Single-Layered Graphitic-C_3N_4 Quantum Dots for Two-Photon Fluorescence Imaging of Cellular Nucleus

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2015/01/30

Abstract:

Fluorescence imaging of living cells plays an essential role to study biological events. However, there are still many key factors that need to be addressed for the safe and effective imaging of living cells, such as phototoxicity, photobleaching and photothermal effect of fluorescence probes. The authors previously demonstrated that water-soluble ultrathin graphitic carbon nitride (g-C_3N_4) nanosheet shows blue light photoluminescence with high quantum yield and high stability, excellent biocompatibility and nontoxicity. In this study, they introduce a novel fluorescent probe, g-C_3N_4 single-layered quantum dot (QD), for two-photon fluorescence imaging of cellular nucleus.

The g-C_3N_4 single-layered QDs were prepared from bulk g-C_3N_4 by three steps, including the formation of porous g-C_3N_4, exfoliation of obtained porous g-C_3N_4 and ultrasonication of the porous g-C_3N_4 nanosheets into single-layered g-C_3N_4 single-layered QDs in water. The size of the obtained g-C_3N_4 QDs mainly located at ~4 nm, and they could emit strong two-photon fluorescence with the two-photon absorption (TPA) cross section as high as 28000 GM at 750 nm. The g-C_3N_4 QDs are noncytotoxic as shown by MTT assay results. The interaction studies between the g-C_3N_4 QDs and histone/ DNA showed very strong affinities. Finally, the two-photon confocal fluorescent imaging of g-C_3N_4 QDs with HepG2 cells was performed and the QDs could even match with the commercial reagent DAPI. The cost of g-C_3N_4 QDs is much lower (< 0.01 USD/ mg) than that of DAPI and other commonly used nuclear dyes, indicating the promising commercial applications of them.

References:

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