N-doped Carbon Quantum Dots-Based Selective and Sensitive Fluorescent Probes: Portable in situ Water Monitoring Prototype Kit for Hg2+ and Pb2+

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Increasing heavy metal pollution needs efficient water monitoring. Hence, this study optimized N-doped Carbon Quantum Dots (NCQDs) for heavy metal sensing. Incorporating an emerging approach in the quantification of NCQD's fluorescence with the established linearity between metal concentration and fluorescence intensity, the Red Green Blue (RGB) channel intensities accurately reflect the heavy metal concentration present in water. The study synthesized biomass-derived NCQD from Averrhoa bilimbi and Citrofortunella microcarpa. Through hydrothermal treatment, carbonized laboratory grade citric acid was complexed with urea for NCQD synthesis. Samples were characterized for functional groups via FTIR, optical properties (excitation ?: 365nm; emission ?: 428nm) via microplate and fluorolog, crystallinity via XRD, size (1.39nm) and morphology via AFM and FE-SEM. Fluorescence Spectroscopy proved NCQD as selective and sensitive for mercury and lead with a promising Limit of Detection(LOD)=0.72ppb for mercury using 80,000x diluted NCQD. Furthermore, the 360nm UV diode-employed kit collects RGB intensities with LOD=27.87ppb using 7,500x dilution. Results proved that the NCQDs' blue channel and fluorescence intensity linearly change with the increase of mercury concentrations by quantifying fluorescence quenching of diluted samples (10-80,000x) ranging (0-50ppb) metal concentration. For its application, field samples were subjected to heavy metal detection using the kit confirming absence of heavy metals in collected wastewater. Thus, the optimized NCQD-based kit was established to be cheaper, portable, practical and more sensitive instrument for heavy metal sensing. Keywords: N-doped Carbon Quantum Dots, RGB Channel Intensities, Heavy Metal Detection, Mercury, Lead

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