Optical properties and optical spectroscopy studies of semiconducting single walled carbon nanotubes-based nanomaterials

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Among all the exciting properties of single-walled carbon nanotubes (SWNT), the optical properties (absorption and photoluminescence) in the NIR of semiconducting SWNT (s-SWNT) is particularly fascinating and promising for designing multifunctional nanomaterials and devices. In this talk, we will review the excitonic properties of s-SWNT and discuss how one can engineer and take advantage of their optical properties. We will also review how optical spectroscopy studies (absorption, Raman and photoluminescence) can be used to characterize properly the structure, the dispersion and the dielectric environment of s-SWNT [1,2] (figures 1-2). Finally, we will discuss possible applications based on these optical properties, eg luminescent thin films [3,4] and composites [5], biosensors and photo-thermal switches.

References

[1] Dispersion and individualization of SWNT in surfactant-free suspensions and composites of hydrosoluble polymers, F. Torres-Canas et al, J. Phys. Chem. C 119, 703 (2015)

[2] Hydroxide Ions Stabilize Open SWNT in Degassed Water, G. Bepete et al, ACS Nano 12, 8606 (2018)

[3] Dispersion and orientation of SWNT in a chromonic liquid crystal, N. Ould-Moussa et al, Liq. Cryst. 40, 1 (2013)

[4] Conductivity anisotropy of assembled and oriented SWNT, C. Zamora-Ledezma et al, Phys. Rev. E 85, 062701(5) (2012)

[5] Orientational order of SWNT in stretch-aligned photoluminescent composites, C. Zamora-Ledezma, et al, Phys. Rev. B 80, 113407 (2009)

Figures

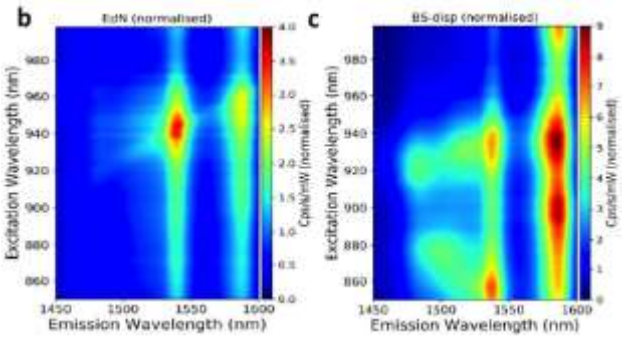

Figure 1: Compared photoluminescence excitation (PLE) maps of ''eau de nanotubes'' (left) and bile salt-stabilized aqueous dispersion (irght) of SWNT [1]

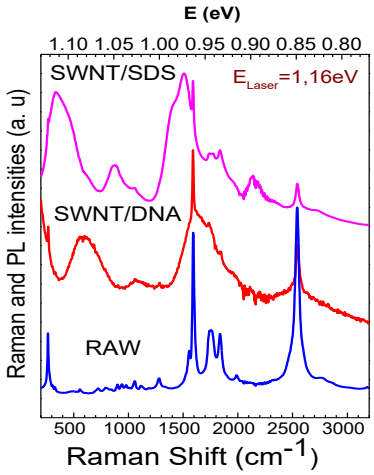

Figure 2: Coupled resonant Raman/photoluminescence (PL) studies of s-SWNT in powder and in aqueous dispersions stabilized by SDS or DNA. showing how the PL signatures are sensitive to the dielectric environment