Carbon Dots in Water and Mesoporous Matrix: Chasing the Origin of their Photoluminescence

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Carbon-dots (CDs) are nanoparticles (diameter <10 nm) whose emission properties can be tuned by surface functionalization and the quantum yields in the blue/green range is almost competitive to those of quantum dots. To achieve photonic applications the fluorescent compounds should be embedded in suitable matrices, such as mesoporous silica (MS). The analysis of the interaction of CDs with the matrix, in terms of physical and chemical confinement of emitting compounds, is a strategic issue to fill the current knowledge gap about CDs in embedded systems.

In this talk, we present our recent results on the optical properties of microwave-synthesized carbon dots dispersed in water and in mesoporous ordered silica. By studying bare CDs and nitrogen-doped samples (nitrogen doping increases the emission efficiency) we singled out the presence of two emission bands (at about 430 and 520 nm) and we discuss their origin in terms of CDs polydispersity and distribution of green emitting centres. Once dispersed in MS, the relative contribution of the two emission bands is modified, promoting the green photoluminescence. The properties of the emission bands are studied as a function of excitation energy power and cumulative exposure time at fixed excitation energy to chase the origin of the fluorescence, looking at the interaction with the silica matrix for applications in solid-state photonics.