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Unravelling inter-wall interactions on optical transition in double-wall carbon nanotubes

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Double-wall carbon nanotube (DWCNT) is one of the most fundamental systems to examine the effect of inter-wall interactions on the optically-allowed electronic transitions. To study the inter-wall coupling in DWCNTs in detail, we develop a direct preparation method of long and clean suspended individual DWCNTs on an open slit by using alcohol catalytic chemical vapor deposition (ACCVD), which enables us to apply two complementary experimental techniques, Rayleigh scattering spectroscopy and TEM observations, on the same DWCNT for characterizations of electronic transition energies in DWCNTs with defined inner and outer wall structures.

We systematically examined tens of suspended individual DWCNTs consisting of tubes with different electronic types, e.g., semiconducting@semiconducting (semi@semi) and semiconducting@metallic (semi@metallic). We found the transition energies (energy levels of ground excitons) were downshifted in all the samples. In addition, the degree of the shifts strongly depend on the type of electronic combinations, that is, the shifts in semiconducting tube in semi@metallic are much larger than those in semi@semi. Inter-wall Coulombic screening effect on intra-wall exctions explains these experimental findings. At presentation, we will discuss the experimental procedures and the interlayer coupling effects on the electronic transition energies in detail.

[1] F. Wang, et al., Science. 7, 308, 838 (2005).
[2] K. Liu, et al., Nature Nanotech. 7, 325 (2012).