



Global COE program "Electronic Devices Innovation" Global Seminar

Dynamics of One-Dimensional Electrons, Phonons, and Excitons in Carbon Nanotubes

27 February, 2009 13:30 ~ 15:00

Room E3-316, Division of Electric, Electronic and Information Engineering,
Graduate School of Engineering, Osaka University, Suita, Osaka, Japan

Speaker

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Abstract

Single-walled carbon nanotubes (SWNTs) represent one of the most direct realizations of a one-dimensional (1-D) electron system available today. Since their discovery in 1993, their exotic physical, chemical, and mechanical properties have been extensively studied. They are one of the leading candidate technologies to unify electronic and optical functions in nanoscale circuits. At the same time, they provide ideal model 1-D condensed matter systems in which to explore exotic 1-D physics. This talk will describe our recent optical studies of SWNTs using a variety of spectroscopy methods [1-6], revealing some unusual properties 1-D carriers, phonons, and excitons. I will discuss how a tube-threading magnetic flux can modify the band structure and excitonic states of semiconducting SWNTs in a truly exotic manner through the Aharonov-Bohm phase [1-3]. In particular, we demonstrate that such a symmetrybreaking magnetic field can dramatically "brighten" an optically-inactive, or dark, exciton state at low temperature. Finally, I will describe our recent observation of coherent phonons of the radial-breathing mode in SWNTs [5,6]. We have proven coherent phonon spectroscopy to be a powerful method for determining phonon and exciton energies in an ensemble of SWNTs with different chiralities.

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3. A. Srivastava *et al.*, Phys. Rev. Lett. 101, 087402 (2008).
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5. Y.-S. Lim *et al.*, Nano Lett. 6, 2696 (2006).
6. J.-H. Kim *et al.*, Phys. Rev. Lett. 102, 037402 (2009); <http://arxiv.org/abs/0812.1953>.

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