

Electronic supplementary information:

## **A Physical Approach for the Estimation of SERS Enhancement Factor through Enrichment, Separation of Target Molecules using Magnetic Absorbents**

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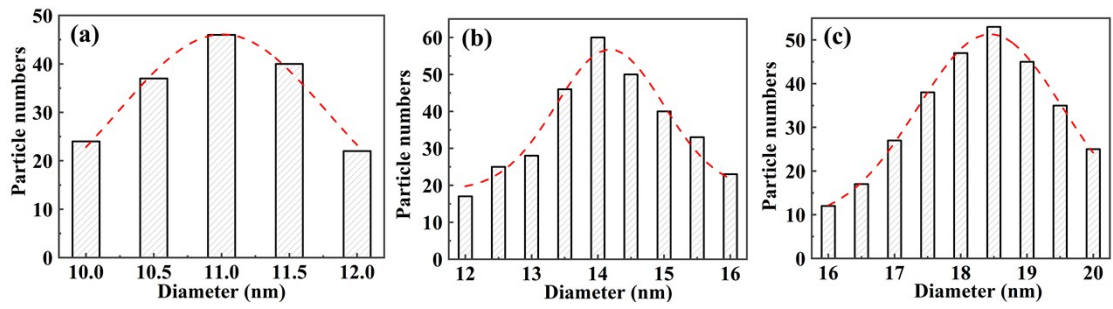


Figure S1: The size distribution of the (a) Fe<sub>3</sub>O<sub>4</sub>@1G NPs; (b) Fe<sub>3</sub>O<sub>4</sub>@3G NPs; and (c) Fe<sub>3</sub>O<sub>4</sub>@5G NPs.

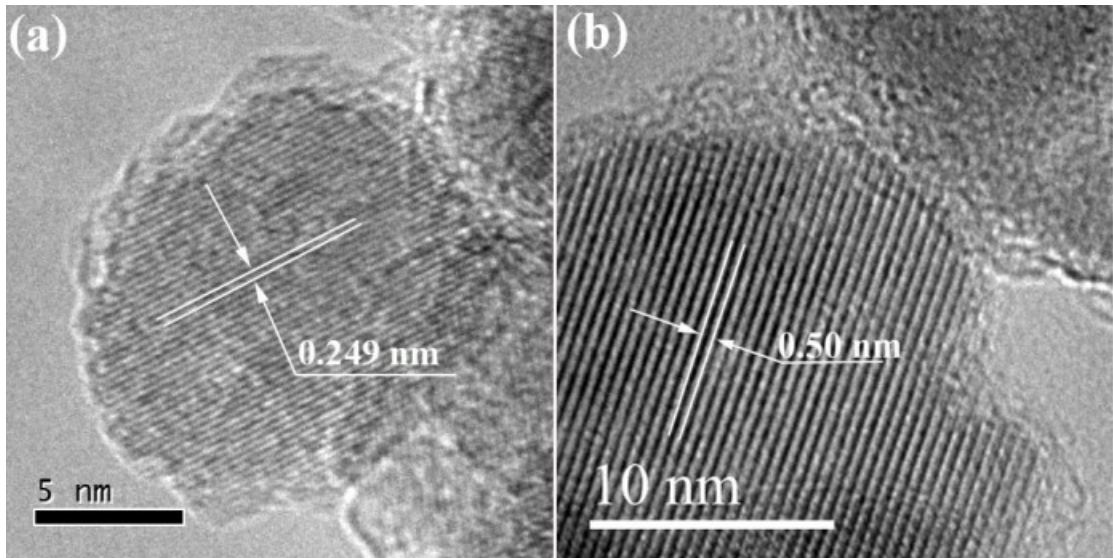


Figure S2: High-magnification TEM images.

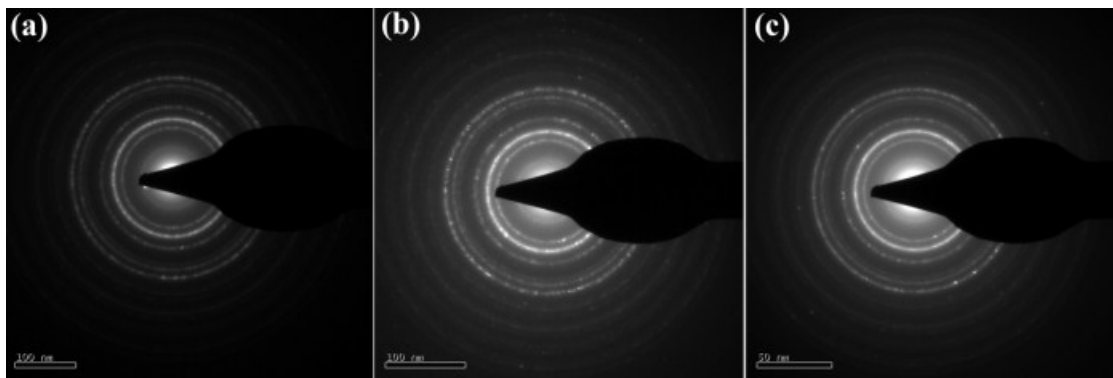


Figure S3: SAED patterns of the (a) Fe<sub>3</sub>O<sub>4</sub>@1G NPs; (b) Fe<sub>3</sub>O<sub>4</sub>@3G NPs; and (c) Fe<sub>3</sub>O<sub>4</sub>@5G NPs.

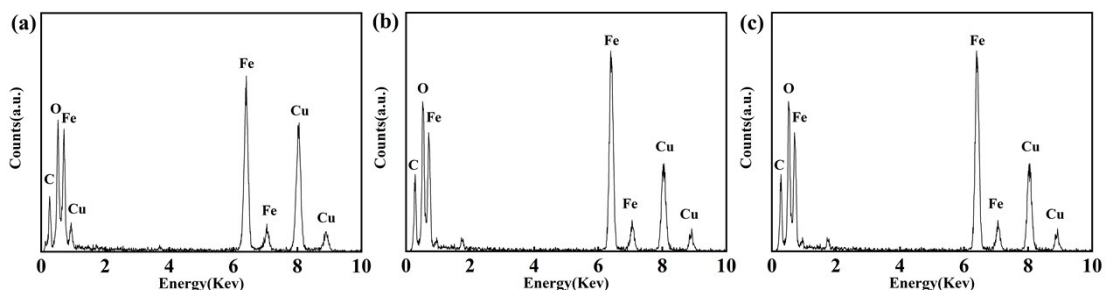


Figure S4: EDS spectra of (a)  $\text{Fe}_3\text{O}_4@1\text{G}$  NPs; (b)  $\text{Fe}_3\text{O}_4@3\text{G}$  NPs; and (c)  $\text{Fe}_3\text{O}_4@5\text{G}$  NPs.



### Molecular Structure of PVA

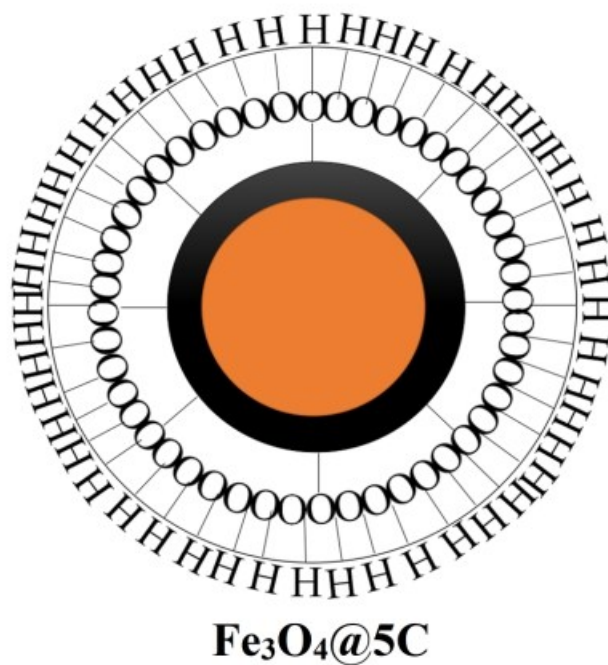
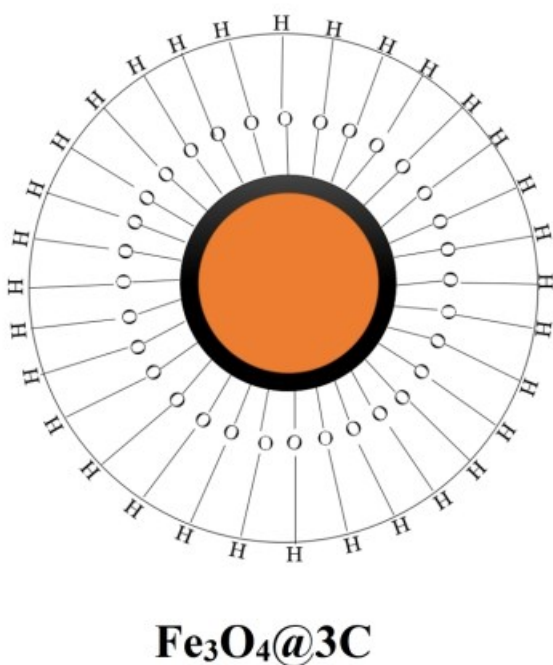
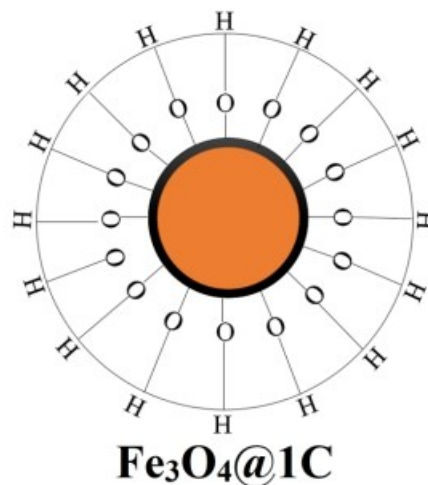


Fig. S5 Schematic diagram of the formation of core-shell  $\text{Fe}_3\text{O}_4@$ DGL NPs with different core sizes and graphene layers.

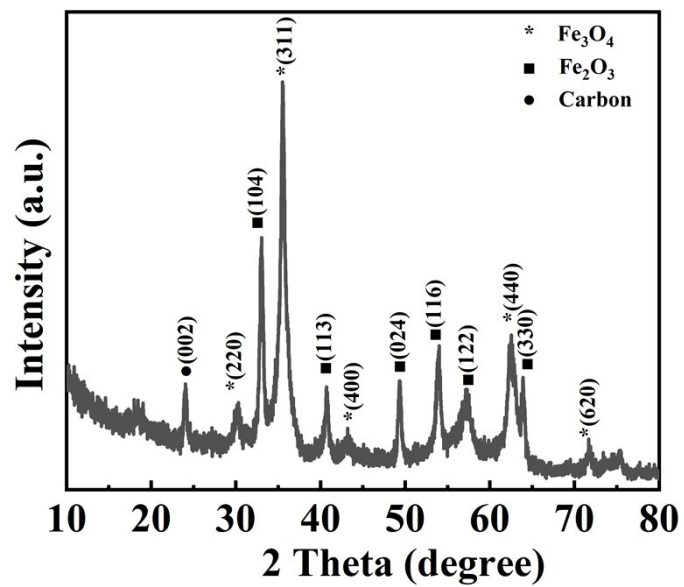


Figure S6: XRD pattern of the product prepared using H<sub>2</sub>O/ EG ratio of 60 mL:20 mL.

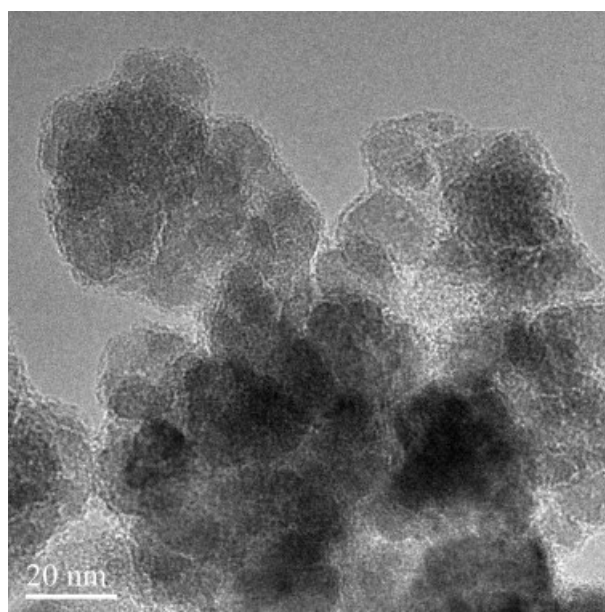


Figure S7: High-resolution TEM image of the product prepared using H<sub>2</sub>O/ EG ratio of 60 mL:20 mL.

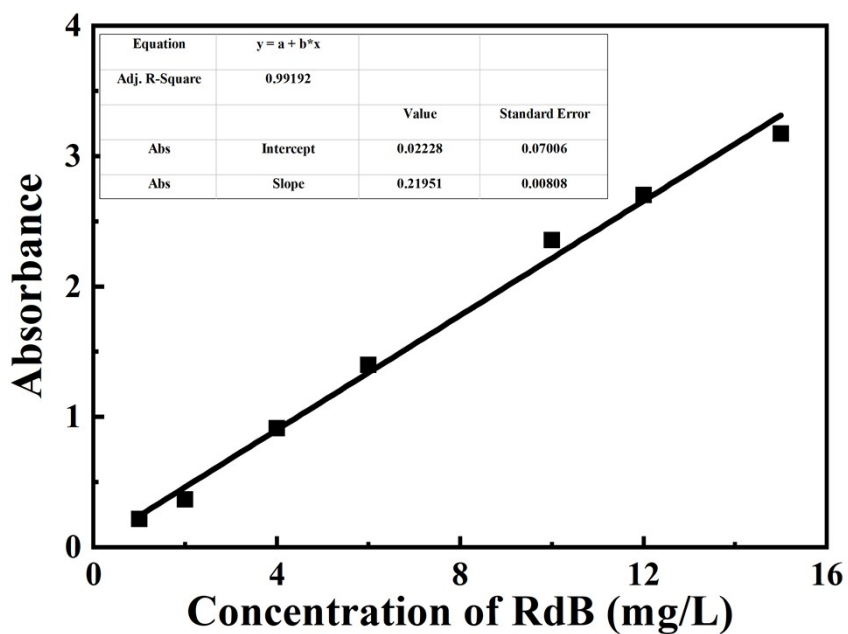


Figure S8: The calibration curve of RhB working solution.

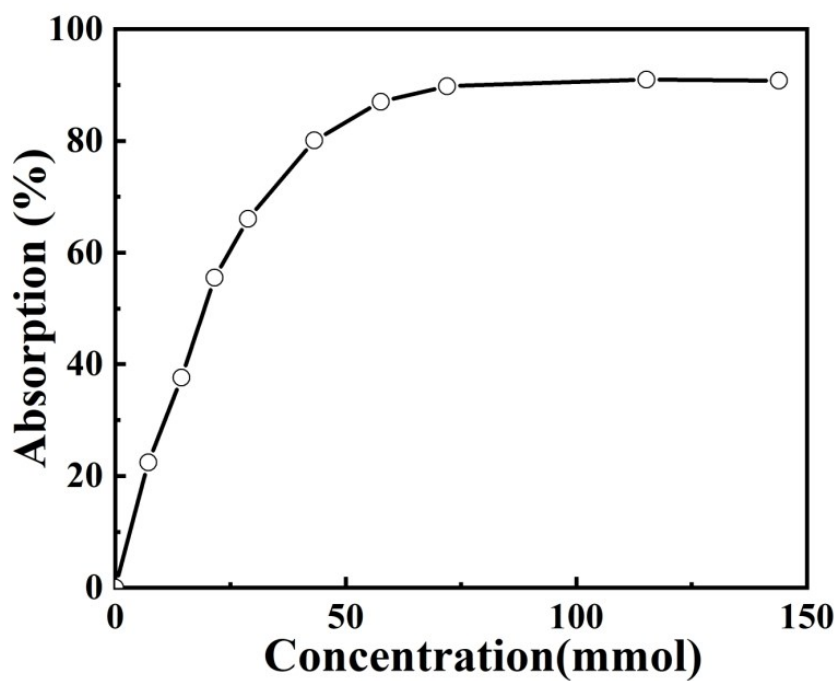
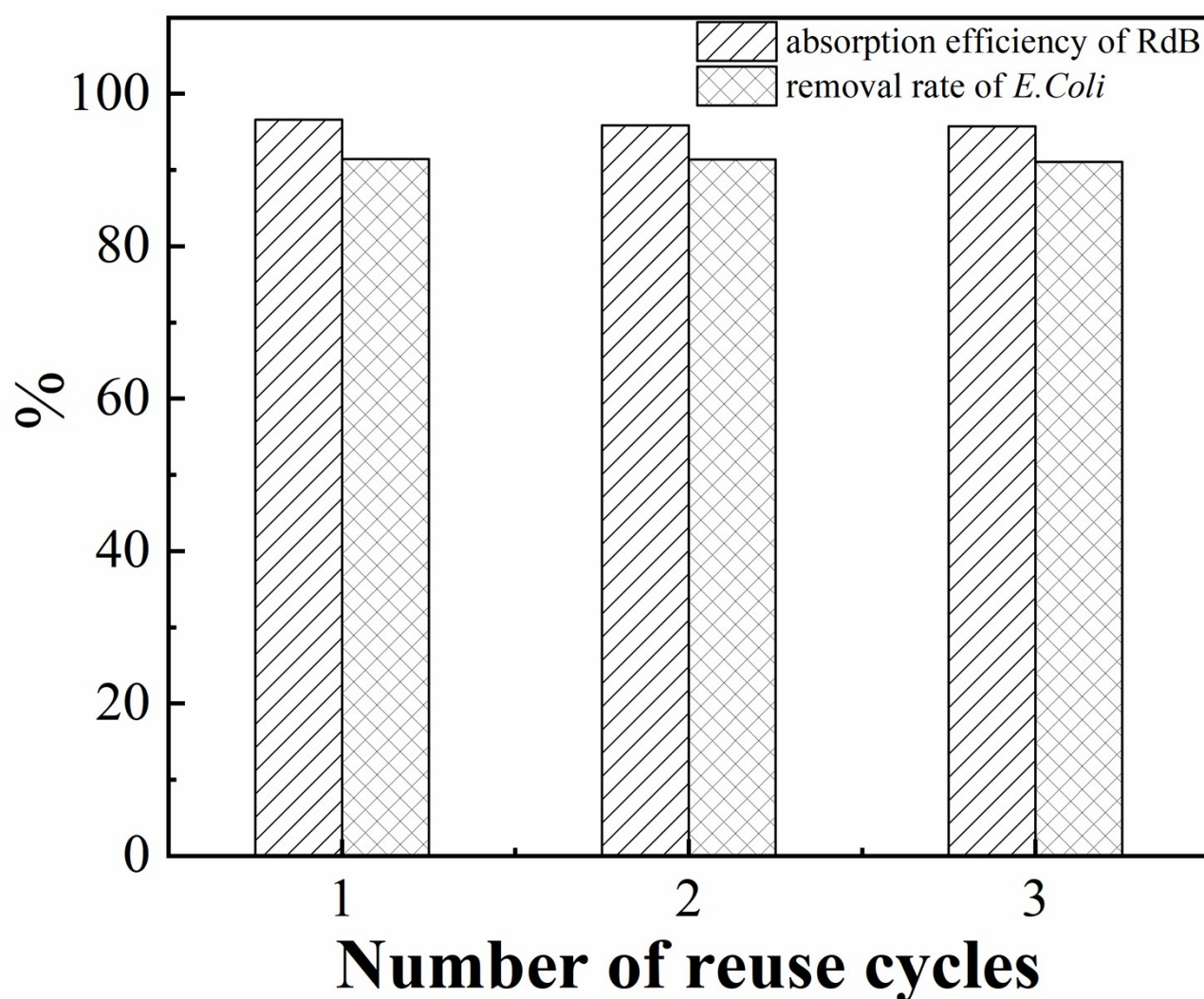


Fig. S9 The absorption efficiency of RhB using Fe<sub>3</sub>O<sub>4</sub>@1G NPs as nano-absorbent

**Table S1. The intensities and band assignments in SERS spectra of RdB with concentration of  $10^{-5}$  m/L from the  $\text{Fe}_3\text{O}_4@1\text{G}$  NPs**

Characteristic bands of RdB	Assignment	$\text{Fe}_3\text{O}_4@1\text{G}$ EF
1645 $\text{cm}^{-1}$	arom C-C stretching	$1.64 \times 10^5$
1507 $\text{cm}^{-1}$	arom C-C stretching	$2.2 \times 10^5$
1355 $\text{cm}^{-1}$	arom C-C stretching	$1.75 \times 10^5$
1280 $\text{cm}^{-1}$	C-H in plane bending	$1.31 \times 10^5$
1192 $\text{cm}^{-1}$	C-H in plane bending	$1.26 \times 10^5$



**Fig. S10 The recyclability of 200 mg  $\text{Fe}_3\text{O}_4@1\text{G}$  NPs for the adsorption of RdB and removal of *E. Coli* from water (conditions: Room temperature =  $25 \pm 1^\circ\text{C}$ ; contact time = 4 hr).**