition system.

Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) with energy dispersive spectroscopy (EDS) of octopus-like nanostructure demonstrated that the head part is mixture of gold, nickel, silicon and oxygen elements and the feet part is amorphous silicon oxide. The alloy-like head part was around 300 nanometers in diameter and SEM images showed great uniformity in size and distribution. TEM observations and electron diffraction analyses revealed that all feet part nanowires are amorphous and homogeneous without any crystalline domains. Various heat treatment parameters were introduced to understand the growth mechanism of octopus-like nanostructure. It indicate that the growth of octopus-like nanostructure is analogous to the solution-liquid-solid (SLS) process.

The CNTs could be grown with different density according to the atomic percent of nickel in octopus-like nanostructure. The field emission properties of CNTs with different density were measured. The lowest turn on voltage at 2.2 V/μm and highest enhancement factor at 2386 was obtained from the lowest density of CNTs with density of 3.3×10^{7} cm^{-2}.