be observed as stepwise quenching of PL intensity. By analyzing the relative amplitudes of quenching steps, the range of exciton excursion along the nanotube during their lifetime was found be ~100 nm. In this study we describe a refined experimental methodology for quantifying exciton mobility of individual SWCNTs. We report exciton ranges of 140-240 nm in different environments that correlate weakly with PL intensity. These results are consistent with a model of localized SWCNT excitons having substantial mobility along the nanotube axis. An approximate proportionality was deduced between exciton range and the square root of excitonic lifetime indicating that exciton motion is diffusional and that it depends systematically on environment. However, exciton ranges measured for a variety of (n,m) structures indicate no substantial dependency on chirality, diameter and PL intensity.

Poster Board | 107

Photophysics of polymer wrapped Single–Walled Carbon Nanotubes

Jia Gao, *University Of Groningen* | **Maria Antonietta Loi**, *University Of Groningen*

Recently, polyfluorene homo- and copolymers have proven to be very effective in the dispersion of single-walled carbon nanotubes (SWNTs), showing unique selectivity for a narrow distribution of semiconducting species [1,2]. The photophysical properties of such hybrids are extremely interesting because they offer the possibility to study the interaction between the polymer and SWNTs with minimal influence from metallic components. We report on the properties of poly (9,9-dioctylfluorenyl-2,7-diyl) (PFO)-wrapped SWNTs. We found that the photophysical properties of the dispersed SWNTs are strongly influenced by the solvent, the SWNT-polymer weight ratio and post- processing treatment [2]. Time-resolved photoluminescence measurements show a variation of the decay of (7,5) tubes from a few picoseconds to tens of picoseconds. It is rationalized that the difference is due to inter-tube exciton energy transfer from larger to smaller band gap tubes, and clearly such interaction became more efficient with the increase of the residual bundles in the dispersion. Moreover, by means of low temperature time-resolved photoluminescence measurements we gain a deep understanding of the dynamics of 'bright' excitons in semiconducting nanotubes. [1] F. Chen, B. Wang, Y. Chen, L. -J. Li, Nano Letters. 2007, 7, 3013 [2] J. Gao, M. A. Loi, The European Physical Journal B-Condensed Matter. DOI: 10.1140/epjb/e2009-00420-0

Poster Board | 116

Optical properties and electronic structure of (6,5)/(6,4) single wall carbon nanotubes

Thomas Pichler, *University of Vienna* | **Katrien De Blauwe**, *University of Vienna* | **Duncan Mowbray**, *Donostia Science Center San Sebastian* | **Paola Ayala**, *University of Vienna* | **Ferenc Simon**, *University of Vienna* | **Angel Rubio**, *Donostia Science Center San Sebastian* | **Patrick Hoffman**, *Helmhotz Center Berlin* | **Hidetsugu Shiozawa**, *Surrey University* | **Yasumitsu Miyata**, *Nagoya University* | **Hans Kuzmany**, *University of Vienna* | **K Yanagi**, *Tokyo Metropolitan University* | **Hiromichi Kataura**, *AIST Tsukuba*

Due to the growing number of applications of small diameter single wall carbon nanotubes (SWCNTs) in opto- electronics and biological imaging, there is a strong need for better understanding their electronic properties. This presentation reports on a detailed analysis of the electronic structure of (6,5)/(6,4) nanotubes using high energy spectroscopy and optical techniques as probes. First the distribution and relative fraction of the two constituents are elucidated using optical, luminescence and resonance Raman spectroscopy. The details of the Resonance will be compared to the complementary resonance Raman response of (6,5),(6,4) inner tubes in DWCNT grown from ferrocene precursors with special emphasis to the influence of different van der Waals interactions. In the second part we will present the detailed valence and conduction band response of these narrow diameter tubes using x-ray absorption and photoemission as probes. For thick diameter tubes the results of these measurements allow a direct comparison to tight binding and ab-initio calculations. For the narrow diameter tubes these calculations are influenced by curvature effects giving rise to modified band structure and excitation spectrum. Here we compare the observed electronic structure and optical properties to recent ab-initio calculations. Work supported by the DFG projects PI 440 3/4/5 and FWF project P21333-N20.

Poster Board | 119

Thermal light emission from suspended films and individual carbon nanotube transistors

Elyse Adam, *École Polytechnique de Montréal* | **Benoit Cardin St-Antoine**, *École Polytechnique de Montréal* | **Pierre Lévesque**, *Université de Montréal* | **David Ménard**, *École Polytechnique de Montréal* | **Richard Martel**, *Université de Montréal*

In the last few years, many papers reported on the light emission from electrically excited individual and network carbon nanotube transistors. Most of these works ascribed the emission to originate from electroluminescence. There are however a few reports on possible thermal contributions to the emission.[1-3] To clarify this question, we measured light emission spectra from two different types of CNT devices where thermal effects are expected in order to extract the spectral characteristics of the emission. The first type is a macroscopic suspended carbon nanotubes film where thermal radiation from Joule heating is expected. The second type is composed of individual carbon nanotube transistors deposited on a substrate and measured in vacuum. For both types of devices, an agreement between the Planck's formula and the spectra has been found at high bias. This indicates that the light emission at high bias arises mainly from heat. We compared these thermal spectra with typical electroluminescence spectra and extracted the main spectral signature from both regimes. While the thermal spectra follow the Planck's law, the electroluminescence spectra show a peak coming from excitonic recombinations. Both spectral signatures can be observed on the same devices by changing the operating conditions. [1] Marty et al., Phys. Rev. Lett. 96, 136803 (2006) [2] Mann et al., Nat. Nano. 2, 33 (2007) [3] Lefebvre et al., Phys. Status Solidi RRL, 3, 199 (2009)

Poster Board | 122

Exciton diffusion in air-suspended (9,8) carbon nanotubes

S. Moritsubo, *Institute of Engineering Innovation, The University of Tokyo* | **T. Murai**, *Institute of Engineering Innovation, The University of Tokyo* | **T. Shimada**, *Institute of Engineering Innovation, The University of Tokyo* | **Y. Murakami**, *Global Edge Institute, Tokyo Institute of Technology* | **S. Chiashi**, *Department of Mechanical Engineering, The University of Tokyo* | **S. Maruyama**, *Department of Mechanical Engineering, The University of Tokyo* | **Y. K. Kato** *Institute of Engineering Innovation, The University of Tokyo; PRESTO, Japan Science and Technology Agency*

Understanding of exciton dynamics in single-walled carbon nanotubes is essential for developing carbon-based nanoscale optoelectronics. In particular, diffusion of excitons governs the exciton-exciton annihilation process, which in turn determines the efficiency of optical emission from nanotubes. Here we report direct measurements of the diffusion length of excitons in air-suspended single-walled carbon nanotubes [arXiv:1003.0733]. Individual nanotubes are identified by photoluminescence imaging, while their lengths and chiral indices are determined by excitation spectroscopy and polarization measurements. With data obtained from 35 individual (9,8) carbon nanotubes, we are able to extract the exciton diffusion length by comparing the dependence of photoluminescence intensity on the nanotube length with numerical solutions of diffusion equations. We find that the diffusion length is at least 610 nm, which is substantially longer than those reported for micelle-encapsulated carbon nanotubes. The apparent diffusion length becomes shorter with higher excitation powers, consistent with exciton-exciton annihilation effects.