Preparation and Characterization of Nitrogen-functionalized Biochar-derived Carbon Quantum Dots

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ABSTRACT

Carbon quantum dots (CQDs) as a new series of fluorescent nanomaterials have attracted tremendous attention in recent years owning to their unique physicochemical, optical and biocompatibility properties compared with semiconductor quantum dots. The development of facile and efficient synthetic approaches of functionalized-CQDs is of critically urgency. In this study, highly blue-luminescent Nitrogen-functionalized carbon quantum dots (N-CQDs) have been prepared via a greener and simpler microwave-assisted method using Empty fruit bunch (EFB) biochar and urea as precursors. Remarkably, short reaction time under microwave irradiation (t=5 min) are sufficient to prepare luminescent N-CQDs. The effect of nitrogen loading on CQDs were investigated and characterized by FTIR, UV-vis spectroscopy, PL spectroscopy, FESEM and FESEM-EDX analysis. The as-prepared N-CQDs possessed desirable amino functional groups on the surface of CQDs. Furthermore, the obtained 0.6 g of N-CQDs exhibited a brightest blue emission under the excitation wavelength of 250 nm and exhibited excitation wavelength-dependent PL behaviour. The introduction of amino functional groups on the surface of CQDs dramatically affected the photoluminescence profiles as well as their conversion yield. It was attributed by the presence of NH2 groups which produce several surface traps level that make the N-CQDs emit light that varies with excitation energy. Furthermore, we have investigated the utilization of the as-prepared N-CQDs in algacultural system, which demonstrated that the as-obtained N-CQDs have the potential applications in augmenting photosynthesis of microalgae. As measured, the growth rate of Chlorella vulgaris was higher and the chlorophyll content (a, b and carotenoid) also increased after the addition of N-CQDs.
as compared to the control.

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