

Supporting Information

Multifunctional Fe₃O₄@Ag/SiO₂/Au Core-shell Microspheres as a Novel SERS-Activity Label via Long-Range Plasmon Coupling

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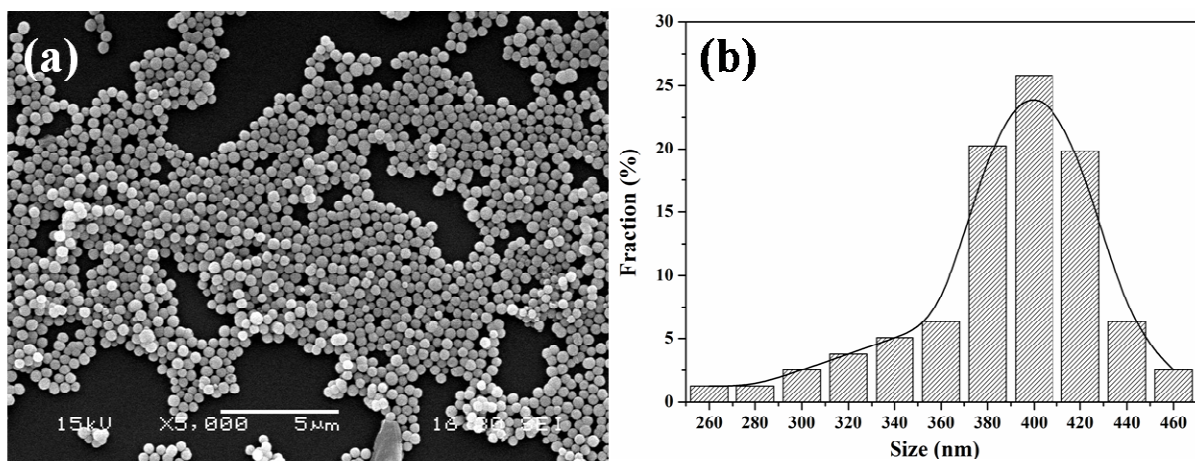


Figure S1. (a) SEM images of Fe_3O_4 particles. (b) Diameter distribution of Fe_3O_4 particles.

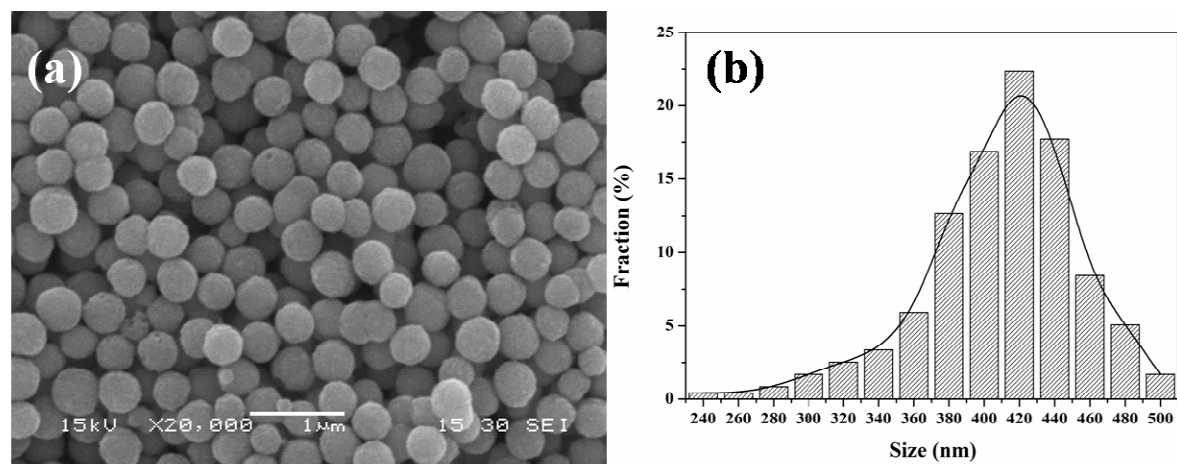


Figure S2. (a) SEM images of $\text{Fe}_3\text{O}_4@Ag$ microspheres. (b) Diameter distribution of $\text{Fe}_3\text{O}_4@Ag$ microspheres.

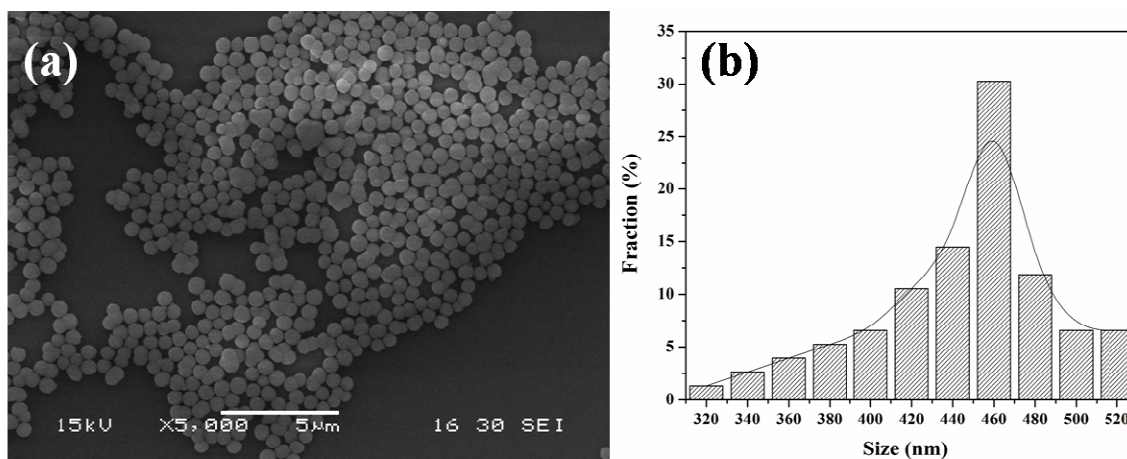


Figure S3. (a) SEM images of $\text{Fe}_3\text{O}_4@\text{Ag}/\text{SiO}_2$ microspheres. (b) Diameter distribution of $\text{Fe}_3\text{O}_4@\text{Ag}/\text{SiO}_2$ microspheres.

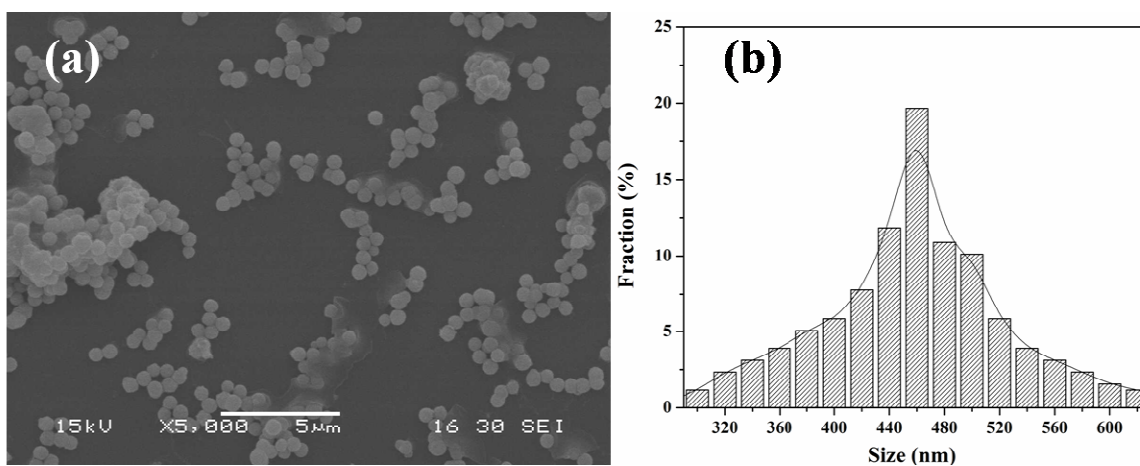


Figure S4. (a) SEM images of $\text{Fe}_3\text{O}_4@\text{Ag}/\text{SiO}_2/\text{Au}$ microspheres. (b) Diameter distribution of $\text{Fe}_3\text{O}_4@\text{Ag}/\text{SiO}_2/\text{Au}$ microspheres.

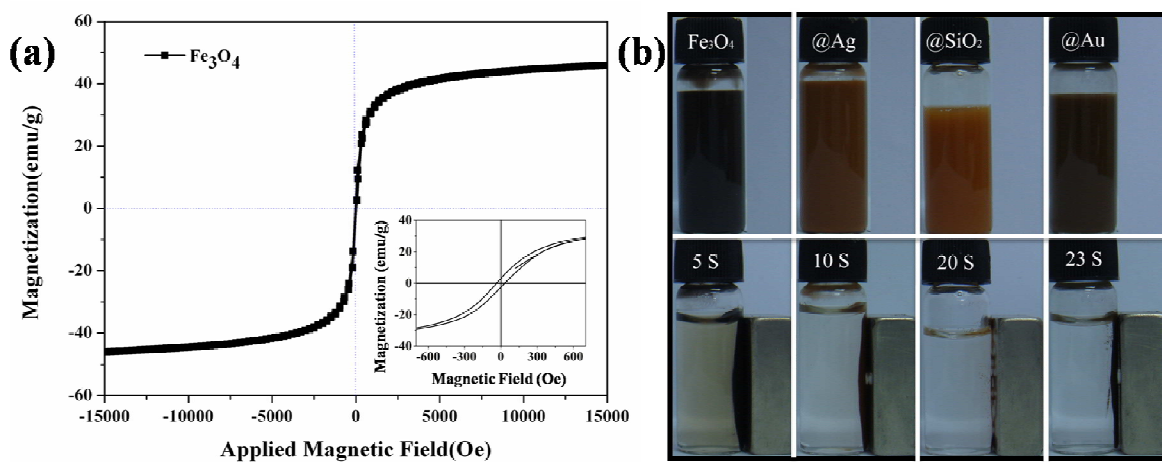


Figure S5. (a) Room-temperature magnetic hysteresis curve of the Fe₃O₄ particles; the insert is corresponding part hysteresis curves (field from -700 to 700 Oe). (b) Photographs of the Fe₃O₄ particles, Fe₃O₄@Ag microspheres Fe₃O₄@Ag/SiO₂ microspheres and Fe₃O₄@Ag/SiO₂/Au microspheres under an external magnetic field, respectively.

Table S1. The intensities and band assignments in SERS spectra of RdB

Characteristic bands of RdB	Assignment	Fe ₃ O ₄ @Ag EF (10 ³)	Fe ₃ O ₄ @Ag/SiO ₂ EF (10 ³)	Fe ₃ O ₄ @Ag/SiO ₂ /Au EF (10 ³)
1192 cm ⁻¹	C-H ip bend	33	19	39
1355 cm ⁻¹	arom C-C str	26	16	35
1503 cm ⁻¹	arom C-C str	19	10	21
1580 cm ⁻¹	arom C-C str	24	14	26
1652 cm ⁻¹	arom C-C str	6.7	4.2	22

EF-SERS enhancement factor, str-stretching, ip-in plane.

The SERS enhancement factor, EF, is defined as

$$EF = (I_{SERS}/I_{bulk}) \times (N_{bulk}/N_{surf}) \quad (1)$$

where I_{SERS} and I_{bulk} are the vibration intensities in the SERS and normal Raman spectra of RdB, respectively. N_{bulk} and N_{surf} are the number of molecules under laser illumination for the bulk sample, and the number of molecules in the self-assembled monolayers (SAMs), respectively.