Carbon Nanodots: From Fundamental Insights to Biomedical Applications

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Carbon Nanodots (CDs) are an emerging family of non-toxic carbon-based nanoparticles characterized by intense and tunable light absorption-emission in the visible range. Notably, their optical behavior demonstrates exceptional sensitivity to external stimuli, such as solvent molecules, ions in solution, and other nanoparticles, offering a rich array of applications when comprehensively understood. For instance, CD emission decreases in presence of metal ions in solution because of a high electron donor capability of CDs. In contrast, CD emission can be strongly enhanced through the interaction with plasmonic metal nanoparticles, if the nanoobjects are at a certain distance from each other. The versatility of their possible optical behaviours as a function of external environment promisingly projects the use of CDs as components in biomedical nanocomposites. In addition, the surface of CDs is very easy to be functionalized with different moieties. The combination of this characteristic with the non-toxicity increases the possible use of CDs as bio-conjugated nanomaterials for drug delivery and bioimaging.

In this presentation, we will offer an overview of our research concerning CDs, elucidating their fundamental properties before delving into our recent breakthroughs in biomedical applications. Our focus will be on exploring the prospect of CDs as nanotheranostic agents and drug delivery vehicles, leveraging their versatile optical behaviors to advance precision medicine and therapeutics.