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Sustainable Science and Technology **Extended Abstract**

Track (SM)

Hit Multiple Targets with One Arrow: Pb^{2+} and ClO^- Detection by Edge Functionalized Graphene Quantum Dots and Their Applications in Living Cells

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ABSTRACT: Recently, multimodal detection of analytes through a single nanoprobe has become an eminent approach for researchers. Herein a fluorescent nanoprobe, functionalized-GQD (F-GQD), has been designed through edge functionalization of graphene quantum dots (GQDs) by 2,6-diaminopyridine molecules. The fluorescence of F-GQD is quite sensitive to medium pH, making it a suitable pH sensor within the pH range 2−6. Interestingly, F-GQD shows dual sensing of Pb^{2+} and ClO^- by entirely different pathways; Pb^{2+} exhibits fluorescence turn-on performance while ClO^- triggers turn-off fluorescence quenching. The fluorescence enhancement may originate from the Pb^{2+}-induced aggregation of the nanodots. The limit of detection (LOD) was also impressive, 1.2 μM and 12.6 nM for Pb^{2+} and ClO^-, respectively. The detailed mechanistic investigations reveal that both dynamic and static quenching effects operate together in the F-GQD-ClO^- system. The dynamic quenching was attributed to the energy migration from F-GQD to ClO^- through hydrogen bonding interaction (static quenching) between the amine group at the F-GQD surface and ClO^-. The F-GQD nanodot reveals excellent sensitivity toward the detection of ClO^- in real samples. Moreover, the F GQDs also serve as multicolor fluorescent probes for cell imaging; the probe can easily penetrate the cell membrane and successfully detect intracellular ClO^-.

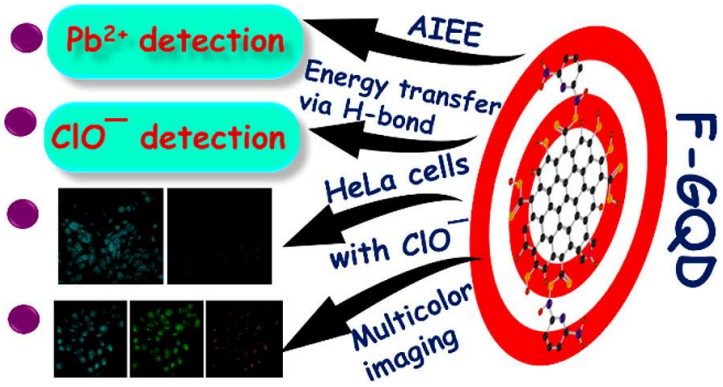
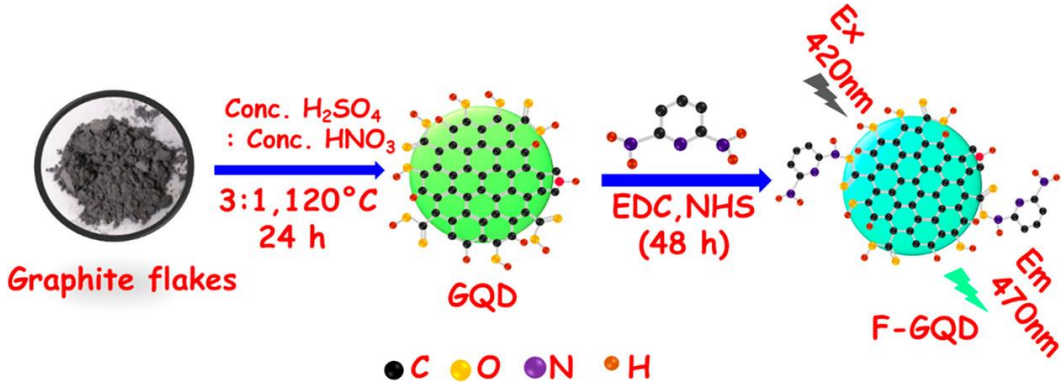


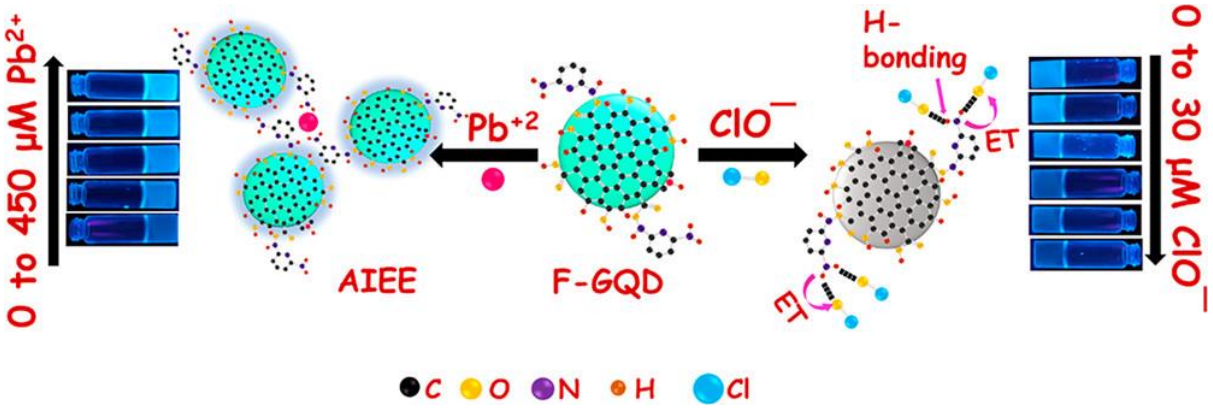
Table of content. F-GQD with dual mode detection of Pb^{2+}, ClO^-, multicoloured bio-imaging and applications

Synthesis route



Scheme 1. Schematics of the Synthesis Procedure of F-GQDs

Application



Scheme 2. Sensing Approach for Multimode Detection of Pb^{2+} and ClO^-

Results

- Here a novel fluorescent nanoprobe FGQD via a simple one-step coupling reaction between GQDsand the DAP moiety. The heterogeneous polar groups at the edge makes it intrinsically pH-responsive. The nanoprobe shows multimodal sensing behavior; it is a fluorescence turn-on sensor for Pb^{2+}, whereas a fluorescence turn-off sensor for ClO^-.
- The fluorescence amplification arises through the remarkable AIEE effect upon complexation with Pb^{2+}.
- The ClO− recognition mechanism consists of both static and dynamic quenching effects. The dynamics effect arises by energy dissipation from F-GQDs to ClO^- via the N−H···O−Cl H-bonding network between amine group in F-GQD and ClO^-.
- The F-GQDs were used as an efficient FL nanoprobe for multicolor HeLa cell imaging due to its excitation-dependent emission property.
- Besides, F-GQDs can efficiently sense the exogenous ClO^- in HeLa cells. This work affords an effective approach for designing efficient fluorescence probes based on the functionalization of GQDs.