CPP 27 Nano tubes and fibres

Zeit: Dienstag 14:00–15:00 Raum: TU C243

CPP 27.1 Di 14:00 TU C243

Chirality dependence of electronic and vibrational properties in carbon nanotubes: a resonant Raman study — •Hagen Telg[1], Janina Maultzsch[1], Maria Machón[1], Stephanie Reich[2], Christian Thomsen[1], and Frank Hennrich[3] — [1]Institut für Festkörperphysik, Technische Universität Berlin, Germany — [2]Department of Engineering, University of Cambridge, United Kingdom — [3]Institut für Physikalische Chemie, Universität Karlsruhe, Germany

Many technological applications of carbon nanotubes require the knowledge of the exact helical structure of the tubes applied. Using resonant Raman techniques we assigned the low energy Raman modes, the so called radial breathing modes (RBM), and the optical transition energies to specific nanotube structures (n_1, n_2) [1]. Based on this assignment, which for the first time includes metallic nanotubes, we analyzed the Raman cross section as a function of various structural properties like the chiral angle or the nanotube family $\nu = (n_1 - n_2) \bmod 3$. We also observed deviations of the linear relation between the tube diameter and the inverse RBM frequency and an influence of the solvent the nanotubes were dispersed in. Our experimental results agree well with predictions from theory. We extended our resonant Raman measurements to the other vibrational modes of carbon nanotubes with regard to the assignment made.

[1] H. Telg *et al.*, Phys. Rev. Lett. **93**, 177401 (2004)

CPP 27.2 Di 14:15 TU C243

Raman cross section of single-walled carbon nanotubes — •Janina Maultzsch[1], María Machón[1], Stephanie Reich[2], Hagen Telg[1], and Christian Thomsen[1] — [1]Institut für Festkörperphysik, Technische Universität Berlin — [2]Departement of Engineering, University of Cambridge, UK

We determine the absolute Raman cross section of single-walled carbon nanotubes both experimentally and by *ab-initio* calculations. Normalizing the measured Raman intensity to the second-order Si signal, we found for the radial breathing mode of an individual tube $dS/d\Omega = 1.1\,\mathrm{m}^{-1}\mathrm{sr}^{-1}$. The theoretical value obtained from *ab-initio* calculations is by only one order of magnitude smaller. We discuss these results with respect to single and double-resonant Raman scattering. The *relative* Raman intensity for different tube structures agrees very well with the systematic dependencies predicted by theory.

CPP 27.3 Di 14:30 TU C243

UV Raman measurements of very small nanotubes grown in zeolite — •María Machón[1], Janina Maultzsch[1], Pascal Puech[2], Stephanie Reich[3] und Christian Thomsen[1] — [1]Institut für Festkörperphysik, Technische Universität Berlin, Hardenbergstrasse 36, 10623 Berlin, Germany — [2]Laboratoire Physique des Solides de Toulouse UMR-CNRS 5477, IRSAMC, Université Paul Sabatier, 118 Route de Narbonne, 31062 Toulouse, France — [3]Cambridge University, Engineering Department, Trumpington Street, Cambridge CB2 1PZ, United Kingdom

We present a UV resonant Raman study of the smallest single-walled nanotubes, grown in the channels of zeolite crystals. The size of the zeolite channels limits the diameter of the nanotubes and its shape forces their alignment, both exceptional characteristics for nanotube samples. The Raman spectrum presents great differences with that of bigger nanotubes. They may be related to the extremely small diameter of the nanotubes or to the symmetry breaking due to the environment. We discuss our measurements in light of the double resonance theory. Particularly, the peak at $\approx 650\,\mathrm{cm}^{-1}$, resonant at an energy of about 3.4 eV suggests the presence of smaller nanotubes than supposed up to now, i.e., with a diameter under 4 Å.

CPP 27.4 Di 14:45 TU C243

Thiophene nanofibers on mica — •Laxman Kankate, Frank Balzer, and Horst Niehus — Humboldt-Universität zu Berlin, Institut für Physik / ASP

Recently, we have demonstrated the dipole assisted self-assembly of para-hexaphenyl (p-6P) molecules into mutually parallel, blue-light emitting nanofibers on mica [1]. Thiophenes (α-quaterthiophene, α-4T, and α-sexithiophene, α-6T) condense into single-crystalline nanofibers on mica after vacuum sublimation, too, but with less mutual alignment. Optical properties and morphology of the nanofibers are studied by fluorescence microscopy, optical spectroscopy and atomic force microscopy. Thiophene nanofibers are mainly aligned along three different directions on the surface, whereas p-6P fibers only exhibit two different orientations. Polarized luminescence from single fibers is related to their morphological properties and compared to aggregates from other organic molecules.

1. F. Balzer and H.-G. Rubahn, Appl. Phys. Lett. 79 (2001), 3860 - 3862.