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Structural Control of VA-MWNTs by Dual-RF-Plasma CVD JITENDRA MENDA, LAKSHMAN VANGA, BENJAMIN ULMEN, YOKE KHIN YAP, Michigan Technological University, ZHENGWEI PAN, ILIA IVANOV, ALEX PURETZKY, University of Tennessee/ORNL, DAVID GEOHEGAN, ORNL — Plasma enhanced CVD is the only known technique for growing vertically-aligned multiwalled carbon nanotubes (VA-MWNTs) at controllable tube densities. These VA-MWNTs are important for electron field emission and sensors. Previously, these VA-MWNTs were grown by a one-plasma approach and have highly distorted structures. Here, we show that dual-RF-plasma enhanced CVD offers unique capability for controlling the graphitic order and diameters of VA-MWNTs. We decoupled two plasmas in a parallel-plate configuration. One of them is applied on the top electrode and responsible for the decomposition of methane gas. Another one is applied on the substrates and initiated a negative dc bias voltage. Ni catalysts are used for the growth. We have examined the effects of catalyst film thickness, growth temperatures, and plasma parameters on the structural properties of VA-MWNTs. High-resolution transmission electron microscopy and Raman spectroscopy indicate that the diameters and graphitic order of VA-MWNTs increased with the increase of the RF power to the top electrode. An increase of substrate biasing also resulted in bigger tube diameters, but decreased when excessive biasing is applied. There is a minimum substrate biasing and RF power required for the growth of VA-MWNTs with enhanced graphitic order.

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