Abstract

The fluorescence of carbon dots (CDs) of <10 nm diameter has been tuned by doping N and S in one case and B in the other. Again the fluorescence of CDs has been tuned with Au nanoparticles. Finally, nonfluorescing nanohybrid CDs have been obtained. All these systems have been successfully exploited for sensing, cell imaging and biological applications.

Intriguingly fluorescing CDs have been obtained from dopamine (DA) and cysteine (Cys) mixture from hydrothermal treatment. Then Cys sensing has been made possible as Cys mediated enhanced fluorescence has been reproducibly registered. Interestingly, the intriguing fluorescence of DA and Cys mediated CDs, in aqueous medium, gets selectively quenched in the presence of trace level of acetone. The surface electronic interaction between CDs and acetone makes acetone detection possible. The as-synthesized cytocompatible CDs become an excellent fluorescent probe for live cell imaging also. Ascorbic acid (AA) with different boron precursors upon hydrothermal treatment evolves differently fluorescing B-doped CDs. It has been shown that the emission intensity of the as-prepared CDs increases with the increase in the B content in CDs. Theoretical calculation suggests that variable amount of B doping-related huge charge polarization within the carbon surface leads to the formation of surface defects causing change in the emission properties of the CDs. Then successive fluorescence quenching by Fe(III) and fluorescence enhancement by AA have been documented for their quantification from the solution phase. On the other hand, simple hydrothermal treatment of AA produces a moderately fluorescent CD that helps us to study metal enhanced fluorescence (MEF). The fluorescence platform becomes tunable with aliphatic thiol derivatized Au nanoparticles. Au has been brought into the picture because of its rich plasmon band. It is reported here that with the increase in the chain length of the thiol, the MEF becomes more pronounced. The long chain thiols work as spacers between fluorophore and metal surface. To make the study a general phenomenon, amine derivatized Ag nanoparticles has been introduced.

Furthermore, hybridization of CDs has been considered to widen the perspective of DA-Cys mediated CDs and AA prompted CDs. In the first case, Ag(0) anchoring on the CDs paves the way for sensing, catalysis and antimicrobial activity studies. The second hybrid i.e. CD- MnO_2 adduct has been tested for the fluorescence resonance energy transfer (FRET) studies. This adduct has been used for selective detection of N-acetyl-L-cysteine followed by construction of a molecular logic gate.

Keywords: Carbon dots, Doping, Metal enhanced fluorescence, Sensing, Bio-imaging, Hybridization, Antimicrobial activity, Precursor dependence, FRET, Molecular logic gate.