Synthesis of polychromatic carbon quantum dots for multicolor bio-imaging application

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Shape-specific carbon quantum dots (CQDs) with a well-ordered edge structure and multi-color fluorescence were prepared via monitoring the reaction time. Selecting phloroglucinol (three-fold symmetry, C_{3h}) as a precursor of CQDs is useful for directing the shape and structure of CQDs during dehydration mediated controlled growth. We report the rapid synthesis of novel shape-specific (trilateral and quadrilateral) CQDs with multi-color fluorescence emission [blue (B-CQDs), green (G-CQDs), and yellow (Y-CQDs)]. The mechanism of controlled bottom-up growth involves six-membered ring cyclization of the single precursor (phloroglucinol) through the elimination of neighbouring active -OH and -H groups in a sulfuric acid medium. We consider that the evolution of the tunable photoluminescence (PL) emission can be attributed to both the size of the conjugated domain and oxygen-/sulfur-containing edge electronic states. Furthermore, the multi-color fluorescence CQDs are successfully used as propitious fluorescent probes for multi-color cell (HeLa) and zebra fish imaging owing to an effective intracellular distribution and good biocompatibility.