

Supporting Information

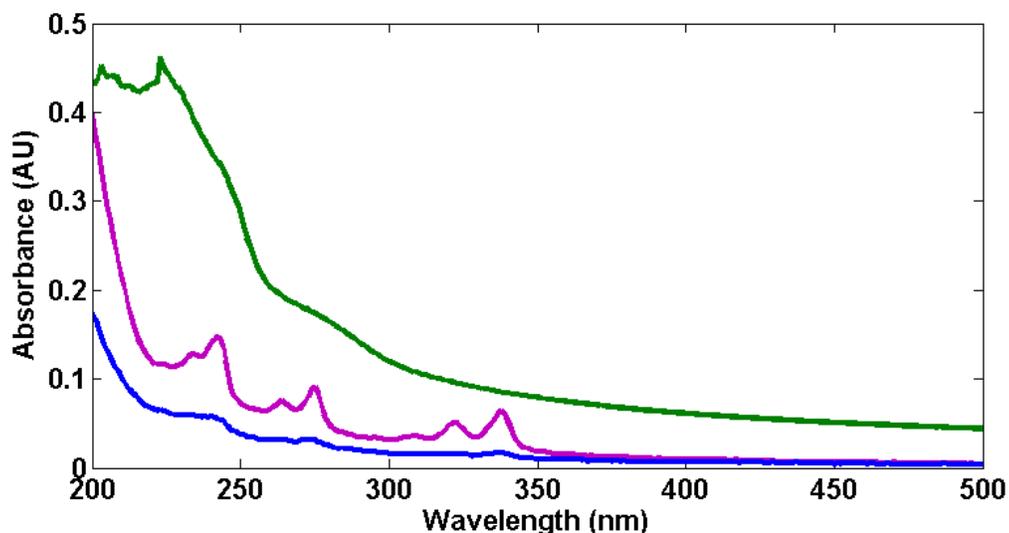


Figure S1 UV-VIS spectra of lecithin (green), pristine SWNT (blue) and lipid-SWNT assembly (violet)

The change in band gap of pristine and lecithin functionalized SWNTs is also reflected in UV-VIS spectra as shown in Figure S1. The spectral change in absorption spectra of SWNTs and lipid-SWNT assembly confirm the band gap change of SWNTs.

Depending upon the exact amount of energy (band gap energy) absorbance, the electrons at highest occupied molecular orbital (HOMO) of valence band reaches at Fermi level and a very small population may also reach directly to the Lowest occupied molecular orbital (LUMO) of conduction band. The electrons excited electrons again reaches to LUMO of conduction band upon further energy absorbance. But the number of available electrons in LUMO decreases with time because a maximum portion of the free electrons of HOMO are repelled by the electron cloud of the Fermi level. So a hole is generated in HOMO and the electron density increases in Fermi level. Therefore a electron-hole pair is generated. Same pair production is possible in

between Fermi level and LUMO state as well but the probability of such pair production in between two states is less. When the excited electrons relax to its ground state a circulation is created (hole-electron-hole) in between these states. A circulation of electron-hole pair production takes place in between the HOMO-Fermi level (high probability) and Fermi level-LUMO of such functionalized SWNTs (self-assembly) in nanodimension. Such an electronic transition (electric dipole moment) between the electronic states creates a circulating current result a magnetic field in this nano-dimension of such self-assembly.

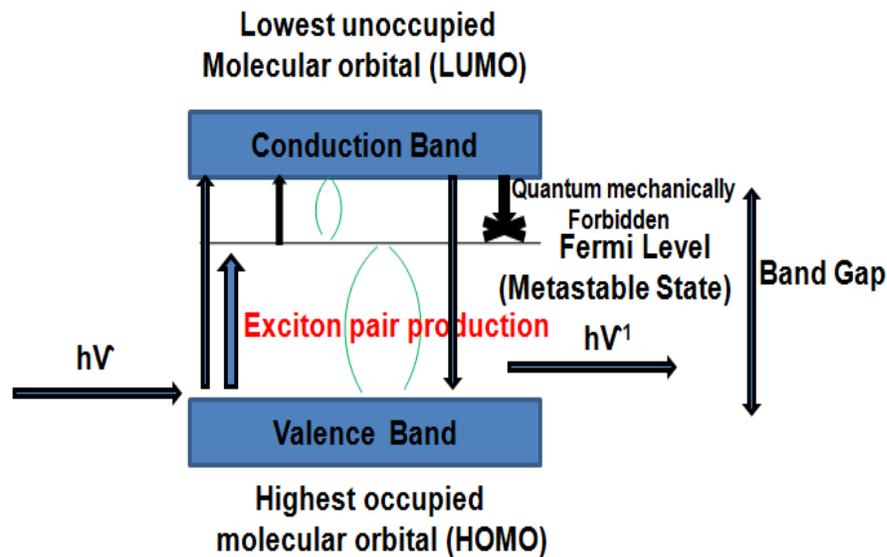


Figure S2 Probabilistic model of exciton pair production

Raman Study

The Tangential (G band) and Disordered (D band) bands of the pristine SWNT is located at 1582 cm^{-1} and 1312 cm^{-1} as shown in Figure S3^{1, 2}. The Raman spectra of pristine SWNTs significantly differ with SWNT-lipid complex prior to functionalization as shown in Figure S3. The significant intensity decrement of G band and the Raman shift of G band (1586 cm^{-1}) and D

band (1318 cm^{-1}) of such complex give the hints for the solid state functionalization. The I_D/I_G ratio is a good indicator for measuring the structural defects in SWNTs. Normally the ratio is highly asymmetric for pristine SWNTs (intensity ratio 0.25) but the ratio increases after functionalization ^{1,2}. The I_D/I_G intensity ratio is found to be 0.95 which confirms the formation of a new lecithin-SWNT self-assembly ^{1,2} during solid state functionalization process. The 2D peak shows a single Lorentzian peak at 2574 cm^{-1} .

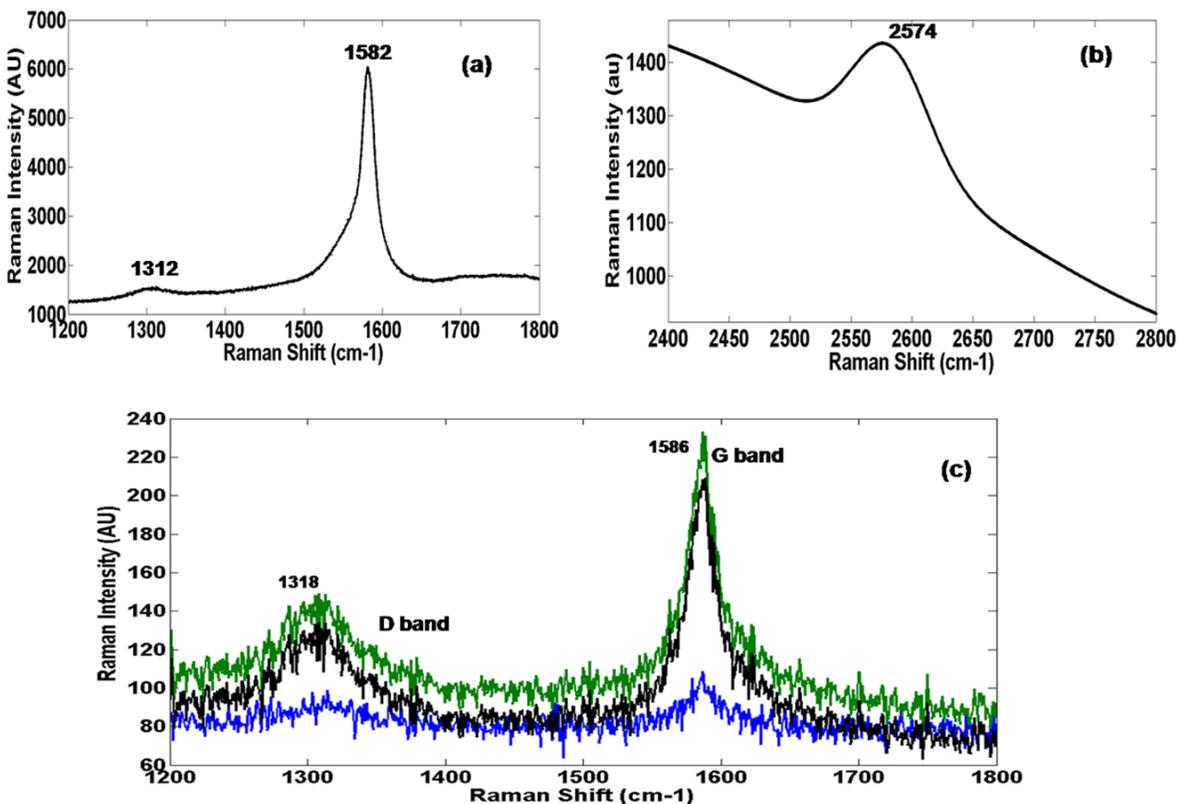


Figure S3 (a) Raman spectra of pristine SWNTs (b) 2D spectra of pristine SWNTs and (c) lipid functionalized SWNTs (blue color for 0.1 mg/ml SWNT conc., black color for 0.2 mg/ml SWNT conc. and green color for 0.4 mg/ml SWNT conc.)

Circular Dichroism Study

Figure S4 shows the entire CD spectra of pristine SWNTs, lipid and lipid functionalized SWNTs but CD signal is observed in between 200 and 300 nm.

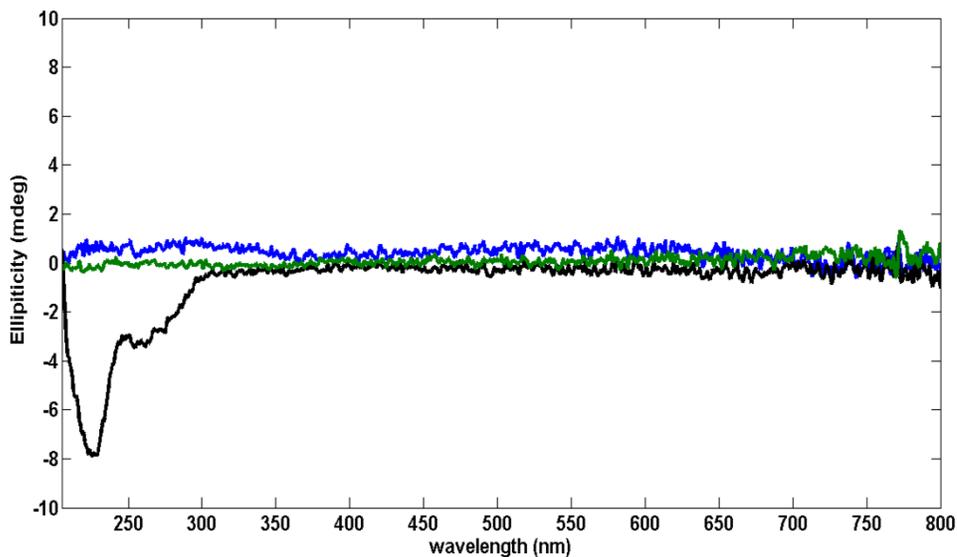


Figure S4 CD spectra of pristine SWNTs (green), lecithin (blue) and lipid-ecithin self-assembly (black)

Figure S5 (a) shows that soya lecithin exhibit the same chirality just like egg yolk lecithin but nanotube CD signal disappears with other lipids with similar nanotube concentration (see Figure S5 (b)-(d)). This means that a unique chiral structure formation appears for lecithin-SWNT self-assembly.

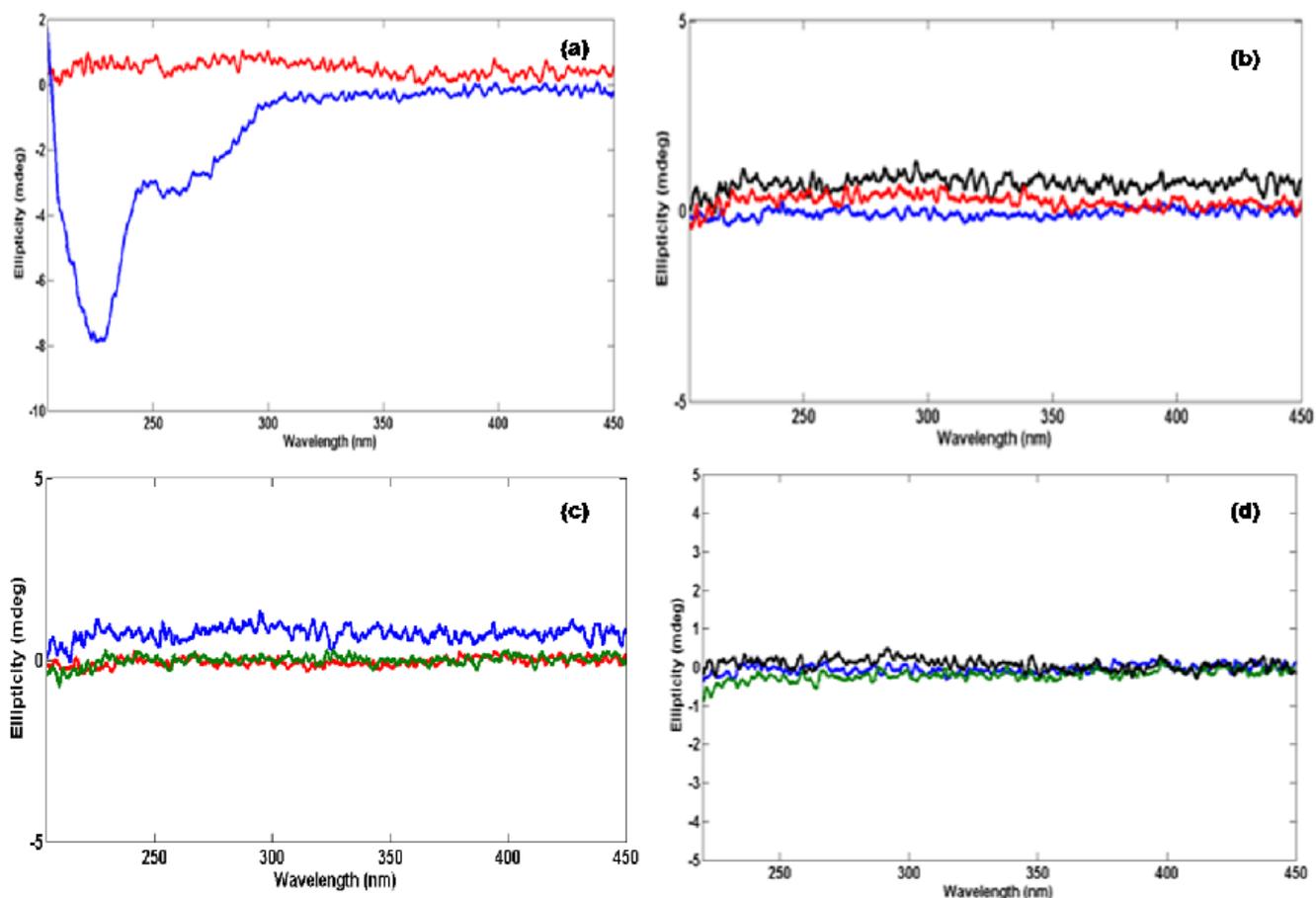


Figure S5 CD spectra of (a) soya-lecithin functionalized SWNTs (red-soya lecithin, blue-soya lecithin functionalized SWNTs); (b) DPPC functionalized SWNTs (blue-pristine SWNTs, black-DPPC, red- DPPC functionalized SWNTs); (c) DMPC functionalized SWNTs (red-pristine SWNTs, blue-DMPC, green-DMPC functionalized SWNTs); (d) L-alpha phosphatidylcholine serine functionalized SWNTs (green-pristine SWNTs, black- L-alpha phosphatidylcholine serine, blue- L-alpha phosphatidylcholine serine functionalized SWNTs).

References

1. T. Bhattacharyya, A. K. Dasgupta, N. R. Ray and S. Sarkar S, *Nanotechnology*, 2012, 23, 385304.1-385304.8.
2. T. Bhattacharyya, S. Samaddar and A. K. Dasgupta, *Nanoscale*, 2013, 5, 9231-9237.