Low Temperature Growth of Single-WalledCarbon NanotubesUsing Plasma-Assisted Chemical VaporDeposition System

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Single-walled carbon nanotubes (SWNTs)have attracted much attention due to both their outstanding physical propertiesand their nanoscale dimensions. Although SWNTs canbe obtained by several processes, the most prevailing method to control tubestructure, growth direction, diameter, and chirality, would be a thermalchemical vapor deposition (TCVD). However, the high temperature operation ofthis method limits the industrial accessibility. Plasma-enhanced chemical vapordeposition (PECVD) is a well-known for growth temperature reduction althoughthe SWNTs grown by PECVD are generally perpendicular to the substrate inconventional vertical chamber along the electric field line, which limits the furthermanipulation of SWNTs.

We here demonstrate thelow temperature growth of SWNTs using a plasma-assisted TCVD system. The systemis made of 1 inch horizontal quartz tube and composed of inductively coupledplasma (ICP) production region for efficient decomposition of feedstock andTCVD region for SWNTs growth region. The growth substrate installed at thecenter of the TCVD region and varied the distance from the plasma generationregion to find avoid probable ion damages. We used iron thin film and ethylenegas as growth catalyst and feedstock, respectively. Optical emission spectroscopywas used to analyze ion and active species in the plasma with respect to theprocess parameters, such as plasma power, pressure, gas composition, and distancefrom the plasma formation region. The detail of the results will be discussedat the meeting.