Zero-bias anomalies in multisection carbon nanotube FETs

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Carbon nanotube field effect transistors (CNFETs) with high transparency contacts show maxima of differential conductance at zero bias voltage [1]. These zero-bias anomalies (ZBAs) occur at large negative gate voltages and in narrow gate voltage ranges (about 1 V wide). Our proposed explanation is superconductivity in the nanotubes, occurring when the gate voltage shifts the Fermi energy into van Hove singularities of the electronic density of states. Here we probe this scenario using 3 FETs fabricated from different sections of one semiconducting carbon nanotube. Source and drain electrodes were patterned by e-beam lithography to achieve FET lengths of 500 nm, 1500 nm and 7000 nm, respectively. All devices showed high transparency contacts to their Pd electrodes. We report the observation of pronounced ZBAs in the multi-section CNFETs, their magnetic field (up to 7 T) and temperature evolution, and the modulation on the ZBAs by Fabry-Perot oscillation.

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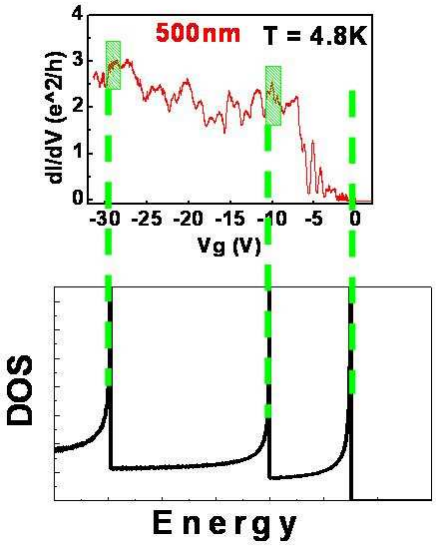
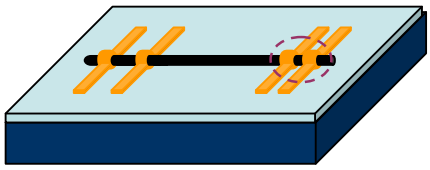
References:

[1] J. Zhang, A. Tselev, Y. Yang, K. Hatton, P. Barbara, and S. Shafraniuk, Zero-bias anomaly and possible superconductivity in single-walled carbon nanotubes, Phys. Rev. B, **74**, 155414 (2006).

Figures:





Top plot: Differential conductance vs. gate for the 500 nm section (see section circled by a dotted line in the sample layout). The shaded green areas indicate the locations of the ZBAs and the green dotted lines are traced for a tentative alignment with van Hove singularities in the DOS (bottom plot).