Supporting Information

Surface-enhanced Raman scattering using monolayer graphene-encapsulated Ag nanoparticles as a substrate for sensitive detection of 2,4,6-trinitrotoluene

Zhuo Chen\textsuperscript{a}, Lu Qiu\textsuperscript{b}, Yunfei Tian\textsuperscript{b}, Yong-Ill Lee\textsuperscript{c}, Xiandeng Hou\textsuperscript{a,b}, Li Wu\textsuperscript{b,*}

\textsuperscript{a} Key Laboratory of Green Chemistry & Technology of MOE, College of Chemistry, Sichuan University, Chengdu, Sichuan 610064, China

\textsuperscript{b} Analytical & Testing Centre, Sichuan University, Chengdu, Sichuan 610064, China.

Email: wuli@scu.edu.cn

\textsuperscript{c} Department of Chemistry, Changwon National University, Changwan 641773, Republic of Korea
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1. AFM image of the CVD-grown graphene on copper.

Fig. S1. AFM image of the CVD-grown graphene on copper.
2. SEM image and EDS spectrum of as-synthesized graphene-encapsulated Ag NPs.

![Image](image_url)

**Fig. S2.** (a) SEM image of the fresh as-synthesized Ag NPs (bright zone) and the graphene-encapsulated Ag NPs (dark zone); and (b) Energy dispersive spectrum (EDS) of the graphene-encapsulated Ag NPs.
3. Raman enhancement factor.

![Raman spectra](image)

**Fig. S3.** Raman spectra of $10^{-2}$ mol L$^{-1}$ RhB on Si (black), $10^{-7}$ mol L$^{-1}$ RhB on the Ag NPs (blue) and $10^{-7}$ mol L$^{-1}$ RhB on the graphene-encapsulated Ag NPs (red).

4. Investigation of protective effects of graphene in air.

![Raman intensity](image)

**Fig. S4.** Raman intensity of RhB@1650 cm$^{-1}$ on the graphene-encapsulated Ag NPs (a) and the bare Ag NPs (b) at different time.
5. Influence of temperature on Raman enhancement effect.

Fig. S5. Raman spectra of RhB on the bare Ag NPs (a) and the graphene-encapsulated Ag NPs (b) under different temperature annealed for 0.5 h.

6. Investigation of stability of bare Ag NPs and graphene-encapsulated Ag NPs in different media.

Fig. S6. Stability of the graphene-encapsulated Ag NPs and the Ag NPs. Time-dependent Raman intensity of RhB@1650 cm\(^{-1}\) in (a) 6% H\(_2\)O\(_2\); (b) 0.5 mmol L\(^{-1}\) Na\(_2\)S; (c) 0.5 mol L\(^{-1}\) HNO\(_3\) and (d) NaOH (pH 13).
7. Investigation of stability of silver colloid in different media.

![Fig. S7](image)

**Fig. S7.** (a) UV-visible absorption spectra of the bare Ag colloid in 0.5 mmol L\(^{-1}\) Na\(_2\)S, NaOH (pH 13), 0.5 mol L\(^{-1}\) HNO\(_3\) and 6% H\(_2\)O\(_2\), and the inset: the photos of the bare Ag colloid in different media; (b) Raman intensity of RhB@1650 cm\(^{-1}\) in Ag colloid with the presence of HNO\(_3\), NaOH (PH 13), Na\(_2\)S and H\(_2\)O\(_2\).

8. Mass spectra of TNT before and after Fenton oxidation degradation.

![Fig. S8](image)

**Fig. S8.** Mass spectra of 10\(^{-6}\) mol L\(^{-1}\) TNT (black) and the residue after Fenton oxidation degradation of 10\(^{-6}\) mol L\(^{-1}\) TNT (red).
9. The comparison of present method with other optical sensors.

Table S1. The comparison of the LOD by the present method with those by other optical sensors.

<table>
<thead>
<tr>
<th>Method</th>
<th>Materials</th>
<th>Linear range (mol L(^{-1}))</th>
<th>LOD (mol L(^{-1}))</th>
<th>Measuring period</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescence</td>
<td>CdSe-ZnS QDs</td>
<td>(2.2 \times 10^{-6} - 4.4 \times 10^{-5})</td>
<td>-</td>
<td>15 min</td>
<td>1</td>
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<tr>
<td></td>
<td>Si QDs</td>
<td>(5 \times 10^{-9} - 5 \times 10^{-7})</td>
<td>(10^{-9})</td>
<td>2 min</td>
<td>2</td>
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<tr>
<td></td>
<td>MIP@QDs</td>
<td>(5 \times 10^{-8} - 6 \times 10^{-7})</td>
<td>(1.5 \times 10^{-8})</td>
<td>15 min</td>
<td>3</td>
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<tr>
<td>Luminescence</td>
<td>Au NPs-NaYF(_4)</td>
<td>(2.2 \times 10^{-6} - 3.5 \times 10^{-5})</td>
<td>-</td>
<td>10 min</td>
<td>4</td>
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<tr>
<td></td>
<td>Ru/LDH hybrid</td>
<td>(4.4 \times 10^{-6} - 2.2 \times 10^{-5})</td>
<td>(4.4 \times 10^{-6})</td>
<td>-</td>
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<tr>
<td>Colorimetric</td>
<td>Au NPs</td>
<td>(5 \times 10^{-9} - 5 \times 10^{-13})</td>
<td>-</td>
<td>2h</td>
<td>6</td>
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<tr>
<td>Visualization</td>
<td>Au NPs</td>
<td>(8 \times 10^{-5} - 1.2 \times 10^{-3})</td>
<td>(2.7 \times 10^{-5})</td>
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<td>7</td>
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<tr>
<td>This work</td>
<td>G-Ag NPs</td>
<td>(10^{-9} - 10^{-7})</td>
<td>(6.6 \times 10^{-10})</td>
<td>5 min</td>
<td>-</td>
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</table>

References


