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Design and photophysical insights on graphene quantum dots for use as nanosensor in differentiating methamphetamine and morphine in solution

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Abstract

Fluorescent graphene quantum dots (GQDs) were prepared and utilized as nanosensor for differentiation and determination of two most common narcotic drugs i.e. morphine and methamphetamine. The microstructure and optical properties of the GQDs were investigated by various physicochemical methods. XRD analysis indicated low crystalline nature, demonstrating the graphitic nature of the GQDs. According to the Tauc plot derived from UV-Vis spectrum, the optical band gap of the GQDs was determined to ~4.98 eV, assigned to the n–π* transitions. Cyclic voltammetry analysis of the GQDs determined electrochemical band gap of ~4.88 eV with HOMO and LUMO energies equal to -6.83 eV and -1.95 eV, respectively. The GQDs were employed as fluorescent sensing probe for determination of morphine and methamphetamine. The blue fluorescence of the prepared GQDs under the excitation at 362 nm was quenched in the presence of methamphetamine and enhanced in the presence of morphine. The detection limits of 1.48 and 0.5 μg/ml were found for methamphetamine and morphine, respectively. This inexpensive sensing system shows some advantages such as short response time (t < 1min) and low detection limit as well as nontoxicity.

Keywords: Graphene quantum dots; Band gap; Morphine; Methamphetamine; Sensor.

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