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Solid-state synthesis of self-functional carbon quantum dots for detection of bacteria and tumor cells

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Highlights of this work

- Development of a simple solid-state synthesis for preparation of biofunctional fluorescent carbon quantum dots (CQDs).
- Mannose (Man) and folic acid (FA) were self-functionalized to CQDs.
- Man-CQDs can be used for selective labeling of *E. coli*.
- FA-CQDs are highly selective for folate receptor-overexpressing tumor cells.

ABSTRACT

We have developed a simple solid-state synthesis procedure to functionalize fluorescent carbon quantum dots (CQDs), using ammonium citrate as a carbon source and appropriate molecules as recognition ligands. Mannose and folic acid were used to modify CQDs to selectively label *Escherichia coli* (*E. coli*) and tumor cells, respectively. First, fluorescent-core CQDs (approximate size: 3 nm) were synthesized through carbonization of ammonium citrate *via* dry heating. In the second step, CQDs were heated with mannose and folic acid to prepare mannose-functionalized CQDs (Man-CQDs) and folic acid-functionalized CQDs (FA-CQDs), respectively, through a dehydration reaction in the solid state. Solid-state synthesis of the self-functional CQDs is achievable without a coupling agent. We optimized the labeling efficiencies of self-functional Man-CQD and FA-CQD to cells by controlling the ratio of mannose or folic acid to CQDs, as well as the reaction temperature during synthesis. The solid-state synthesized 3

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