

21COE Programme: Mechanical Systems Innovation Open Seminar

21COE Programme: Mechanical System Innovation 16th Open Seminar 2005 will be held as follows. Any participants will be welcome.

Invited Speaker : Junichiro Kono, (Associate Professor of Electrical and Computer Engineering, Rice University, Department of Electrical and Computer Engineering)

Title : Spectroscopy of Single-Walled Carbon Nanotubes

Date & Time: 20th December 2005 (Tuesday), 14:00~15:30

Place: The University of Tokyo, Engineering Building No.8, 2nd Floor,
Meeting Room (8-226)

Abstract:

This talk will describe our recent optical experiments on single-walled carbon nanotubes (SWNTs) probing the states and dynamics of 1-D carriers and excitons [1-7]. We have carried out a series of magneto-optical and ultrafast optical studies of micelle-suspended SWNTs in aqueous solutions. Through high-field magneto-optical experiments, we investigated the influence of a tube-threading magnetic flux on the band structure of semiconducting SWNTs for the first time [2, 4]. The magnetic flux breaks the time-reversal symmetry and thus lifts the degeneracy between 'right-handed' and 'left-handed' electrons, and the amount of state splitting is determined by the Aharonov-Bohm phase. We show that this field-induced symmetry breaking overcomes the Coulomb-induced intervalley mixing which is predicted to make the lowest exciton state optically inactive (or "dark") [6]. Through ultrafast pump-probe experiments [1, 3, 5, 7], we have provided a wealth of new information on the dynamics of carriers and excitons in semiconducting SWNTs. Both intraband and interband dynamics will be discussed in detail and various characteristic time scales will be given. In addition, the stability of 1-D excitons against a Mott transition [5], a 1-D manifestation of the Burstein-Moss effect via pH dependence [1, 3], and the generation and detection of coherent phonons (radial breathing modes) in the time domain [7] will be presented and discussed.

1. G.N. Ostojic et al., Phys. Rev.Lett. 92, 117402 (2004)
2. S.Zaric et al., Science 304, 1129 (2004)
3. J. Kono et al., Appl. Phys. A 78, 1093(2004)
4. S. Zaric et al., Nano Lett. 4, 2219 (2004)
5. G.N. Ostojic et al., Phys. Rev. Lett. 94, 097401 (2005)
6. S. Zaric et al., Phys. Rev. Lett., accepted for publication <http://arxiv.org/abs/cond-mat/0509429>
7. Y.-S. Lim et al., in preparation.

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