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Growth of Vertically Aligned Carbon Nanotube Films: Single- versus Multi-walled SANJU GUPTA, Southwest Missouri State University, YUNYU WANG, ROBERT NEMANICH, NCSU — Vertically aligned high density small diameter carbon nanotube films were deposited by microwave CVD technique. The iron catalyst was prepared by E-beam evaporation on thermally grown silicon dioxide n-type Si(100) substrates. Experiments show that by continuous reduction in the thickness of Fe ($\sim$ 3-5), smaller diameter carbon nanotube can be achieved. Scanning electron and high-resolution transmission electron microscopy show that the diameter of carbon nanotubes ranged $\sim$ 1 - 5 nm and the films are comprised of both the single- and double-wall carbon nanotubes. Visible Raman spectroscopy was used to further verify the diameter of nanotubes. A thick iron film (80 nm) was also used to grow nanotubes for comparison. The results show that the catalyst islands become greater than hundred nanometers with increasing thickness and induce multi-wall and bamboo-like microstructures. While for thinner layer of iron films smaller sizes of catalyst particles/droplets produce hollow concentric tubes without bamboo structure and with less number of walls (single-wall and double-wall carbon nanotubes). The base growth was the most appropriate model to describe the growth mechanism for our films. The electron field emission properties such as field electron emission microscopy (FEEM) in conjunction with the temperature dependence (T-FEEM) were measured to investigate the emission site density and their intensity variation. These findings in terms of the role of adsorption will be briefly discussed.

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