MoS$_2$ Quantum-dots as Label-free Fluorescent Nanoprobe for Highly Selective Detection of Methyl Parathion Pesticide

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The quantum yield (QY) of MoS$_2$ QDs is determined relative to reference quinine sulfate of known QY (0.546). The QY for the MoS$_2$ QDs sample can be calculated as:

\[
QY = QY_{\text{ref}} \frac{\eta^2}{\eta_{\text{ref}}^2} \frac{I}{I_{\text{ref}}} \frac{A_{\text{ref}}}{A}
\]

where $QY_{\text{ref}}$ is the quantum yield of the reference compound, $\eta$ and $\eta_{\text{ref}}$ are the refractive index of the sample and reference solution, $I$ and $I_{\text{ref}}$ are the integrated intensities (areas) of sample and standard spectra, and $A$ and $A_{\text{ref}}$ represent the absorbance of sample and standard.

**Table S1. Quantum yield of MoS$_2$ QDs**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Integrated Emission Intensity</th>
<th>Absorbance at 324 nm</th>
<th>Refractive Index of Solvent ($\eta$)</th>
<th>Quantum Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quinine sulfate</td>
<td>29180.25</td>
<td>0.01412</td>
<td>1.33</td>
<td>0.546$^2$</td>
</tr>
<tr>
<td>MoS$_2$ QDs</td>
<td>1385.1</td>
<td>0.01437</td>
<td>1.33</td>
<td>0.025</td>
</tr>
</tbody>
</table>
Figure S1 UV-Vis spectra of hydrolyzed MP (5 µg.mL⁻¹) at time intervals of 5 min at A) 25°C B) 50°C C) 75°C D) 95°C.
Figure S2

Figure S2 A) PL spectra of MoS$_2$ QDs in different pH and B) corresponding ratio of Original MoS$_2$ QDs PL intensity to MoS$_2$ QDs PL intensities at different pHs (415 nm). A decrease in PL intensities of MoS$_2$ QDs is observed with an increase pH. However, MoS$_2$ QDs are stable with Variation of pH in the range of 8 to 13.
Figure S3

Figure S3 Effect of time on sensor PL response in presence of 10 μg.mL⁻¹ MP and 2.5 mM hydroxide ions.
Figure S4

Figure S4 Plot of Stern–Volmer constants for p-NP quenching of MoS$_2$ QDs against emission wavelengths, and UV–vis spectra of p-NP in the 400–500 nm wavelength region.
Figure S5 UV–vis spectra of MoS$_2$ QDs and p-NP, as well as the theoretical and experimental profiles based on the sum of the MoS$_2$ QDs and p-NP spectra.
Figure S6

Figure S6 The hydrodynamic diameter of Synthesized MoS$_2$ QDs (A) and MoS$_2$ QDs in the presence of p-NP (B) measured by DLS method.
Figure S7

Figure S7 Colorimetric determination of MP. A) UV-Vis Spectra of p-NP formed through hydrolysis reaction of MPs at optimum condition by varying concentration of p-NP (hydrolyzed product pf MP) B) Digital images of solutions at t = 30 min according to increasing concentration of MPs. C) Calculated calibration curve for determination of MP showing a linear pattern at concentration ranges 1 µg.mL⁻¹ to 15 µg.mL⁻¹.

REFERENCES


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