香港浸會大學
HONG KONG BAPTIST UNIVERSITY
FACULTY OF SCIENCE

Department of Physics

COLLOQUIUM

Carbon Nanotube *p-n* Diodes

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January 29, 2019 (Tuesday)
11:30am – 12:30pm
T909, Science Tower, HSH Campus

Bio – LEE

Ji Ung Lee received his Ph.D. in Electrical Engineering from the University of Wisconsin-Madison in 1996. He is currently Professor of Nanoscale Engineering at SUNY Polytechnic Institute, a position he took in 2007. Previously, he was at Argonne National Laboratory from 1996-1997 as a post-doctoral scientist and at the General Electric Global Research Center from 1999-2007 as a Senior Scientist. His interest is in measuring anything small. His focus is in fabricating and characterizing p-n junctions in carbon nanotubes, graphene, transition metal dichalcogenide semiconductors, and DNA. He is the inventor of the first carbon nanotube p-n diode, for which he was awarded the 2004 GE Global Research Hull Award, the highest individual honor for a young scientist, and the 2005 NASA Nanotech Briefs Nano50 Technology Award. He is the recipient of two IBM Faculty Awards (2007, 2012). He holds 25 issued patents, has given over 70 invited talks in the area of nanoelectronics, and has over 70 published articles.

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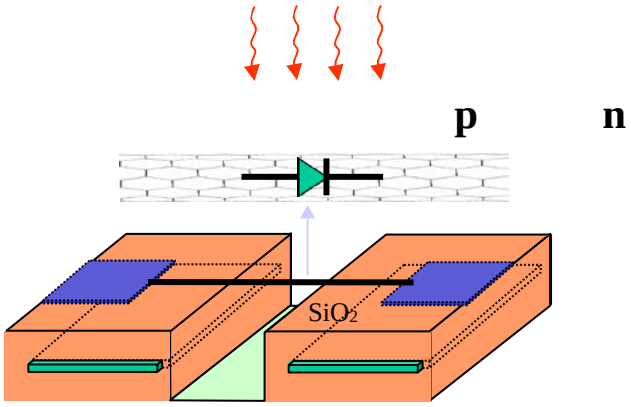
Abstract



The *p-n* junction diode is the basis for nearly all-modern semiconductor electronics, including transistors and optical devices. The *p-n* structure is also useful for studying fundamental materials properties, including the bandgap. Here, we show that a carbon nanotube *p-n* diode can provide a comprehensive probe of the electronic states and optical transitions of individual single-walled carbon nanotubes (SWNTs).

We achieve doping by using a buried split gate structure that electrostatically dopes the two halves of a single nanotube. The resulting diode can exhibit ideal diode behavior, the theoretical limit of performance for any diode. In the photocurrent spectra, an alternating sequence of resonant peaks from the dissociation of excitons and exciton-phonon bound states, for the lowest and higher electronic subbands, is observed. These peaks provide a unique signature of the nanotube chirality and diameter.

Using these properties, we attempt to measure the bandgap of individual intrinsic nanotubes, which still remains an outstanding measurement challenge. We show that many-body effects dominate all aspects of the nanotube electronic states and complicate the measurement of the most important property of semiconducting carbon nanotubes.

All Interested Are Welcome!