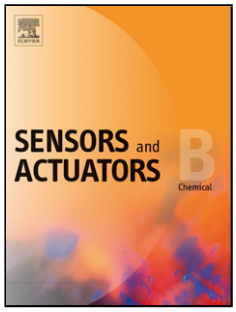

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Solid-state synthesis of self-functional carbon quantum dots for detection of bacteria and tumor cells

Irving Po-Jung Lai[a], Scott G. Harroun[b], Shiow-Yi Chen[a*], Binesh Unnikrishnan[a], Yu-Jia Li[a], Chih-Ching Huang[a,c,d*]

[a]Department of Bioscience and Biotechnology, National Taiwan Ocean University, Keelung, Taiwan

[b]Department of Chemistry, National Taiwan University, Taipei, Taiwan

[c]Center of Excellence for the Oceans, National Taiwan Ocean University, Keelung, Taiwan

[d]School of Pharmacy, College of Pharmacy, Kaohsiung Medical University, Kaohsiung, Taiwan

[*]Corresponding author: Shiow-Yi Chen, Department of Bioscience and Biotechnology, National Taiwan Ocean University, 2, Pei-Ning Road, Keelung 20224, Taiwan; Tel.: 011-886-2-2462-2192 ext. 5519; e-mail: sherry0930@ntou.edu.tw; Chih-Ching Huang, Department of Bioscience and Biotechnology, National Taiwan Ocean University, 2, Pei-Ning Road, Keelung 20224, Taiwan; Tel.: 011-886-2-2462-2192 ext. 5517; e-mail: huanging@ntou.edu.tw 2

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