Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Strong nanocatalysis of silver-doped carbon nitride and its application to aptameric SERS and RRS coupled dual-mode detection of ultra-trace K^+

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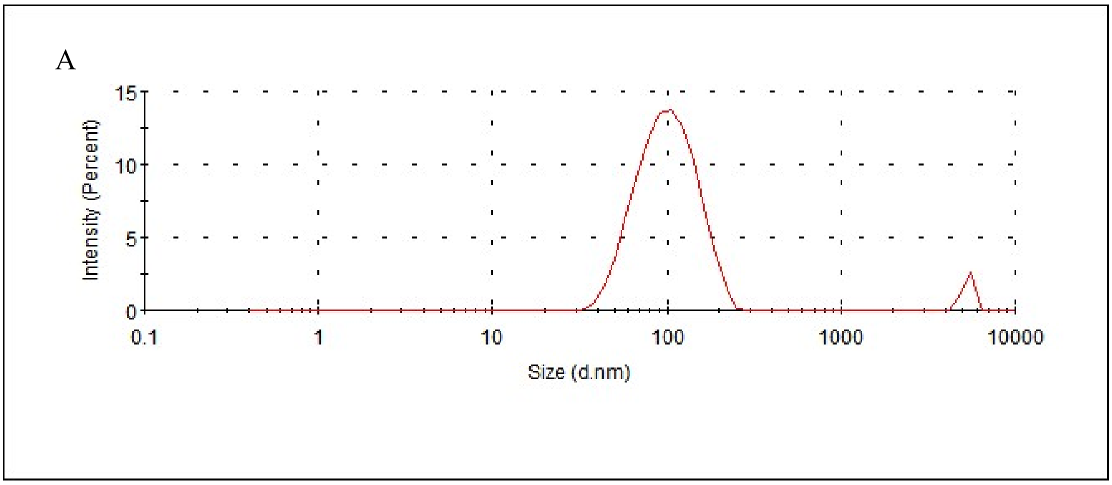
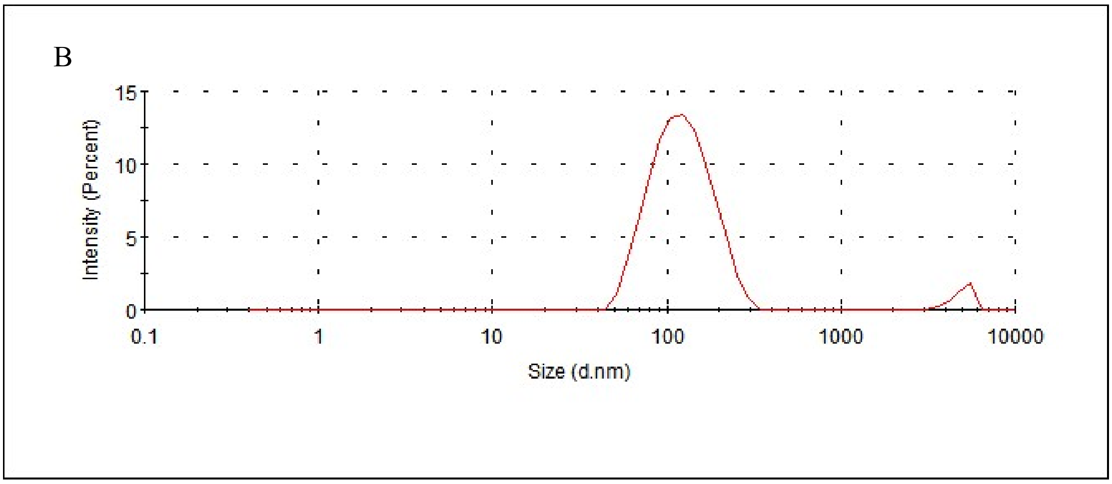




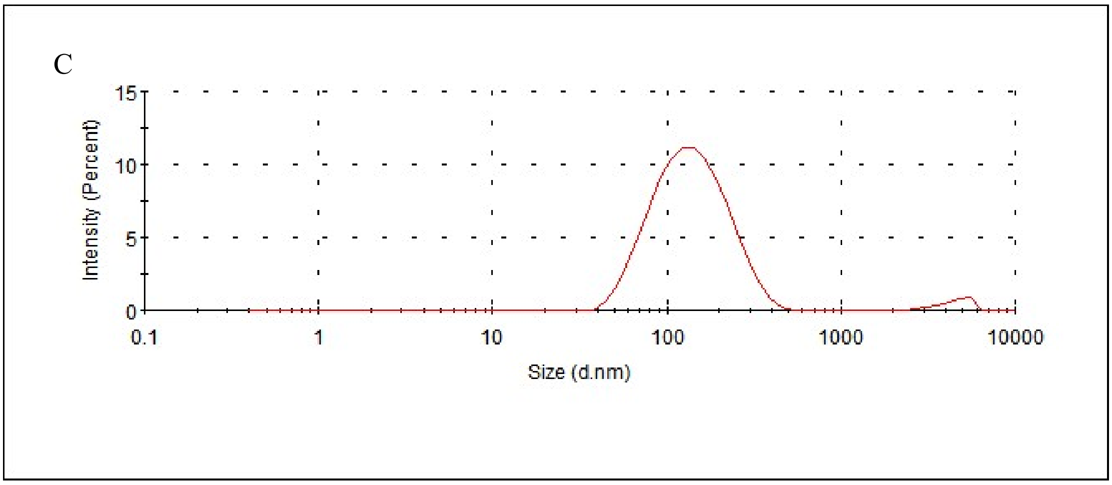


Figure S1 Particle size distribution of KCl-Apt- AgCNs-GL- $HAuCl_4$ systems.

A. 0.1 µmol/L Apt +7.2 µg/mL CNs +5 mmol/L GL +0.25 mmol/L $HAuCl_4$ +1 µmoL/L VBB. B. 0.1 µmol/L Apt +7.2 µg/mL CNs +5 mmol/L GL +0.25 mmol/L $HAuCl_4$ +1 µmoL/L VBB +50 nmol/L KCl. C. 0.1 µmol/L Apt +7.2 µg/mL CNs +5 mmol/L GL +0.25 mmol/L $HAuCl_4$ +1 µmoL/L VBB +100 nmol/L KCl.

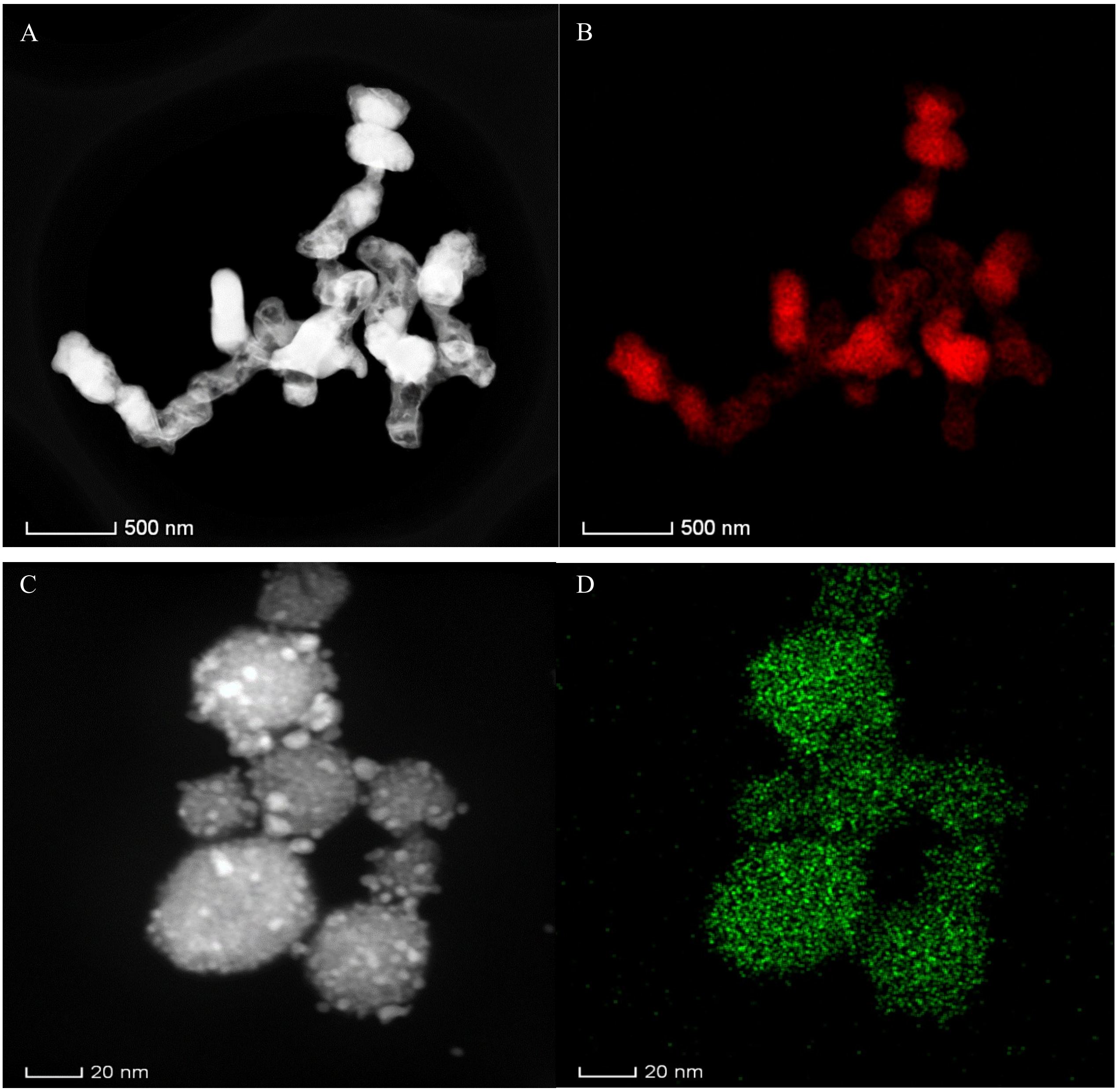
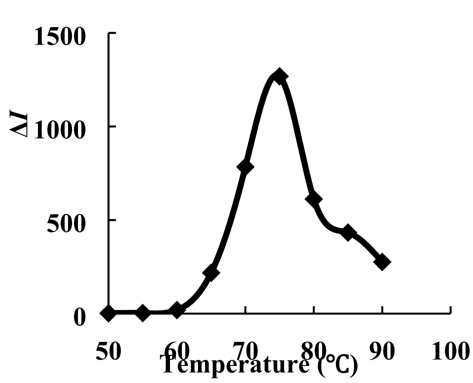
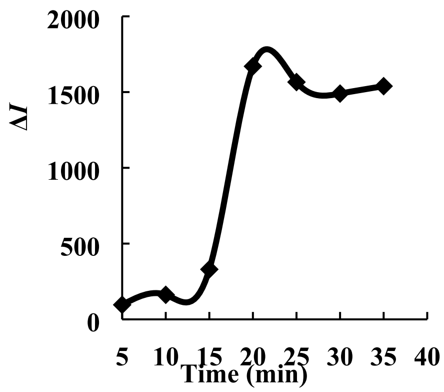


Figure S2. Scanning transmission electron microscope (STEM) and EDS mapping.

A. STEM of AgCNs. B. Ag EDS mapping in AgCNs. C. STEM of reaction system. D. Au EDS mapping in reaction system.



A



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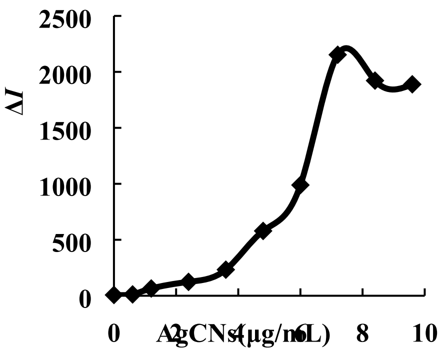

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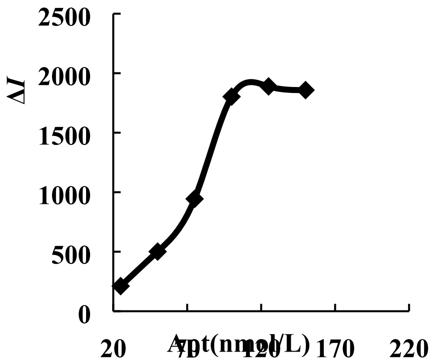

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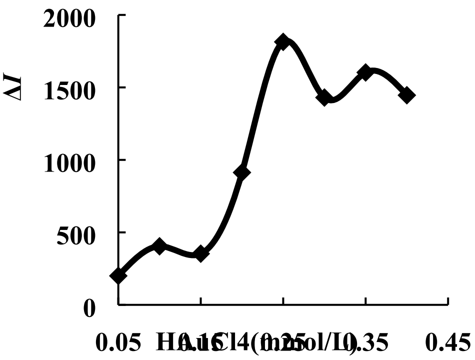

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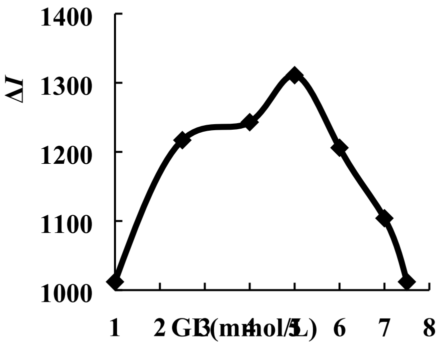

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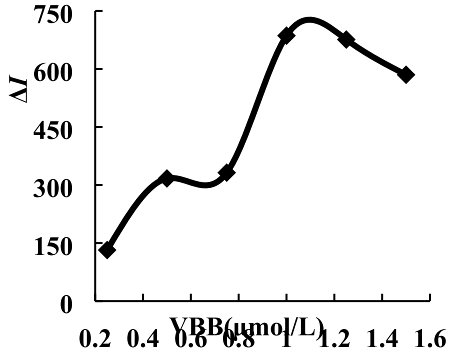

G

Figure S3. Optimization of analysis conditions.

A. Optimization of reaction temperature. 0.1 µmol/L Apt +7.2 µg/mL AgCNs +5 mmol/L GL +0.25 mmol/L $HAuCl_4$ +1 µmoL/L VBB. B. Optimization of reaction time. 0.1 µmol/L Apt +7.2 µg/mL AgCNs +5 mmol/L GL +0.25 mmol/L $HAuCl_4$ +1 µmoL/L VBB. C. Optimization of AgCNs concentration. 0.1 µmol/L Apt +5 mmol/L GL +0.25 mmol/L $HAuCl_4$ +1 µmoL/L VBB. D. Optimization of Apt concentration. 7.2 µg/mL AgCNs +5 mmol/L GL +0.25 mmol/L $HAuCl_4$ +1 µmoL/L VBB. E. Optimization of $HAuCl_4$ concentration. 0.1 µmol/L Apt +7.2 µg/mL AgCNs +5 mmol/L GL +1 µmoL/L VBB. F. Optimization of GL concentration. 0.1 µmol/L Apt +7.2 µg/mL AgCNs +0.25 mmol/L $HAuCl_4$ +1 µmoL/L VBB. G. Optimization of VBB concentration. 0.1 µmol/L Apt +7.2 µg/mL AgCNs +5 mmol/L GL +0.25 mmol/L $HAuCl_4$.

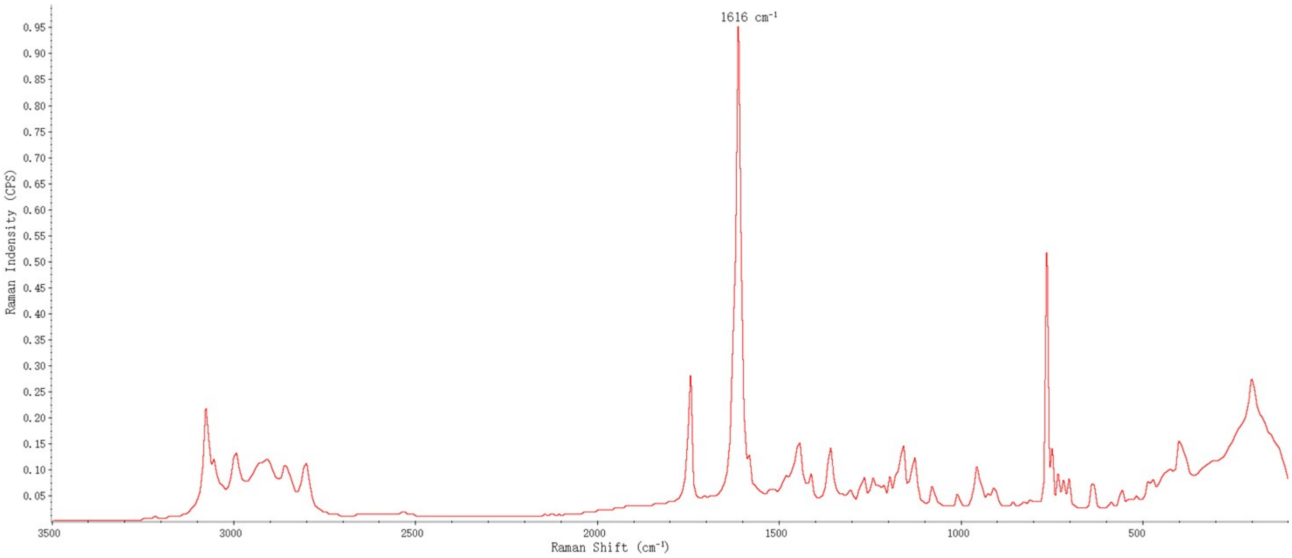

Figure S4. The pure VBB Raman spectrum.

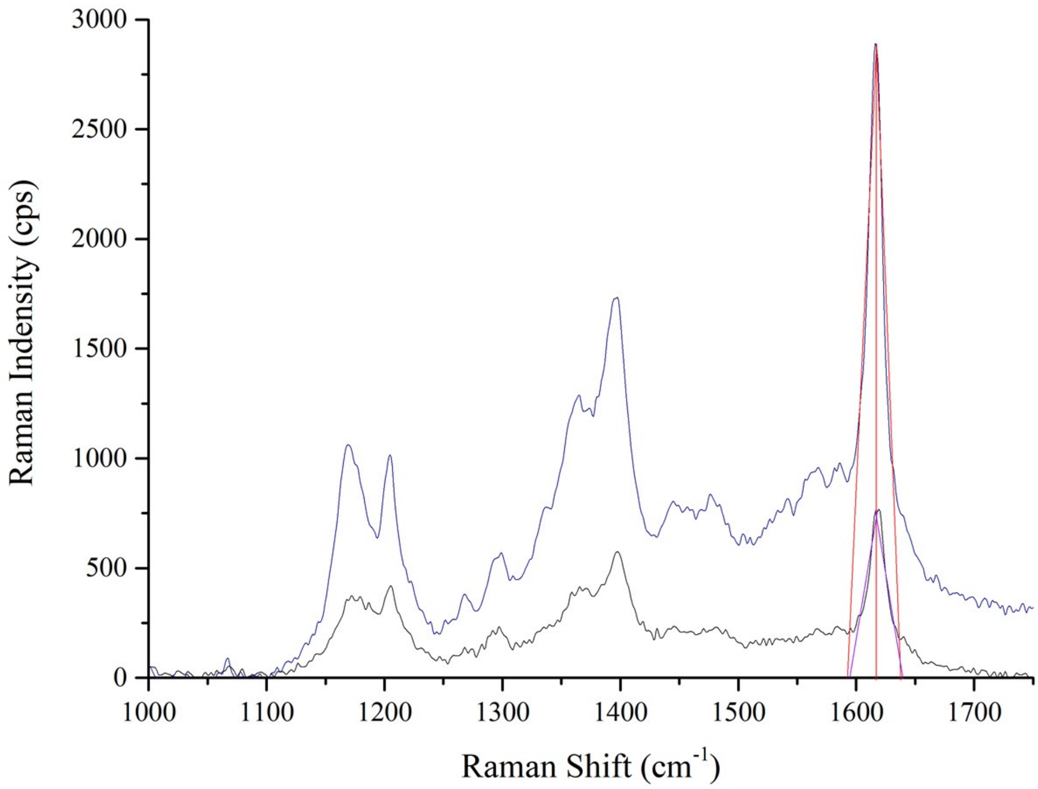

Figure S5. Peak area fitting.

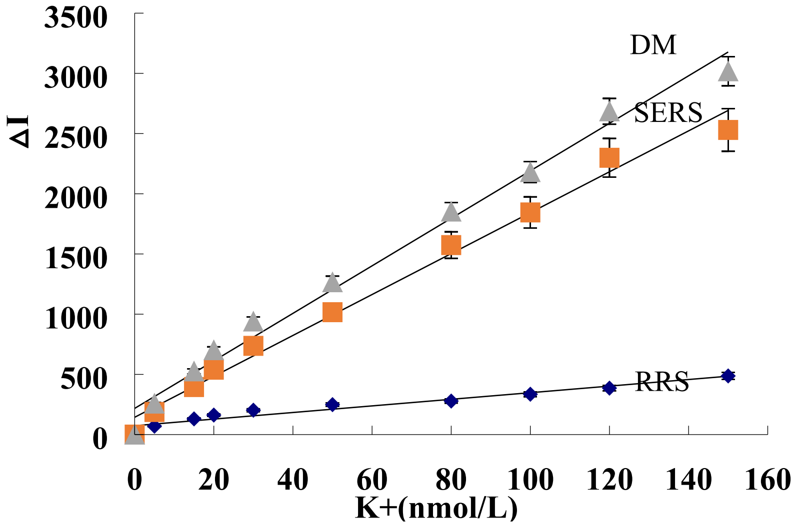

Figure S6. SERS, RRS and dual-mode working curves.

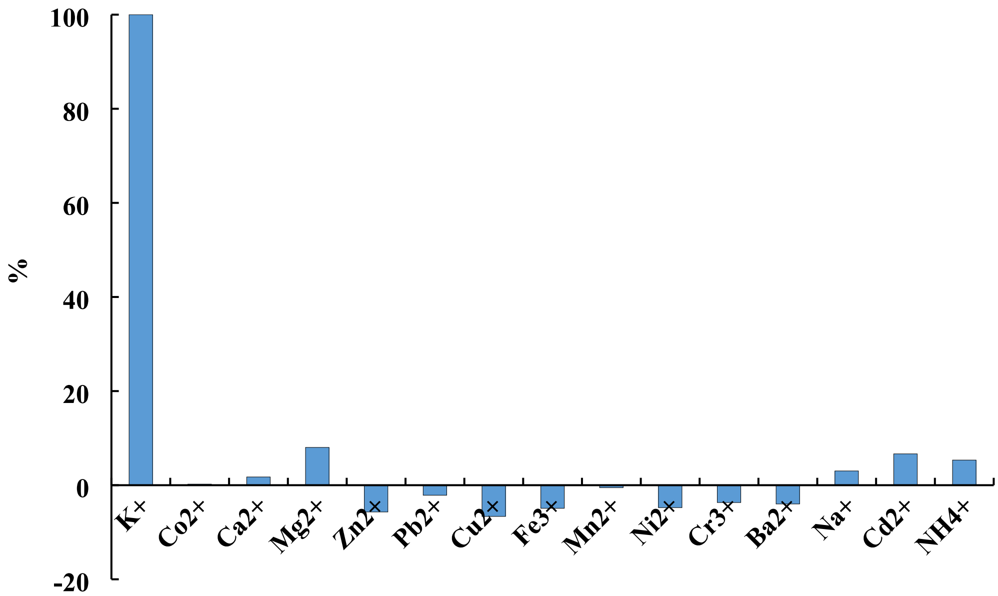

Figure S7. Influence of coexisting substances.

Table S1. Precision of SERS, RRS and dual-mode Apt-mediated nanocatalytic system.

Method	K^+ concentration (nmol/L)	Single measured value (A.U.)	Average (A.U.)	RSD (%)
SERS	20	476, 483, 551, 582, 495, 449, 465	500.14	9.67
	40	841, 838, 912, 793, 813, 799, 841	833.86	4.78
RRS	20	135, 128, 128, 129, 119, 127, 131	128.14	3.78
	40	178, 186, 184, 179, 183, 181, 177	181.14	1.84
SERS-RRS	20	611, 611, 679, 711, 614, 576, 596	628.1	7.68
	40	1019, 1024, 1096, 972, 996, 980, 1018	1014.9	4.04

Table S2. Comparison of reported Apt methods for determining potassium ions.

Method	Method principle	LR	LOD	Comments	Ref.
Colorimetric	Based on DNA G-quadruplex conformation and salt-induced AuNPs aggregation.	1 μM -1 mM	0.42 μmol/L	Low sensitivity	37
Fluorescence	Two arm fragments and a dual-labeled Apt serving as a signal transduction probe complementary of arm fragment sequence.	0.05-1.4 mmol/L	0.014 mmol/L	Narrow linear range	38
Fluorescence	HPPA can be oxidized by H_2O_2 into a fluorescent product in the presence of DNAzyme.	2.5 μM -5 mM(logarithm)	-	Complex material preparation	39
Electrochemical	Based on a conformational change to afford an electric signal transduced electrochemically.	3.61–4.85 mM	-	Narrow linear range	47
Fluorescence resonance energy transfer	Cationic conjugated polyelectrolytes-triggered conformational change of molecular beacon Apt.	-	1.5nM	High sensitivity	48
SER-RRS dual-mode	Apt reduce the SERS and RRS signal of CNs. After adding K^+, the signals recovery.	5-150 nmol/L	0.92 nmol/L	Simple, fast, and highly sensitive.	This article

Table S3. Water sample analysis results（n=5）.

Samples	measured value（nmol/L）	average value (nmol/L)	spiked sample（nmol/L）	spiked sample measured（nmol/L）	Recovery rate（%）	RSD（%）	K^+ actual value (nmol/L)
Sample 1	7.75, 7.94, 8.04, 8.11, 8.12	7.99	50	59.50	103.02	1.92	15.98
Sample2	31.54, 30.21, 31.18, 31.07, 32.01	31.20	50	79.91	97.42	2.13	62.40
Sample 3	17.22, 17.17, 17.68, 17.35, 16.81	17.25	50	67.35	100.21	1.82	35.50