Anisotropic dielectric response and local field effects in single wall carbon nanotubes

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SWCNT are archetypical 1D systems, with peculiar anisotropic electronic properties. The depolarization effects concomitant with dielectric screening of electronic transitions are crucial in optical probes like Raman, optical absorption and luminescence. Only recently 956;m thick freestanding films of vertically aligned SWCNT became available and were characterized regarding the polarization dependent optical response[1]. The plasmon response in electron energy loss spectroscopy is a direct access to the full energy and momentum dependent dielectric function. The full plasmon dispersion allows distinguishing between the effective dielectric screening and depolarization effects. The sparse morphology of the aligned freestanding mats gives rise to a substantial increase in local field corrections as compared to earlier studies on bulk aligned SWCNT[2]. We find two novel branches in the 960; and 963; plasmon, respectively. Varying the effective transverse and parallel momentum transfer conclusively identifies the dispersive branches as parallel and non dispersive branches as perpendicular with respect to the SWCNT axis. These novel findings provide an unprecedented experimental insight into local field and depolarization effects in one dimensional electronic systems.

[1] Y. Murakami et.al. Phys. Rev. Lett. 94, 087402 (2005) [2] X. Liu et al. Synth. Met. 121, 1183 (2001)