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Room-temperature Synthesis of Graphene Quantum Dots via Electron-Beam Irradiation and Their Application in Cell Imaging

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ABSTRACT: We report a room-temperature strategy for the synthesis of single-crystalline fluorescent graphene quantum dots (GQDs) via electron-beam irradiation. The precursor contained high-activity nitro groups is easy to fusion GQDs with the method. Under optimized conditions (0.02 g 1,3,6-trinitropyrene, radiation dose of 400 kGy and 10 ml 0.5 mol/L hydrazine hydrate), the GQDs exhibit highly efficient fluorescence at 475 nm with a quantum yield of 32%. The PL maximum is well corresponded with the excitation wavelength. Moreover, the single-exponential fluorescence lifetime (4.86 ns) exhibited the intrinsic PL characteristic. The pH stability in neutral and alkaline solution, solid solubility and storage time stability of GQDs are satisfactory. Their application as a safety fluorescent probe for cell imaging is demonstrated.

KEYWORDS: Graphene quantum dots, Electron-beam irradiation, Fluorescent probe, Bioimaging

1. Introduction

Graphene quantum dots (GQDs), as a zero-dimension graphene material, have raised much more attentions in comprehensive applications such as bioimaging [1-5], biosensing [6-8], light emitting diodes [9,10], solar cells [11,12], and photocatalysis [13,14] due to their unique physical and chemical properties. Recent five years, many methods, such as hydrothermal method [15-17], acid oxidation [7,18-21], electrochemical synthesis [22-25], pyrolysis [26-28], and microwave treatment