A Green and General Strategy to Synthesize Ag/CdS Hollow Nanocomposites for Superior SERS Performance

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Supporting Information

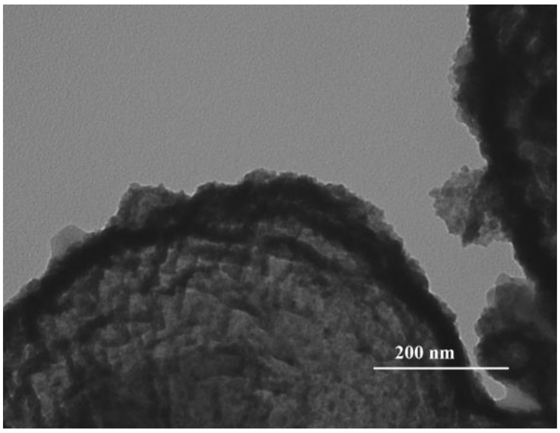

Fig. S1 TEM image of CdS hollow nonasphere

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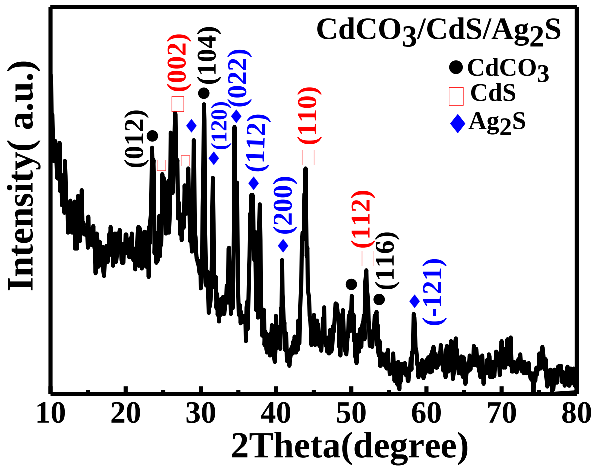

Fig. S2 XRD patterns of $CdCO_3/CdS/Ag_2S$ NCs at the sulfuration reaction time about 24 hours.

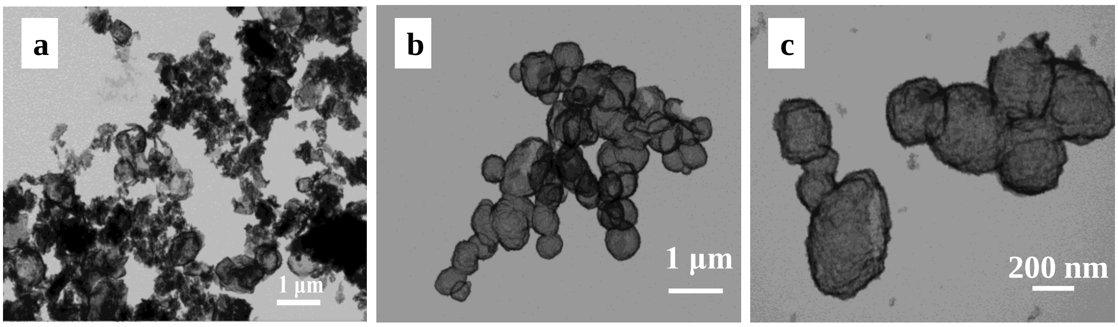

Fig. S3 TEM images of CdS in different time of sulfur ion exchange: (a) 30 minutes, (b) 2 hours, (c) 24 hours.

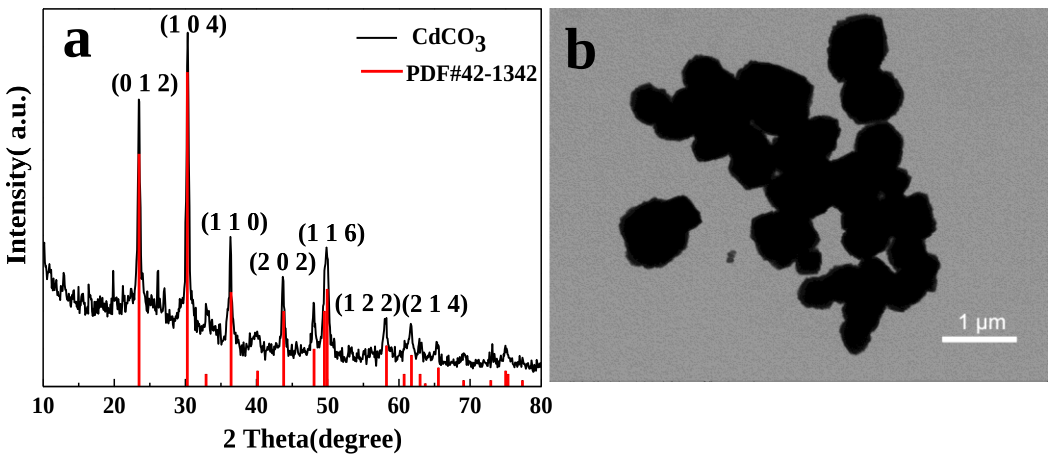

Fig. S4 (a) XRD pattern of the sample after recycling, (b) TEM of the sample after recycling.

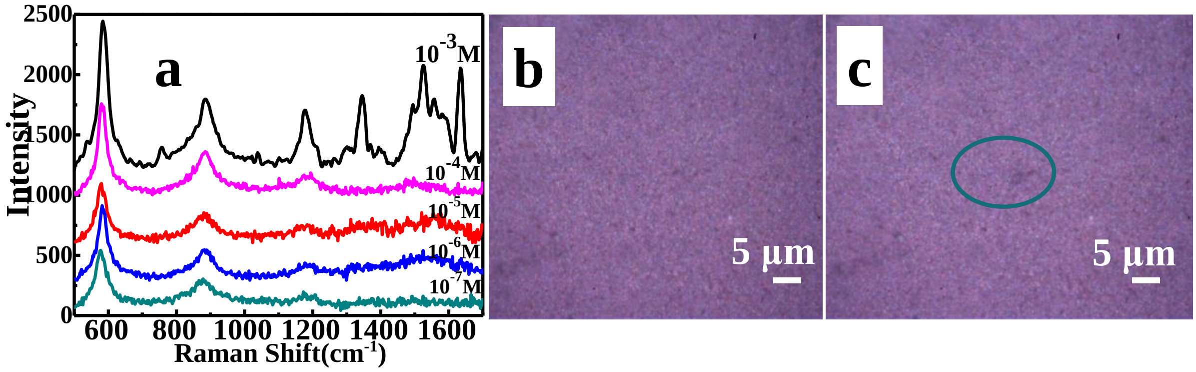

Fig. S5 (a) Raman spectra of 10^{-6} M R6G on the Ag/CdS NCs with the excitation laser line at 473 nm. (b) Raman image of R6G on the Ag/CdS NCs before excited at 473 nm (c) Raman image of R6G on the Ag/CdS NCs After excited at 473 nm

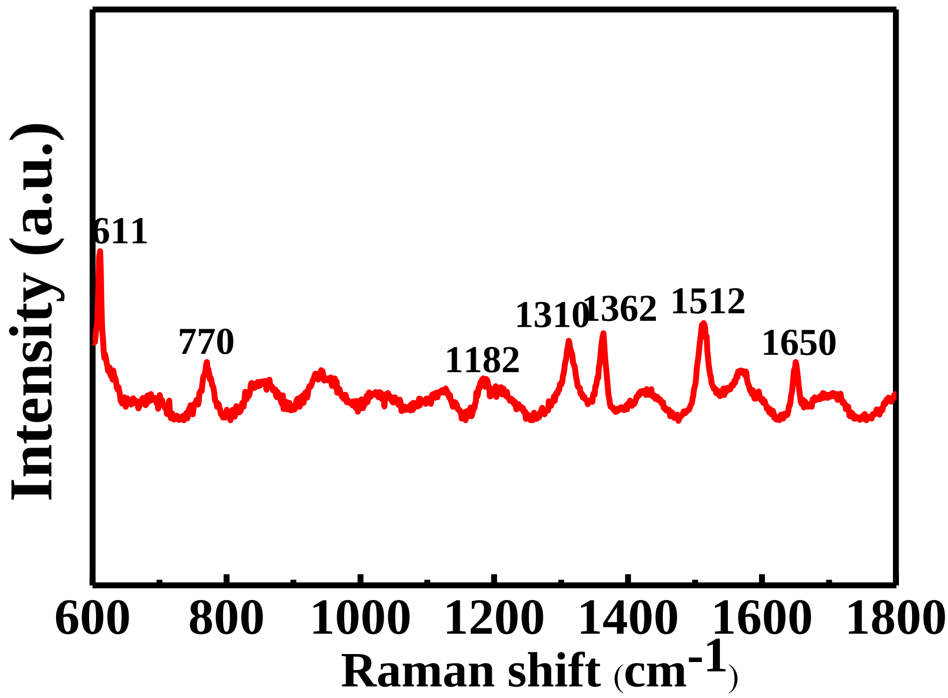

Fig. S6 Raman spectrum of 10^{-3} M R6G on Si substrate.

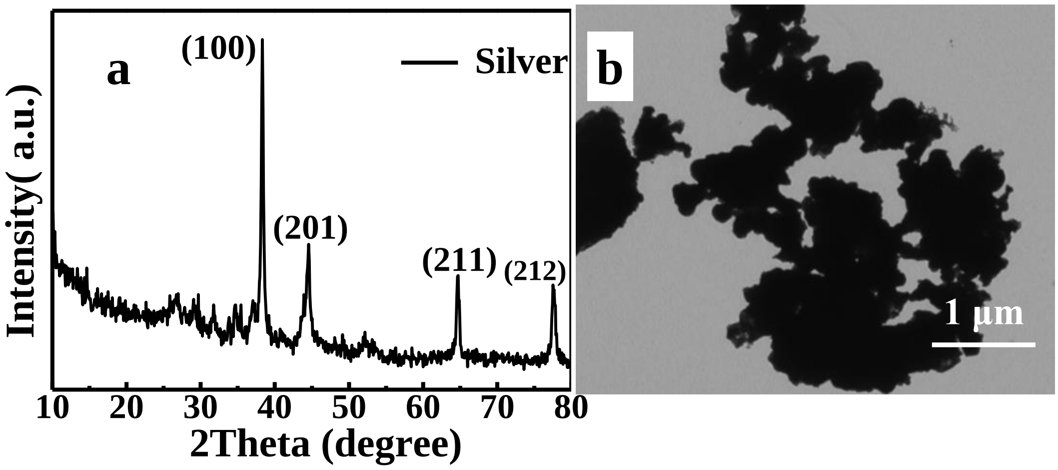

Fig. S7 (a) XRD patterns of silver NPs. (b) TEM images of pure silver NPs prepared in present work.

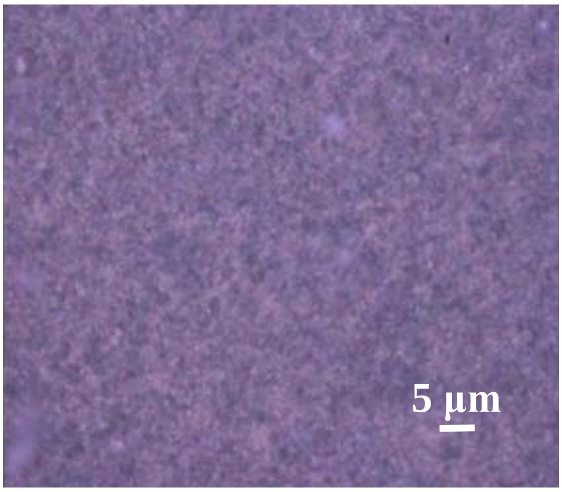

Fig. S8 Raman mapping image of the Ag/CdS NCs substrate.

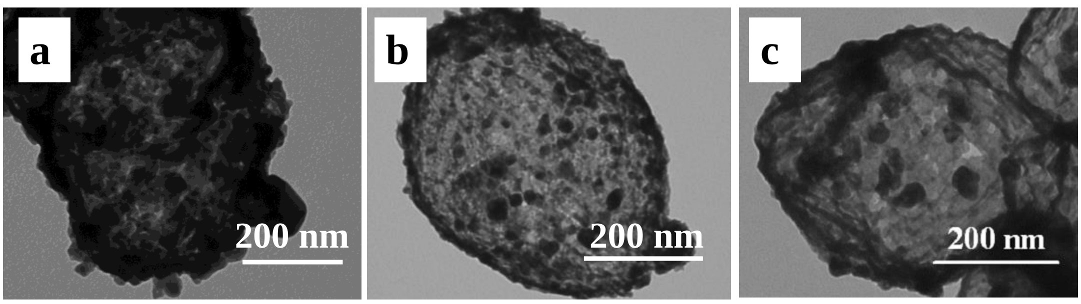

Fig. S9 TEM images of CdS/Ag NCs loaded with amount of silver at prepared $Cd(Ac)_2$: $AgNO_3$ = 4:1, 6:1, 10:1, respectively.

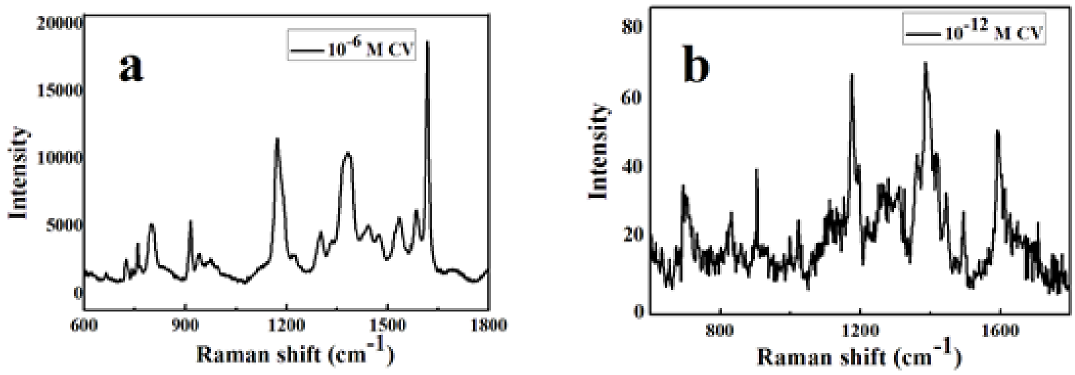

Fig S10 Raman spectrum of 10^{-6} M and 10^{-12} M CV on the Ag/CdS NCs substrate, respectively.

Table S1 Enhancement factors (EFs) for some composite materials are reported in References

Material Probe	molecule	EF	LOD (mol/L)	Reference
Au–CdSe nanowires	CV	10^4	10^{-5}	1
Ag-NP-decorated ZnO nanoflower array	R6G	10^7	10^{-10}	2
Ag- ZnO thin film	R6G	10^7	10^{-10}	3
Ag-coated cellophane	CV	10^5	10^{-9}	4
AuNPs/WS$_2$@AuNPs hybrids	R6G	10^6	10^{-11}	5
3D Ag butterfly wing scale arrays/graphene composites	CV	10^6	10^{-8}	6
Ag/CdS NCs	R6G	10^7	10^{-12}	This work

References

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2. Q. Tao, S. H. Li, C. Y. Ma , K. Liu, and Q. Y. Zhang, *Dalton Trans.*, 2015, **44**, 3447-3453.
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The details of Enhanced Factor Calculation are given as follws:

$$EF = (I_{SERS}/I_{BULK}) \times (N_{BULK}/N_{SERS})$$

where I_{SERS} and I_{BULK} are the integrated intensities of R6G molecules adsorbed on Ag/CdS NCs and 10^{-3} M of R6G bulk, respectively. N_{SERS} and N_{BULK} correspond to the number of R6G molecules adsorbed on the SERS substrate and in the bulk solution excited by the laser beam, respectively.

N_{BULK} is calculated by the following formula:

$$N_{BULK} = \rho AhNA/M$$

where ρ correspond to the density of R6G molecules, A refer to the irradiation area under the laser beam (1 μm in diameter), h is the focal depth of the laser (9.9 μm, h = (2π/633 nm)*(1 μm)^2). N_A is the Avogadro constant. M correspond to the molecule weight of R6G (479 g/mol)

N_{BULK} is calculated by the following formula:

$$N_{SERS} = C_{SERS} V N_A A/\pi r^2$$

where C_{SERS} correspond to the concentration of R6G molecules, V is the volume of one drop R6G molecules (20 μL), r is the diameter of the circle 20 μL R6G solution spread and completely drid (4 mm).

Details of LOD calculation are presented as follows:

A linear log plot of the corresponding Raman intensity at 1361 cm^{-1} and R6G concentrations was established (see Fig.7c). The log-log plot of the Raman intensity I_{1361} and R6G concentrations C_{R6G} follows a linear relationship (R^2 =0.99), $\log_{10}$ (I) = -0.234$\log_{10}$ (C_{R6G}) +4.759. And the error bars in the picture are standard deviations of 3 different positions for each sample. It is obviously observed that the linear equations and correlation coefficients indicate that there are high correlations between Raman intensities and concentrations of R6G. The limits of detection is calculated to 10^{-13} M by the formula,[1-2]

$$\mathrm{LOD} = \frac{3\sigma}{k}$$

Where σ means the standard deviation of several times detection for pure SERS substrate, and k represents the slop of the equation's linear fitting.

Reference

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