Abstract

The photoluminescent carbon dots (C-dots) of size less than 10 nm were fabricated from different bio-based precursors. The fluorescence property of the C-dots has been tuned by heteroatom doping with nitrogen (N), sulphur (S), and boron (B). Initially, C-dots has been synthesized from waste precursors but suffering from low quantum yield and involvement of strong acid. Later on, the C-dots has been synthesized by incorporation of biopolymer and different N, and B precursors to improve the quantum yield as well as photoluminescent property. These systems have been effectively explored for sensing, cell imaging and biomedical applications.

Intriguingly fluorescent C-dots have been acquired from waste kitchen chimney oil with the assistance of concentrated H_2SO_4. The fluorescence emission of the C-dots gets selectively quenched in the presence of trace amount of Fe(III) ions. Afterthat, N and S co-doped C-dots were synthesized from waste *Allium sativum* peel which keeps the synthesis process economical. Presence of both N and S enhances the photoluminescent property of the C-dots which were further used *in vitro* and *in vivo* bio-labeling assay. B and S doped biocompatible C-dots were obtained and the variation of optical properties is examined. Sensing platform of sugar, cytocompatibility, and hemolysis assay was investigated. On the other hand, simple hydrothermal treatment of κ-carrageenan and lemon juice and followed by surface modification produces surface quaternized N and S based C-dots with improved optical properties. Then successive fluorescence quenching by Cr(VI) and fluorescence enhancement by ascorbic acid have been documented for their quantification from the solution phase.

Furthermore, heteroatom N and S co-doped photoluminescent C-dots acquired by hydrothermal method helps us to study C-dots with high quantum yield in biomedical applications. In the first case, N and S co-doped C-dots has been tested for sensitive detection of acetone in solution as well as in human blood. The second phase includes N and S anchoring on the C-dots paves the way for cytocompatibility, fluorescent marker, and targeted cancer cell imaging.

Keywords: Carbon dots; Heteroatom doping; Sensor; Bio-labeling; Cytocompatibility; Antimicrobial activity; Fluorescent marker; Targeted cancer cell imaging; Biomedical applications