Supplementary Materials

Aptamer-Adjusted Carbon Dot Catalysis-Silver Nanosol SERS Spectrometry for Bisphenol A Detection

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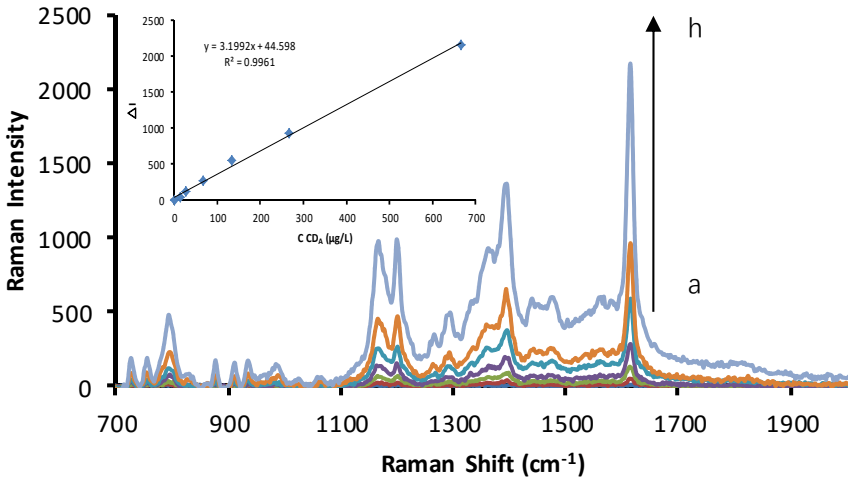

Figure S1. SERS spectra of CD-GN- $AgNO_3$-trisodium citrate (0, 13.33, 26.67, 66.67, 133.33, 266.67, 666.67 μg/L) CD-GN + 1.33 mmol/L $AgNO_3$ + 4.67 mmol/L trisodium citrate +85℃+21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

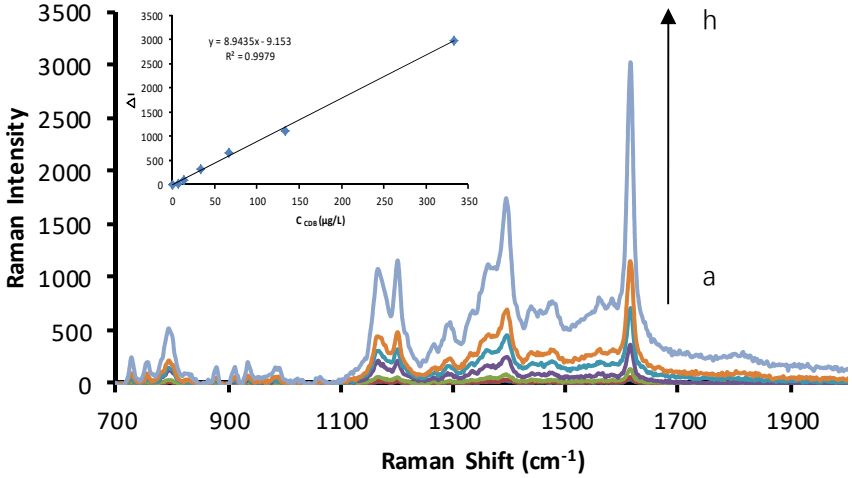

Figure S2. SERS spectra of CD_{Ca}- $AgNO_3$-trisodium citrate (0, 6.67, 13.33, 33.33, 66.67, 133.33, 333.33 μg/L) CD_{Ca} + 1.33 mmol/L $AgNO_3$+ 4.67 mmol/L trisodium citrate +85℃+21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

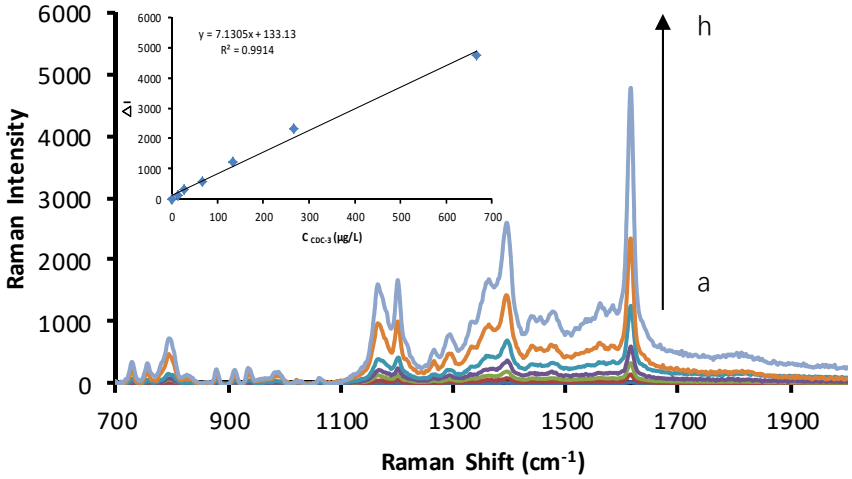

Figure S3. SERS spectra of CD-CN- $AgNO_3$-trisodium citrate (0, 13.33, 26.67, 66.67, 133.33, 266.67, 666.67 μg/L) CD-CN2+ 1.33 mmol/L $AgNO_3$ + 4.67 mmol/L trisodium citrate +85℃+21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

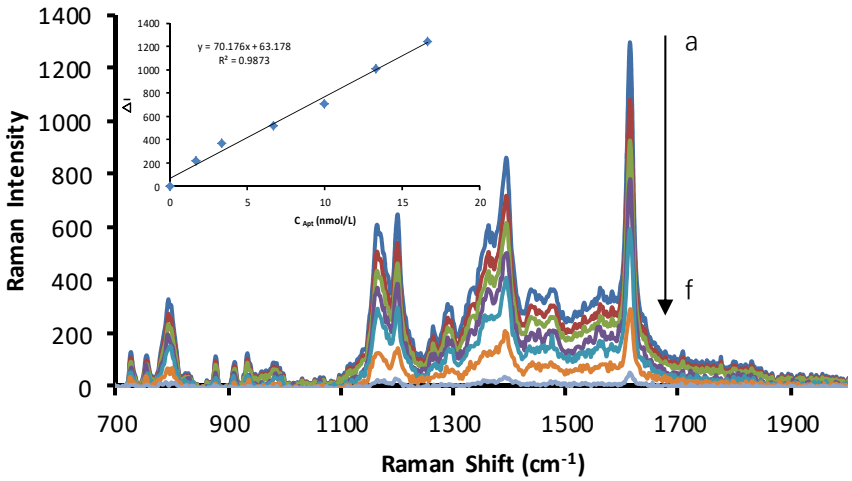

Figure S4. SERS spectra of Apt- CD-CN- $AgNO_3$-trisodium citrate (0, 1.67, 3.33, 6.67, 10, 13.33,16.67 nmol/L) Apt + 266.67 μg/L CD-CN2 + 1.33 mmol/L $AgNO_3$+ 4.67 mmol/L trisodium citrate +85℃+21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

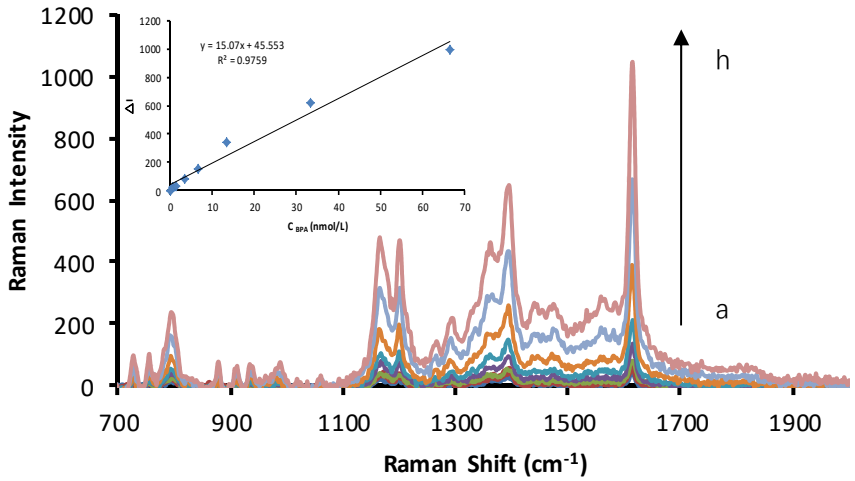

Figure S5. SERS spectra of BPA-Apt- CD-GN- $AgNO_3$-trisodium citrate 16.67 nmol/L Apt + 266.67 μg/L CD-GN + (0, 0.67, 1.33, 3.33, 6.67, 13.33, 33.33, 66.67 nmol/L) BPA + 1.33 mmol/L $AgNO_3$ + 4.67 mmol/L trisodium citrate +85℃+21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

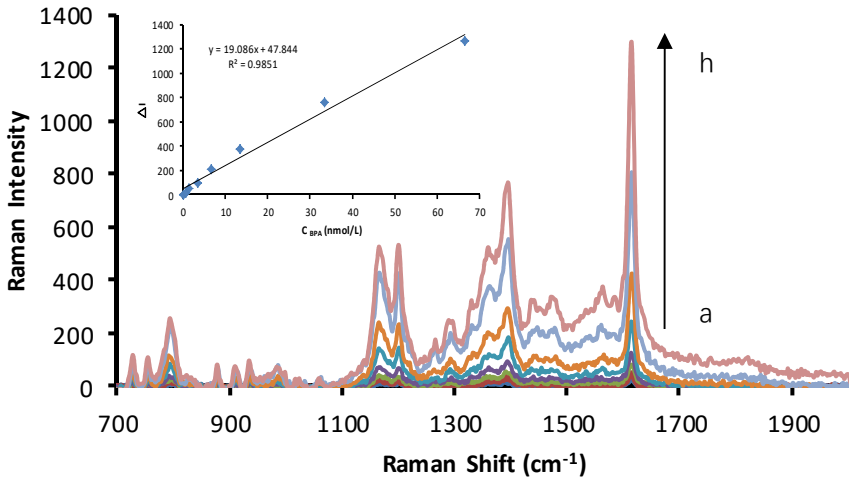

Figure S6. SERS spectra of BPA-Apt- CD_{Ca}- $AgNO_3$-trisodium citrate 13.33 nmol/L Apt + 133.33 μg/L CD_{Ca} + (0, 0.67, 1.33, 3.33, 6.67, 13.33, 33.33, 66.67 nmol/L) BPA + 1.33 mmol/L $AgNO_3$ + 4.67 mmol/L trisodium citrate +85℃+21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

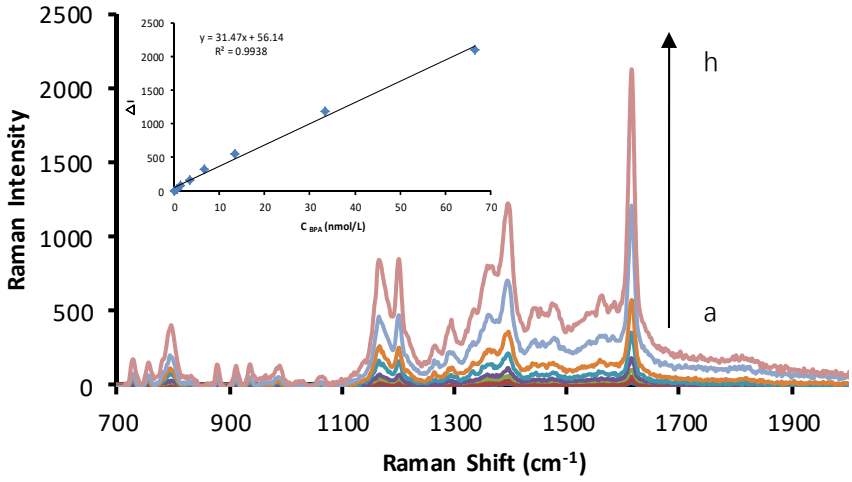

Figure S7. SERS spectra of BPA-Apt- CD-CN- $AgNO_3$-trisodium citrate 13.33 nmol/L Apt + 266.67 μg/L CD-CN2 + 0.67-66.67 nmol/L BPA + 1.33 mmol/L $AgNO_3$ + 4.67 mmol/L trisodium citrate +85℃+21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

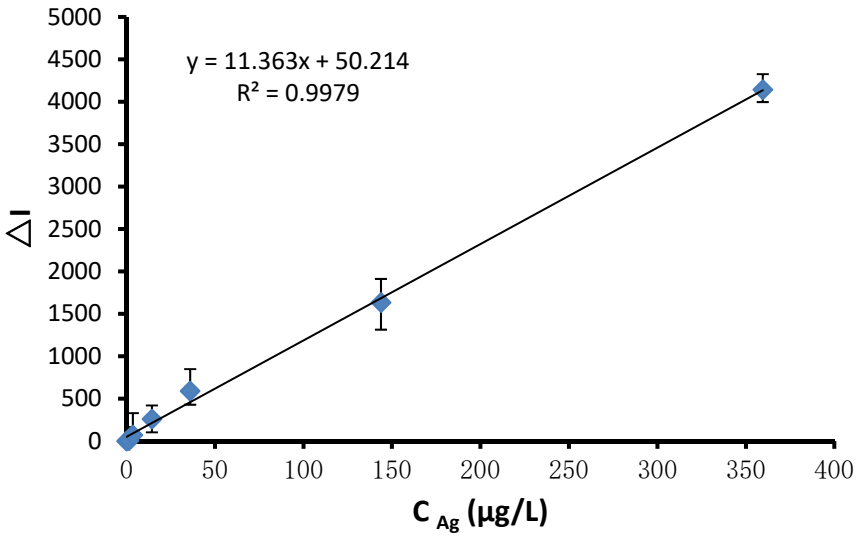

Figure S8. The effect of AgNP on SERS intensity

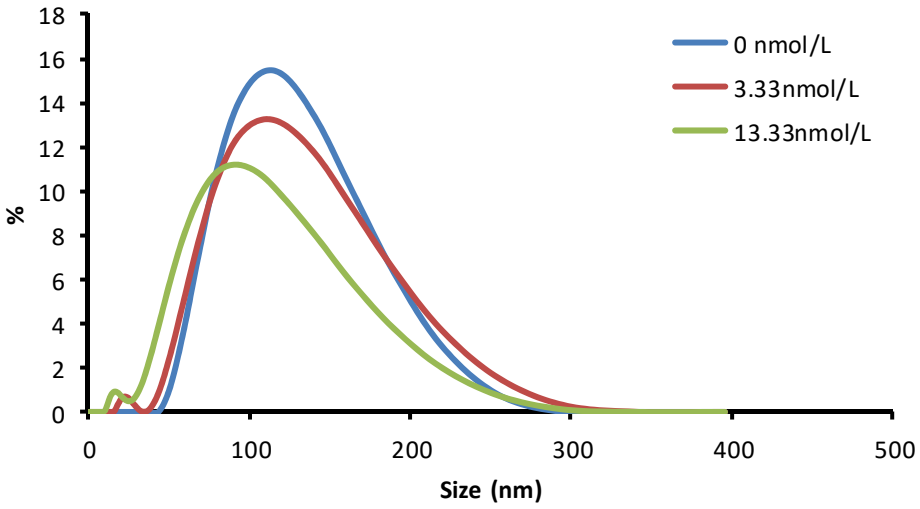

Figure S9. Laser scattering image of Apt- CD-FN3 - $AgNO_3$-TSC-BPA system 20.67 nmol/L Apt + 333.33 μg/L CD-FN3 + 1.33 mmol/L $AgNO_3$ + 4.67 mmol/L TSC+85℃+21 min； b. a+ 3.33 nmol/L BPA； c. a+ 3.33 nmol/L BPA

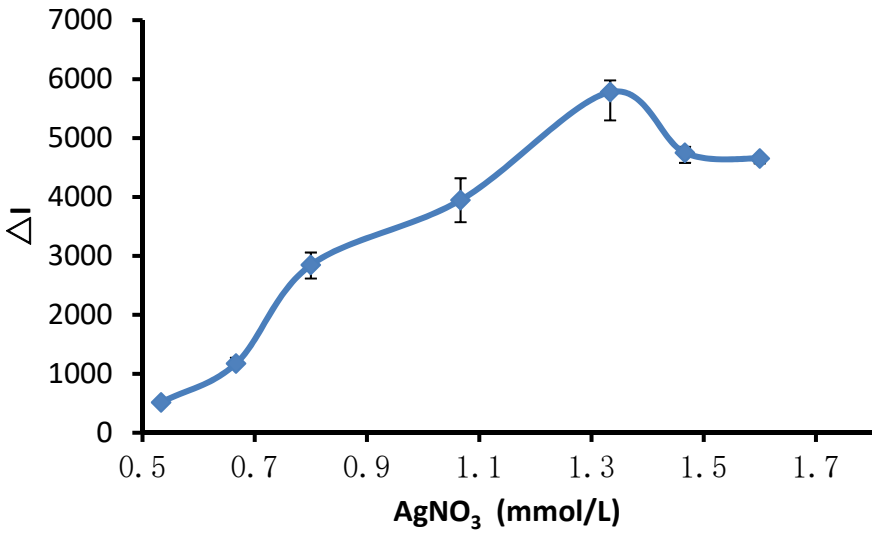

Figure S10. Effect of $AgNO_3$ concentration on the △I value
333.33 μg/L CD-FN3 +x mmol/L $AgNO_3$+6.67 mmol/L TSC+85℃+ 21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

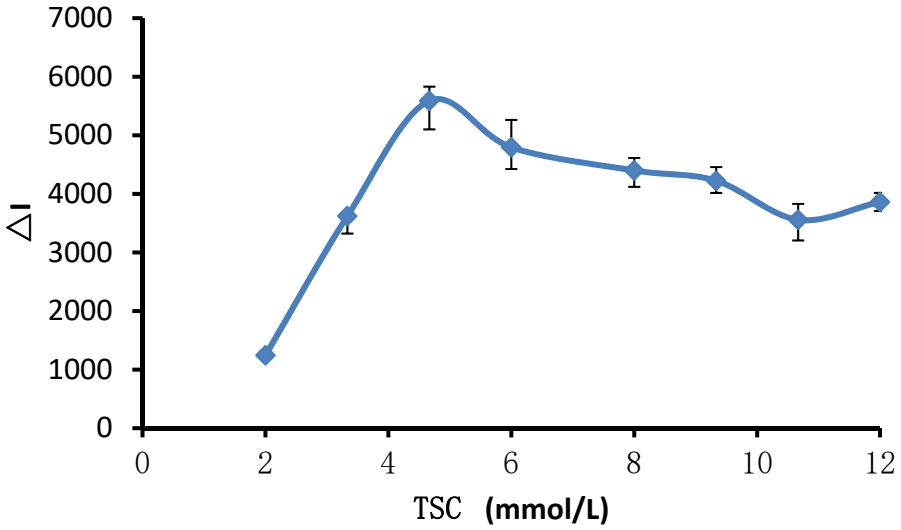

Figure S11. Effect of TSC concentration on the △I value
333.33 μg/L CD-FN3 + 1.33 mmol/L $AgNO_3$+x mmol/L TSC+85℃+ 21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

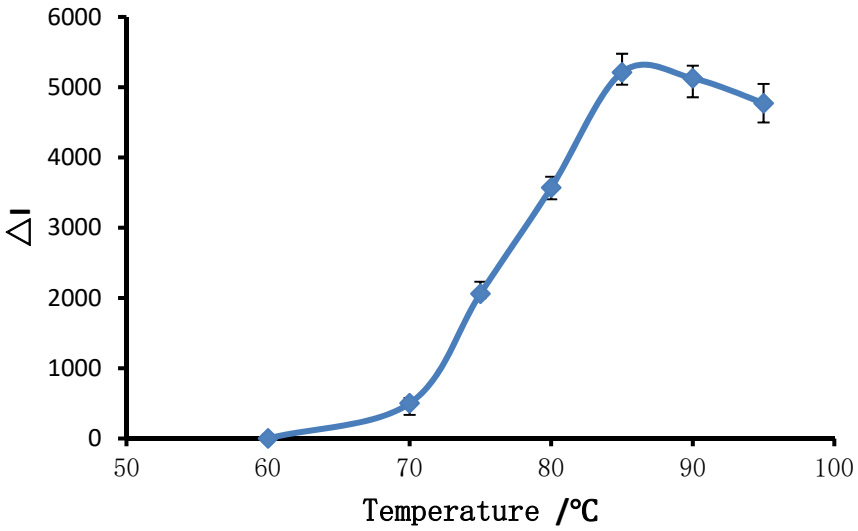

Figure S12. Effect of temperature on the △I value

333.33 μg/L CD-FN3 + 1.33 mmol/L $AgNO_3$+4.67 mmol/L TSC+ x ℃+ 21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

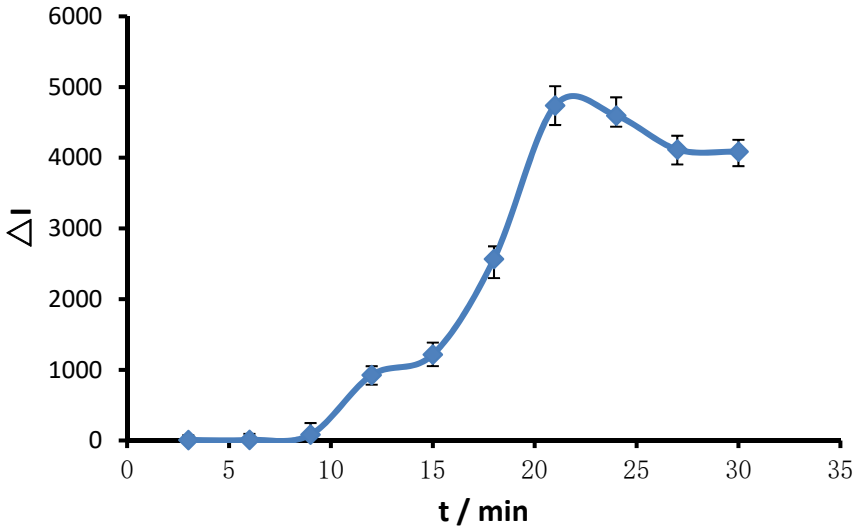

Figure S13. Effect of time on the △I value

333.33 μg/L CD-FN3 + 1.33 mmol/L $AgNO_3$+ 4.67 mmol/L TSC+85℃+ x min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

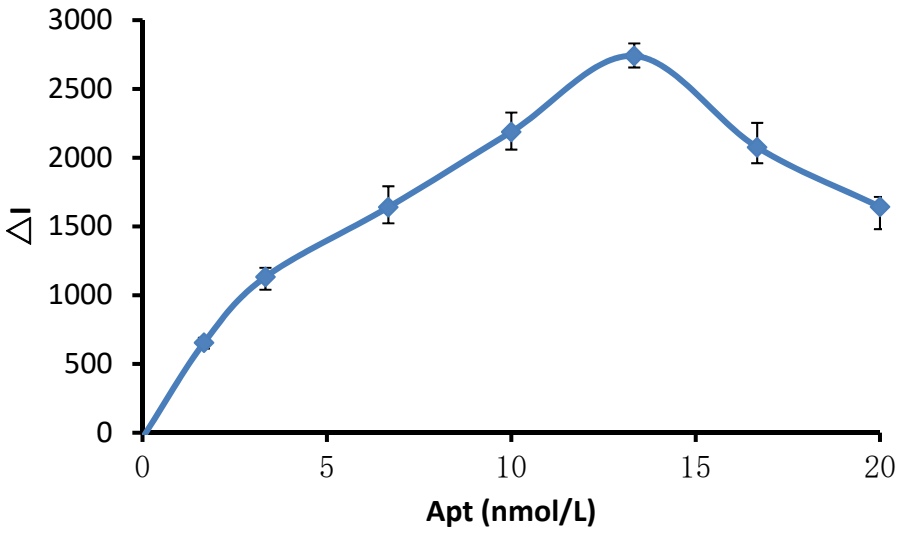

Figure S14. Effect of Apt on the △I value

x nmol/L Apt + 5 μg/L BPA+333.33 μg/L CD-FN3 + 1.33 mmol/L $AgNO_3$+ 4.67 mmol/L TSC+85℃+ 21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

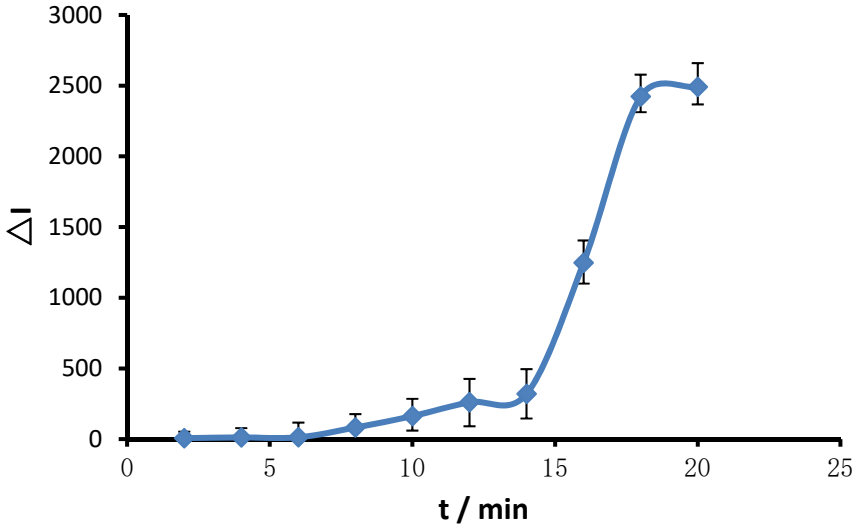

Figure S15. Effect of binding time on the △I value

13.33 nmol/L Apt + 5 μg/LBPA+333.33 μg/L CD-FN3 + 1.33 mmol/L $AgNO_3$+ 4.67 mmol/L TSC+85℃+ 21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

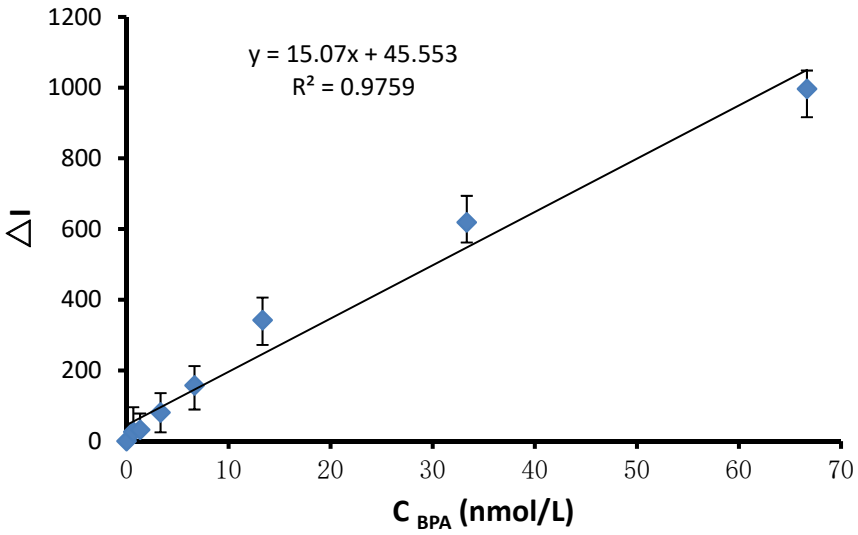

Figure S16. Working curve for the SERS determination of Apt-CD-GN-$AgNO_3$-TSC-BPA 16.67 nmol/L Apt + 266.67 μg/L CD-GN + 0.67-66.67 nmol/L BPA + 1.33 mmol/L $AgNO_3$+ 4.67 mmol/L TSC+85℃+21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

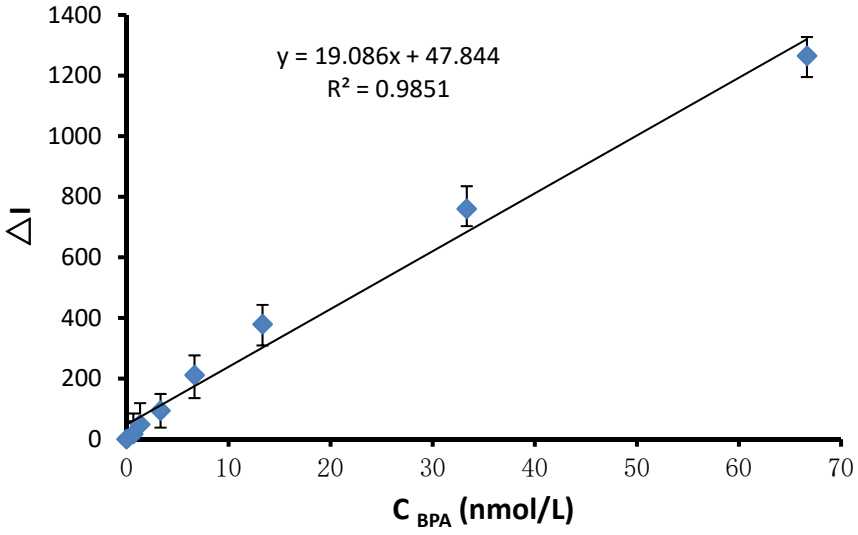

Figure S17. Working curve for the SERS determination of Apt-CD_{Ca}-$AgNO_3$-TSC-BPA 13.33 nmol/L Apt + 133.33 μg/L CD_{Ca} + 0.67-66.67 nmol/L BPA + 1.33 mmol/L $AgNO_3$+ 4.67 mmol/L TSC+85℃+21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

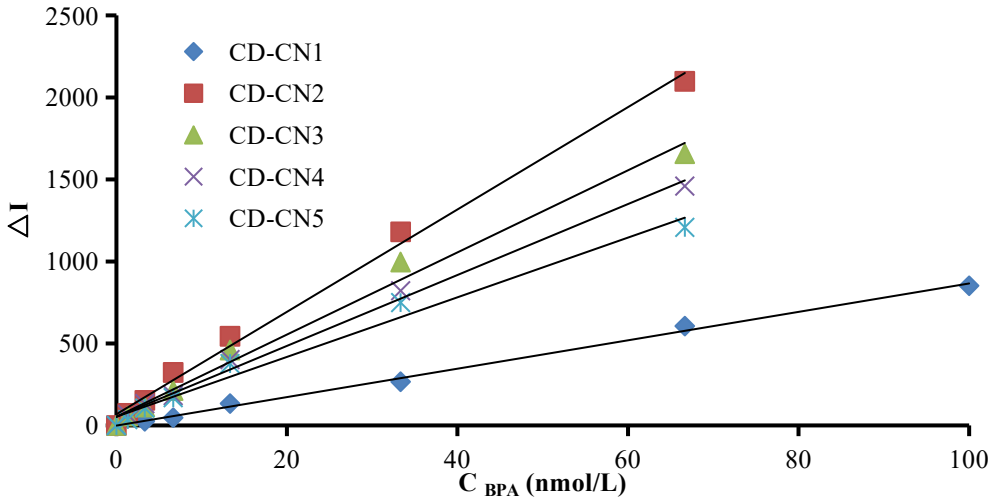

Figure S18. Working curve for the SERS determination of Apt-CD_{CN}-$AgNO_3$-TSC-BPA 13.33 nmol/L Apt + CD_{CN} + 3.33-100 nmol/L BPA + 1.33 mmol/L $AgNO_3$+ 4.67 mmol/L TSC+85℃+21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

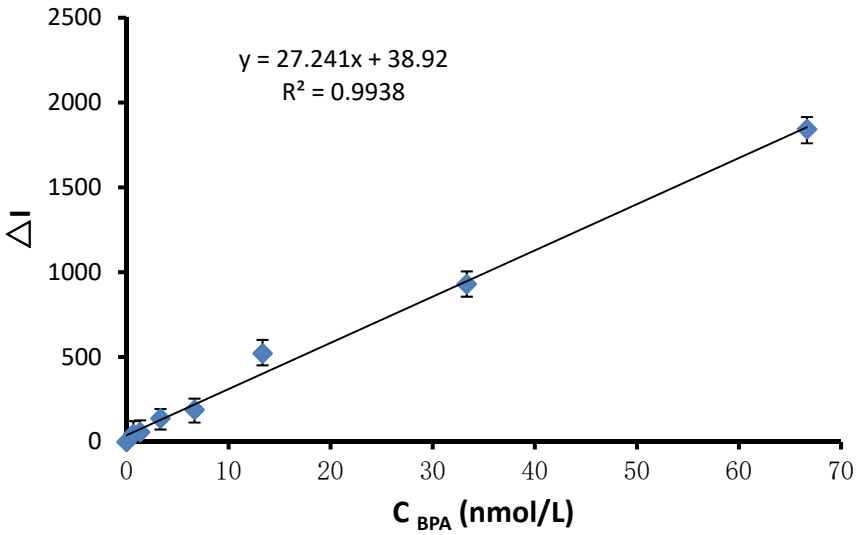

Figure S19. Working curve for the SERS determination of Apt- AgNP -$AgNO_3$-TSC-BPA 6.67 nmol/L Apt + 143.82 μg/L AgNP + 0.67-66.67 nmol/L BPA + 1.33 mmol/L $AgNO_3$+ 4.67 mmol/L TSC+85℃+21 min +3.33×10^{-7} mol/L VBB+0.02 mol/L NaCl

Table S1. The catalytic effect of various catalyst and the inhibiting effect of Apt

Nanocatalyst	Regression equation	Linear range	Correlation coefficient (R^2)
CD-FN0	$\triangle I_{1614cm-1} = 1.00\ C + 66.06$	8.33~1666.67 μg/L	0.985
CD-FN1	$\triangle I_{1614cm-1} = 5.14\ C + 89.51$	3.33~833.33 μg/L	0.9848
CD-FN2	$\triangle I_{1614cm-1} = 14.00\ C + 12.25$	1.67~333.33 μg/L	0.9995
CD-FN3	$\triangle I_{1614cm-1} = 18.97\ C + 15.22$	1.67~333.33 μg/L	0.9985
CD-FN4	$\triangle I_{1614cm-1} = 13.94\ C + 62.59$	1.67~333.33 μg/L	0.989
CD-FN5	$\triangle I_{1614cm-1} = 6.71\ C + 122.74$	8.33~833.33 μg/L	0.994
CD-SN0	$\triangle I_{1614cm-1} = 0.28\ C + 61.53$	83.33~8333.33 μg/L	0.9793
CD-SN1	$\triangle I_{1614cm-1} = 3.41\ C + 73.30$	8.33~1666.67 μg/L	0.9982
CD-SN2	$\triangle I_{1614cm-1} = 7.16\ C + 207.03$	3.33~833.33 μg/L	0.9772
CD-SN3	$\triangle I_{1614cm-1} = 2.48\ C + 112.88$	16.67~1666.67 μg/L	0.9702
CD-SN4	$\triangle I_{1614cm-1} = 2.52\ C + 86.61$	8.33~1666.67 μg/L	0.9889
CD-SN5	$\triangle I_{1614cm-1} = 2.29\ C + 97.20$	8.33~1666.67 μg/L	0.9627
CD_{GN}	$\triangle I_{1614cm-1} = 3.2\ C + 44.60$	13.33~666.67 μg/L	0.9961
CD_{Ca}	$\triangle I_{1614cm-1} = 8.94\ C - 9.15$	6.67~333.33 μg/L	0.9979
CD-CN1	$\triangle I_{1614cm-1} = 0.39\ C + 36.46$	70~2800 μg/L	0.9873
CD-CN2	$\triangle I_{1614cm-1} = 7.13\ C + 133.13$	13.33~666.67 μg/L	0.9914
CD-CN3	$\triangle I_{1614cm-1} = 5.44\ C - 23.67$	13.33~666.67 μg/L	0.9989
CD-CN4	$\triangle I_{1614cm-1} = 6.30\ C + 136.53$	13.33~666.67 μg/L	0.9903
CD-CN5	$\triangle I_{1614cm-1} = 1.77\ C + 49.77$	13.33~1333.33 μg/L	0.9946
Apt- CN3	$\triangle I_{1614cm-1} = 70.17\ C + 63.18$	1.67~16.67 nmol/L	0.9873
Apt- CD-FN3	$\triangle I_{1614cm-1} = 387.19\ C + 213.08$	0.33~10 nmol/L	0.9249
Apt- CD-SN2	$\triangle I_{1614cm-1} = 608.81\ C + 154.77$	0.33~6.67 nmol/L	0.9784
AgNP	$\triangle I_{1614cm-1} = 11.36\ C + 50.21$	1.44~359.56 μg/L	0.9979

Table S2. Selectivity of the analysis of BPA by the SERS method

coexistent ion	Limit times	coexistent ion	Limit times	coexistent ion	Limit times
CO_3^{2-}	1200	K^+	800	Ethyl alcohol	800
Na^+	1000	Zn^{2+}	500	Acetone	800
HCO_3^-	600	Mg^{2+}	200	Phenol	100
Cl^-	1000	NO_3^-	800	HSA	10
Br^-	200	Ca^{2+}	200	BSA	10
BrO_3^-	100	Cu^{2+}	80	Glycine	100
F^-	100	NH_4^+	400	Phenylalanine	50
Ba^{2+}	400	Al^{3+}	100	Valine	50
Fe^{2+}	100	Fe^{3+}	100	Tryptophan	40
Ni^{2+}	80			Glutamic acid	50

Table S3. Sample analysis results (n=5)

Sample	Found		Added	Determination value	Recovery/%
Plastic film 1	-	-	3.33 nmol/L	3.32 nmol/L	99.7%
Plastic film 2	-	-	3.33 nmol/L	3.36 nmol/L	100.9%
Polythene bag 1	-	-	3.33 nmol/L	3.40 nmol/L	102.1%
Polythene bag 2	-	-	3.33 nmol/L	3.28 nmol/L	98.5%
unbranded grocery bag	2.5 nmol/L	2.85 mg/g	3.33 nmol/L	6.01 nmol/L	105.4%
Plastic drinking cup 1	1.4 nmol/L	1.59 mg/g	3.33 nmol/L	4.72 nmol/L	99.7%
Plastic drinking cup 2	-	-	3.33 nmol/L	3.41 nmol/L	102.4%