Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Experimental and Theoretical studies on Synthesis of Massively Aligned Single-Walled Carbon Nanotubes and Transistor Applications. KOUNGMIN RYU, CHONGWU ZHOU, Univ. of Southern California — Synthesis of highly aligned single-walled carbon nanotubes with controlled diameters is an important step towards manufacturable ultra dense carbon nanotube integrated circuits. We have successfully demonstrated the synthesis of highly aligned carbon nanotube arrays on a-plane sapphire and miscut quartz substrates. Our calculation of the Lennard-Jones potential clearly reveals that a nanotube would lie normal to the c-axis of a-plane sapphire for minimized potential energy, consistent with our experimental observation. In addition, we have developed a patterned growth method to control both the orientation and position of the aligned nanotubes. This was achieved by using photolithography to deposit catalyst at desired locations on sapphire or quartz, followed by CVD growth of the aligned nanotubes. Furthermore, based on aligned nanotubes array, we have fabricated transistors combined with Pd source/drain contact and HfO2 high-k dielectric material. The transistors show on/off ratios up to 1000000 and subthreshold swings down to around 150 mV/decade. Our aligned Nanotube growth work paves the way for a better understanding of the aligned synthesis and could eventually lead to the growth of aligned nanotubes with controlled diameters and even chiralities. Moreover, transistors approach based on massively aligned Nanotube arrays may work as a platform for explorations of nanotube integrated circuits.

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Date submitted: 20 Nov 2006 Electronic form version 1.4