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Lunes 11 de Diciembre de 2023 – 11:30 h
Salón de Actos de la Biblioteca

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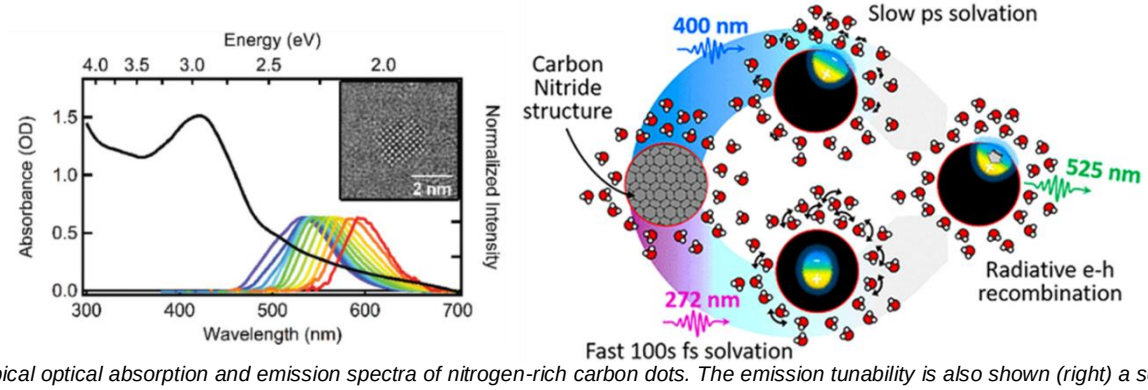
Photophysics and photochemistry of Nitrogen-rich Carbon dots investigated with ultrafast spectroscopy

Carbon nanodots (CDs) are a class of <10 nm C-based nanoparticles surface-passivated by organic moieties. They are a hot topic in nanoscience, as a versatile family of luminescent and non-toxic nanoparticles obtained by easy synthesis. This and other important features, as the tunable absorption/emission and the great electron donating capability, have caused a strong increase of the number of CD-related studies. In fact, CDs are multifunctional nanomaterials that can be exploited in devices ranging from nano-biosensing in vivo and in vitro to downconverters for LED, electroluminescent LEDs, solar cells.

Among the different CD subgroups, nitrogen-rich CDs (NCDs) have gained great popularity because of their hallmark tunable emission covering all the visible spectrum. It is widely accepted that the photoluminescence is the resultant of the radiative recombination of excitons, whose electron is localized on available empty states of the surface groups whereas the hole is buried inside the dot. However, disentangling the origin of their optical absorption and fluorescence properties, uncovering relaxation channels and interactions with solvents are some of the most debated issues in the field. Uncovering these aspects is essential for targeted applications, especially in the fields of photocatalysis, but also photovoltaics and optoelectronics. In this talk I will present the research activity carried out in my labs in the last years, which has been devoted to answer these questions by means of ultrafast spectroscopic techniques.



(left) Typical optical absorption and emission spectra of nitrogen-rich carbon dots. The emission tunability is also shown (right) a schematic the photocycle of the excitonic dynamics upon excitation of the two main transitions at 272 and 400 nm.

References :

ACS Applied Nano Materials 2020, 3 (7), 6925-6934. (DOI: 10.1021/acsanm.0c01259)

C-J Carbon Res 2018, 4 (4), 67. (DOI: 10.1039/c9cp03063h)