Graphene Quantum Dot Bearing Liquid Droplets for Ultra-Sensitive Fluorescence-Based Detection of Nitroaromatics

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Supporting Information

1. TEM data

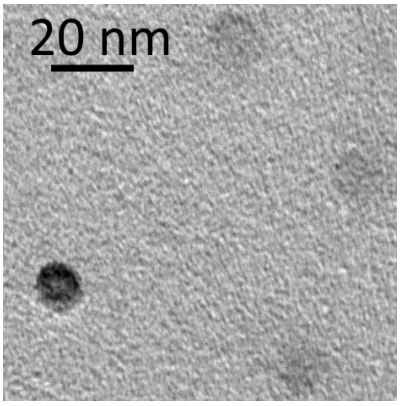

Fig. S1. TEM micrograph of a few particles found in the GQD sample.

2. Equations

For n = 1 we obtain the following solution:

$$g_{PL} = \frac{bk - ak + \sqrt{4bk + (1 + ak - bk)^2} - 1}{2k}. \quad \text{(S1)}$$

With n = 2, one instead obtains:

$$g_{PL} = \frac{1}{6k} \frac{-2k(a-2) + \left(k(-3 + k(a-2)^2)\right)}{\left(9(1+a)k^2 + (a-2)^3k^3 + 3\sqrt{3}\cdot z\right)^{1/3}} + \left(9(1+a)k^2 + (a-2)^3k^3 + 3\sqrt{3}\cdot z\right)^{1/3}, \quad \text{(S2)},$$

where

$$z = \sqrt{k^3\left(1 + k(-1 + 2a(5+a) + (a-2)^3ak)\right)}\,. \quad \text{(S3)}$$

3. Discussion on micro-extraction

Microextraction is the technology where target analytes can be extracted from a sample with an extraction phase with a much smaller volume. Solid-phase microextraction (SPME) and liquid-phase microextraction (LPME) are two main types of microextraction process.[1] In SPME, target analytes are extracted from liquid or gaseous samples onto the solid fibers.[2] In LPME, a solvent with a microliter and even less volume was used as the extraction phase, and target analytes are extracted from the sample which is immiscible with extraction phase.[3] For both SPME and LPME, the extraction of target analytes is based on the passive diffusion across the interface between the sample phase and the extracting phase.[4] Compared with tradition extraction technology, microextraction provides much larger interface that contributes to the higher mass transfer rate between sample phase and the extraction phase. The partition coefficient of target analytes determines the efficiency of microextraction.

Compared with SPME, LPME avoids the residues of samples, the cross-contamination, and the limited choices of solid extraction phases.[5] Dispersive liquid-liquid microextraction (DLLME) is a representative technology based on LPME.[6] The immiscible extractant and the dispersing phase are added into the sample solution, and microdroplets form in the ternary system acting as the extraction phase. High extraction efficiency is obtained due to the larger area of interface attributed to the dispersed microdroplets. However, extra steps, such as centrifuging, are required to collect the extraction phase containing target analytes. An alternative platform is to leverage surface nano-/microdroplets for the highly efficient microextraction process. Microextraction based on surface nano-/microdroplets can be coupled with in-situ chemical analysis without extra collecting steps.[7] In addition, surface nano-/microdroplets are immobilized on the solid substrate, so they can continuously extract the target analytes from a fluidic system. [8]

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