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Properties, Synthesis, Purification, and Integration of Carbon Nanotubes for the Electronic Device Applications

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Since the discovery of carbon nanotubes (CNTs), extensive studies on this new carbon allotrope have formed a new epoch in various fields of science and technology with their excellent physical and electrical properties, and chemical functionality. In particular, understanding of their electrical properties has aroused many research groups in academy and industry to explore the nano-scale electronics based on CNTs such as transistor, memory, interconnect, logic array, and so on. Although the CNT-based electronics is regarded as a strong potential candidate for the next generation electronic devices, many technological barriers are still remained.

First of all, pure nanotubes should be separated from a mixture of single-walled, multi-walled nanotubes, and carbonaceous impurities or should be grown without impurities for reliable device performance. Another critical barrier to integrate nanotubes in devices is uncertainty and uncontrollability in positioning nanotubes on a right region. In addition, transport mechanism in CNTs should be more understood to modulate band gap of them to fabricate various device elements.

In this presentation, we introduce recent efforts to overcome the barriers focusing on transistors based on single-walled carbon nanotubes (SWNTs). Experimental and theoretical studies to control the CNT electronic structure are covered for CNT-field effect transistors. The large scale fabrication of CNT electronic elements are also givenfor the selective growth of CNT that is extendable to device integration. For the growth and purity issue of nanotubes, sono-chemical route to single-walled carbon nanotube, purification method of nanotubes integrated in transistors via sulfidation, and low temperature growth of SWNTs are demonstrated. For the positioning problems, direct photolithographic method using a mixture of catalytic precursors and conventional resists as a catalytic resist is introduced with other positioning methods of nanotubes.