Low Temperature Magneto-Photoluminescence of Single Walled Carbon Nanotubes (SWCNTs)

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We report low temperature photoluminescence data using polarized excitation and collection of emission from nanotubes both parallel and perpendicular to an applied magnetic field (up to 19.5T). We find both alignment-dependent intensity changes and bandgap shifts for polyvinylpyrrolidone- wrapped nanotubes dispersed in solution and dry drop cast polymer matrix films.

Both solution and film samples show comparable PL signal strengths on cooling to 4K and exhibit shifts in PL positions by as much as 30meV. Differences in PL peak shifts with temperature are caused by differences in strain configuration of the nanotubes in the two environments.

For the frozen solution we observe strongly enhanced PL intensities with increasing field (factors up to 2.5) with the smallest diameter, perpendicularly aligned tubes showing the greatest increase. We attribute this behaviour to changes in the electron-hole transport in the tubes, with the additional Lorentz force acting to reduce the probability of carrier diffusion away from the original excitation point. We observe stronger redshifts of the band gaps in tubes parallel rather than perpendicular to the applied field. The shifts are comparable to those expected due to the additional Aharanov-Bohm flux threading the tubes. Perpendicularly aligned tubes still show significant redshifts however, suggesting other factors such as excitonic binding may also need to be taken into account.

The film sample shows magneto-shifts of similar magnitudes to those seen in solution but very different PL intensity behaviour, suggesting the strong polymer wrapping around the suspended nanotubes could also play an important role in electron-hole recombination.

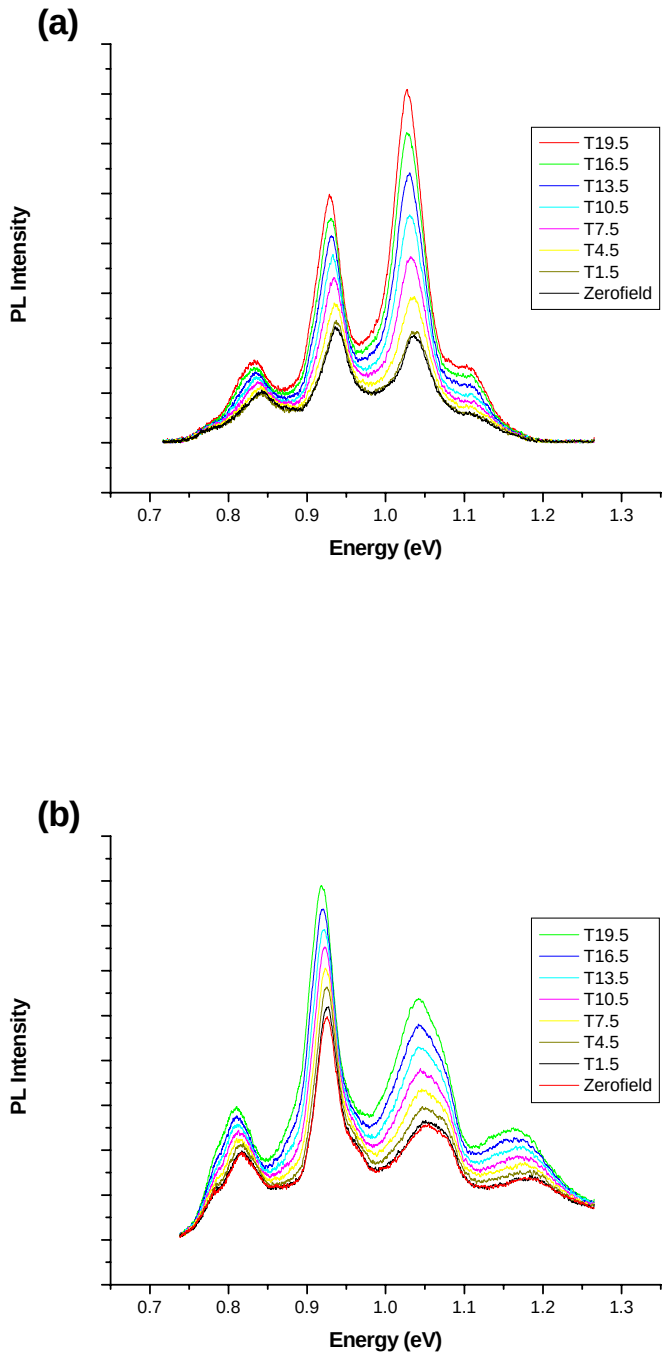

Figure 1 Magneto-PL spectra for (a) solution and (b) polymer matrix suspended perpendicularly aligned SWCNTs.