Supporting Information to

# Carbon based quantum dots capped silver nanoparticles for efficient surface-enhanced Raman scattering sensing

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The calculation of SERS enhancement factors:

$I_{SERS}$ of the R6G at the peak of 1360 $cm^{-1}$ absorbed on the AgNPs@CDs is 3.5 times as large as the $I_{bulk}$ of R6G. The spot diameter of a portable Raman spectrometer (BWS415) is 10 μm, and the spot areal irradiated on the substrate is 78 $\mu m^2$. 1 nM R6G (5 μL) is added to the substrate, and the areal of the substrate is 25 $mm^2$. According to the concentration and volume, the density of distribution of the R6G molecule on the substrate is calculated to be $2\times10^{-22}$ moL/ $\mu m^2$, and then multiply spot areal to get the number of the molecules of the excited SERS signal ($N_{SERS}$=$1.57\times10^{-20}$). The density of R6G solid is 0.79 $g/cm^2$ and the laser penetration depth is about 2 μm,[S1] and then $N_{bulk}$ could be calculated to be $2.59\times10^{-13}$. According to the formula of EF, the EF of R6G at the peak of 1360 $cm^{-1}$ absorbed on the AgNPs@CDs is calculated to be $5.6\times10^7$. The the EF of R6Gabsorbed on the pure AgNPs is calculated to be $1.7\times10^7$ by the same way.

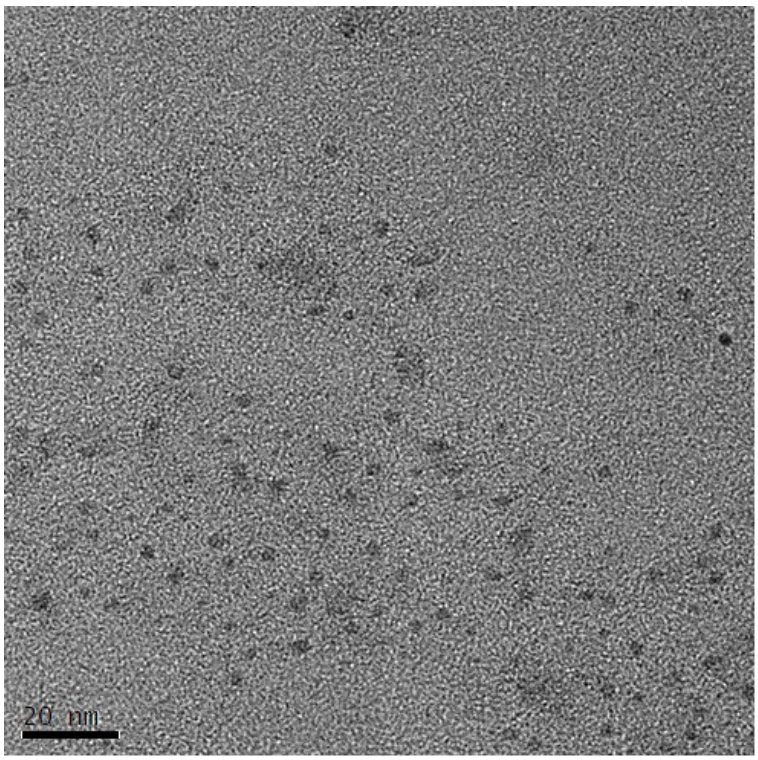


**Fig. S1** TEM image of the used CDs.

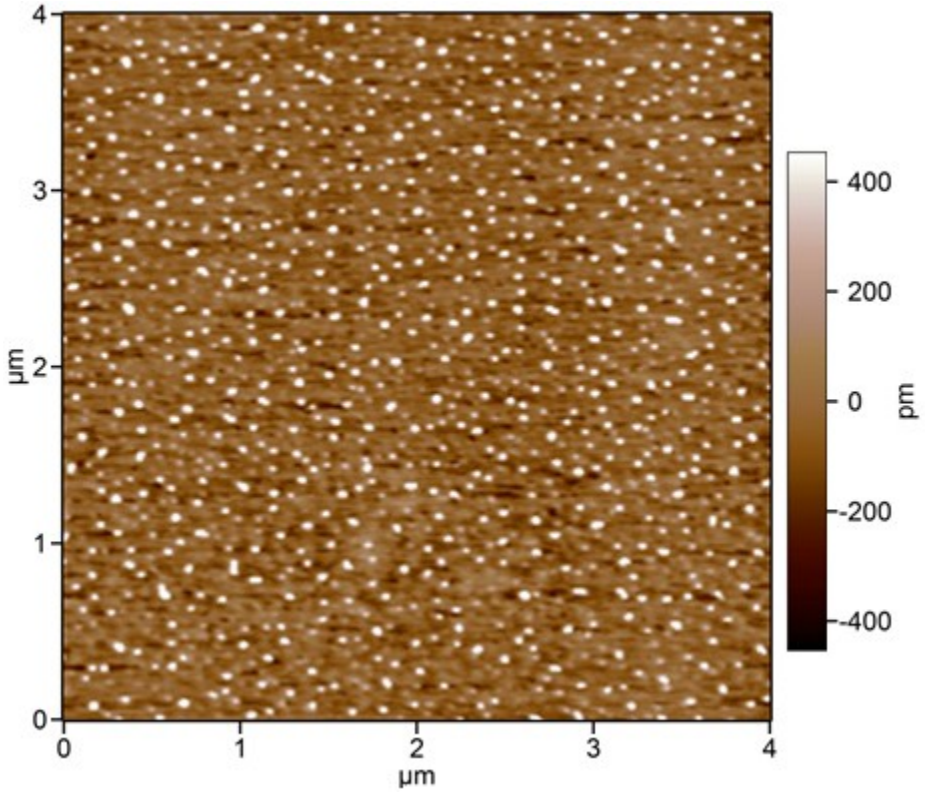


**Fig. S2** AFM image of the used CDs.

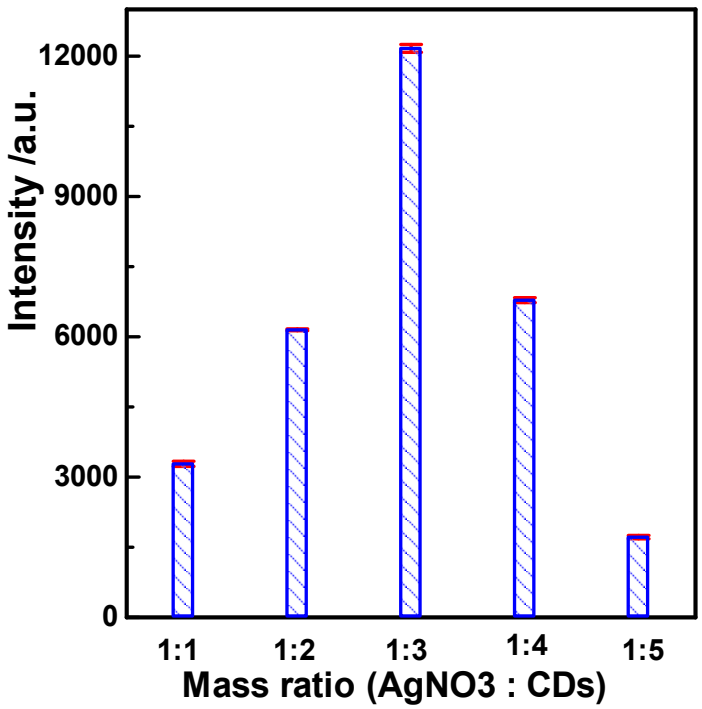


**Fig. S3** Raman peak intensity (n = 20, confidence level of 99.7%) at 1361 $cm^{-1}$ of R6G molecules ($1\times10^{-6}$ M) adsorbed on different AgNPs@CDs synthesized at different mass ratio of $AgNO_3$ to CDs from 1:1 (a), 2:1 (b), 3:1 (c), 4:1 (d) to 5:1 (e).

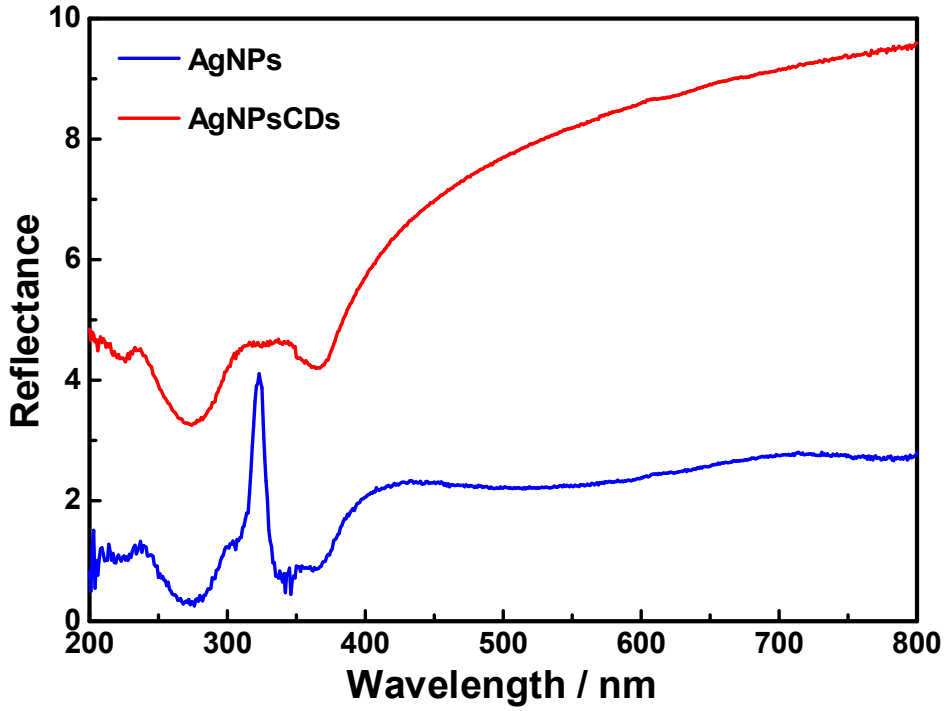


**Fig. S4** Reflectance spectra of AgNPs and AgNPs@CDs.

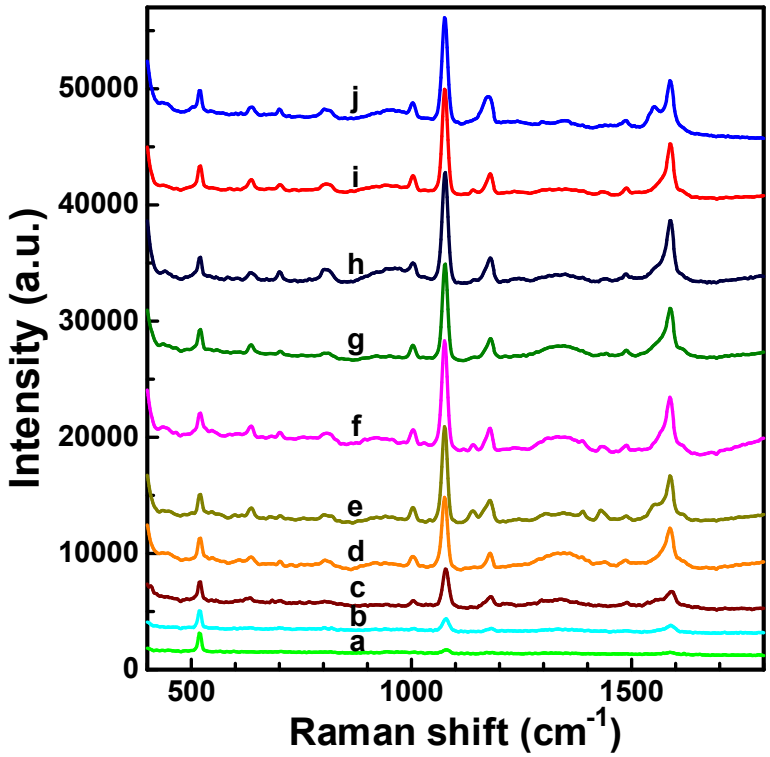


**Fig. S5** Raman spectra of 4-ATP ($1\times10^{-6}$ M) adsorbed on AgNPs@CDs/Si prepared by immersing CTAB modified Si wafer in the AgNPs@CDs solution for 0.5 h (a), 1 h (b), 2 h (c), 3 h (d), 4 h (e), 5 h (f), 6 h (g), 8 h (h), 12 h (i), 24 h (j). The immersed time of AgNPs@CDs/Si in 4-ATP is 6 h.

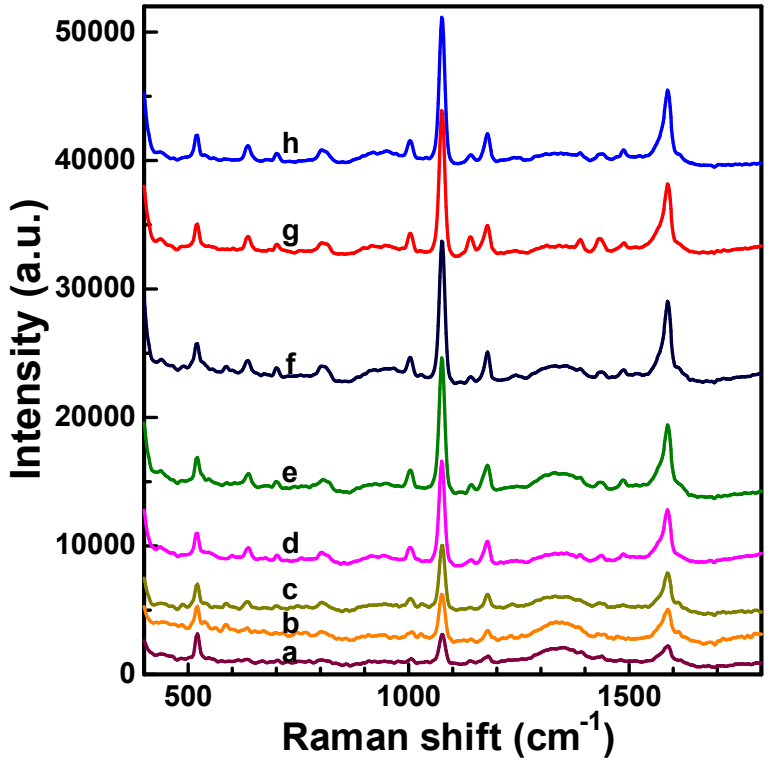


**Fig. S6** Raman spectra of 4-ATP ($1\times10^{-6}$ M) adsorbed on AgNPs@CDs/Si. The immersined times of AgNPs@CDs/Si in 4-ATP solution are 0.5 h (a), 1 h (b), 2 h (c), 3 h (d), 4 h (e), 5 h (f), 6 h (g), 8 h (h). The immersed time of CTAB modified Si wafer in the AgNPs@CDs solution is 5 h.

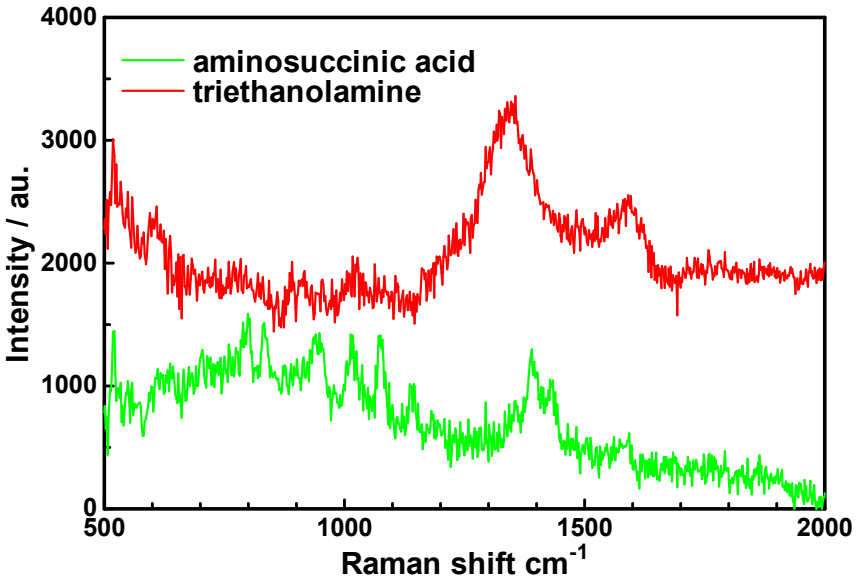


**Fig. S7** Raman spectra of aminosuccinic acid and triethanolamine ($1\times10^{-6}$ M) adsorbed on AgNPs@CDs/Si. The immersined time of AgNPs@CDs/Si in aminosuccinic acid (or triethanolamine) solution is 6 h.

**Reference**

**S1.** W.-L. Zhai, D.-W. Li, L.-L. Qu, J. S. Fossey and Y.-T. Long, *Nanoscale*, 2012, **4**, 137-142.