

## Talk-3

# Graphene and Carbon Nanotubes

Riichiro Saito

*Department of Physics, Tohoku University, Sendai 980-8578, Japan*

We present a general introduction to science of new materials made of only carbon atoms, graphene and carbon nanotubes. Graphene and carbon nanotubes have been widely investigated over the world since these materials are considered to be a candidate of post Si semiconductor materials for both electronics and opt-electronics devices. A great advantage of graphene and carbon nanotubes for the application to the devices is its high mobility (a properties of physics which indicates how fast the electron or hole can move) more than  $100,000\text{cm}^2/\text{Vs}$  even at the room temperature. Thus we expect 1THz operation of a single nanotube device. Further, depending on the diameter and helical structure called chirality, a single wall carbon nanotubes can be either metallic and semiconducting properties. For semiconducting nanotubes, we expect a single photon opto-electronic device such as light emitted diode (LED).

In this talk, we talk what we obtained so far and what are our challenges for the nanotubes technology and physics. We also discuss the similarity of nanotube physics to the elemental particle physics and possible application of graphene and nanotubes.

### References:

“Physical Properties of Carbon Nanotubes” by R. Saito, G. Dresselhaus and M. S. Dresselhaus, Imperial College Press (1998).

“Carbon Nanotubes”, Eds. A. Jorio, G. Dresselhaus and M. S. Dresselhaus, Springer (2003).

“Carbon Nanotube electronics and photonics” by P. Avouris, Physics Today, Jan. 2009.