Fabrication of hundreds of field effect transistors on a single carbon nanotube for basic studies and molecular devices

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Wednesday, November 4, 2015
221 MEC
1:00 to 2:25pm

Abstract:

Due to their unique structure, extraordinary electrical and mechanical properties, and unusual chemical properties, carbon nanotubes (CNTs) are of great interest for many applications. In particular, carbon nanotube field-effect transistors (CNTFETs) have been extensively investigated since they were first fabricated in 1998. Because of their excellent properties such as high conductance, high mobility, and chemical inertness, continuous progress has been carried out on applications of CNTFETs, which includes integrated circuits, nanoelectromechanical systems, and biosensors. In one specifically demanding application, individual CNTFETs are lithographically "cut" and rejoined with single molecules in the gap, to yield circuits that can be used to study the basic electrical transport properties of single molecules, and can form the basis of multiple types of sensors. Because of the extreme precision required, such devices have a yield of only a few percent, which severely limits the speed of progress in implementing CNT-molecule devices. Thus, it is desirable to optimize the CNTFETs platform with high yield and precise characterization for this application. In this talk, I will present our results on the characterization of hundreds of FETs around one single long single walled carbon nanotubes (SWCNT) on the 1×1 cm^2 silicon substrate. I will first outline the experimental details of the technique, and then discuss the performance of transfer curves of all devices fabricated out of one CNT. In the end, I will show that our measurement result with 727 devices on one substrate shows uniform and stable characteristics that significantly exceed previous reports. Overall, the presented new technique allows the goals described above to be addressed to test reproducibility of high-yield devices such as molecular conduction.

About the Speaker:

Dr. Xian Zhang received her B.S. from Shanghai Jiao Tong University, and her M.S. and Ph.D. from Columbia University. She is currently a researcher at Columbia University Energy Frontier Research Center. Her work has been published in leading scientific journals such as Nature, and presented in top international conferences. Dr. Zhang's research interest includes bio-applications of mechanical nano-devices, energy transport in nano-materials, and nano-fabrication.

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