

Electronic Supplementary Material

Cystine-assisted accumulation of gold nanoparticles on ZnO to construct a sensitive surface-enhanced Raman spectroscopy substrate

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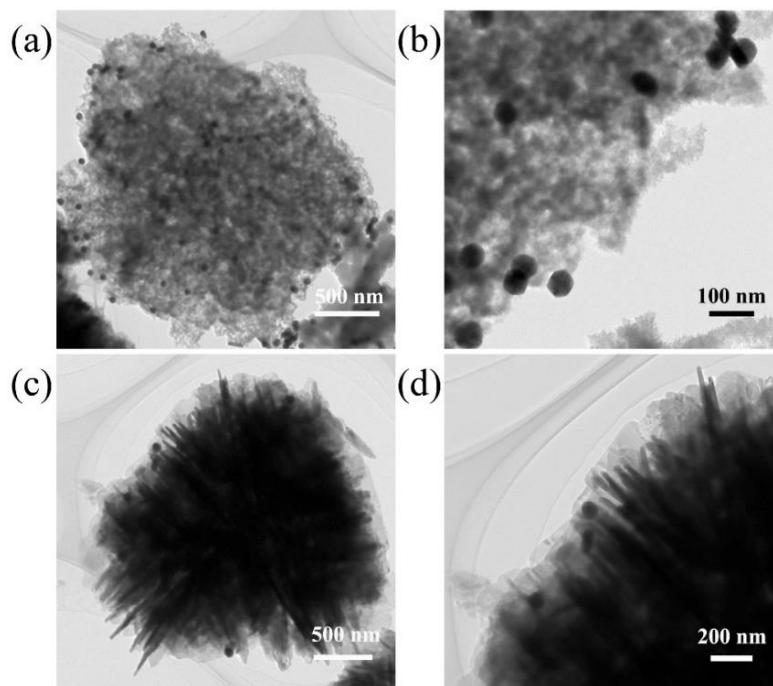


Fig. S1 (a,b) TEM images of ZnO/Au/cys with different magnifications. (c, d) TEM images of ZnO/Au with different magnifications.

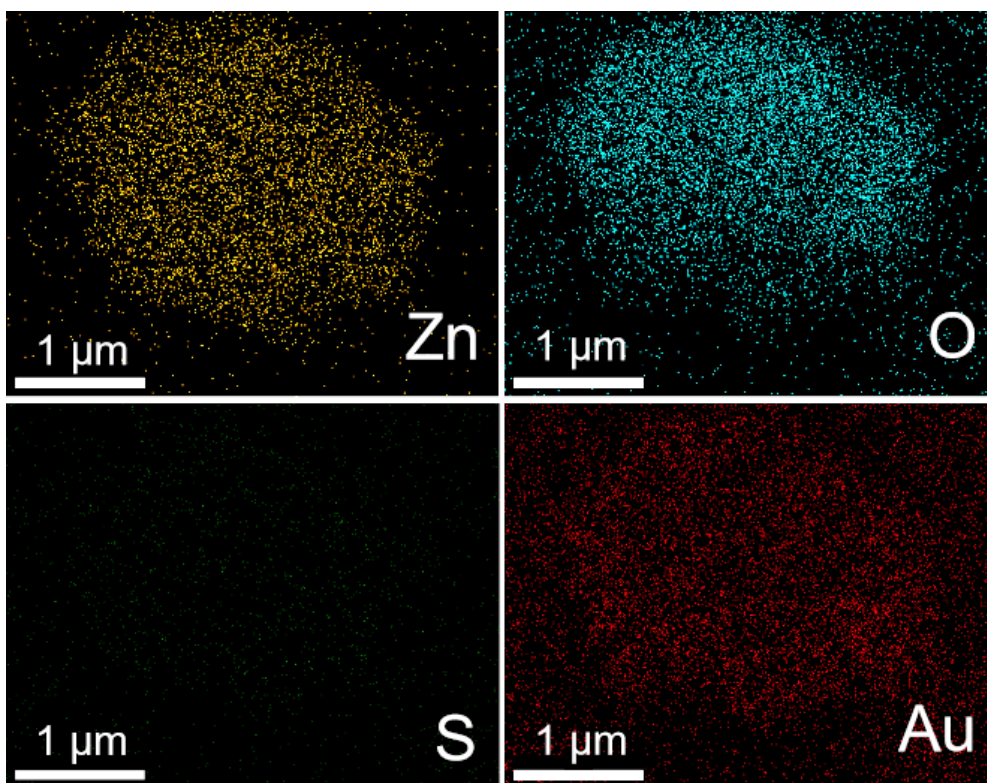


Fig. S2 Elemental analysis of ZnO/Au.

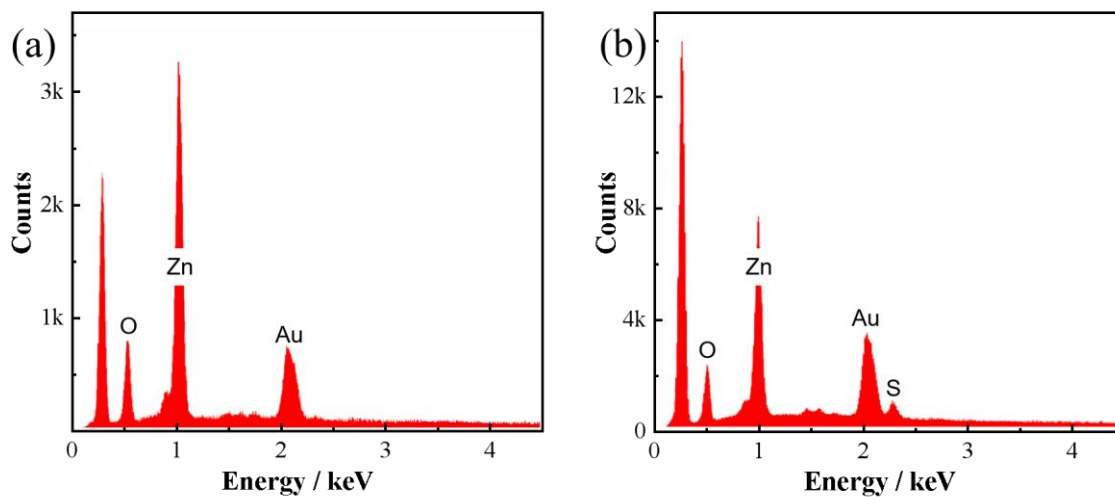


Fig. S3 The EDX spectrum of ZnO/Au (a) and ZnO/Au/cys (b).

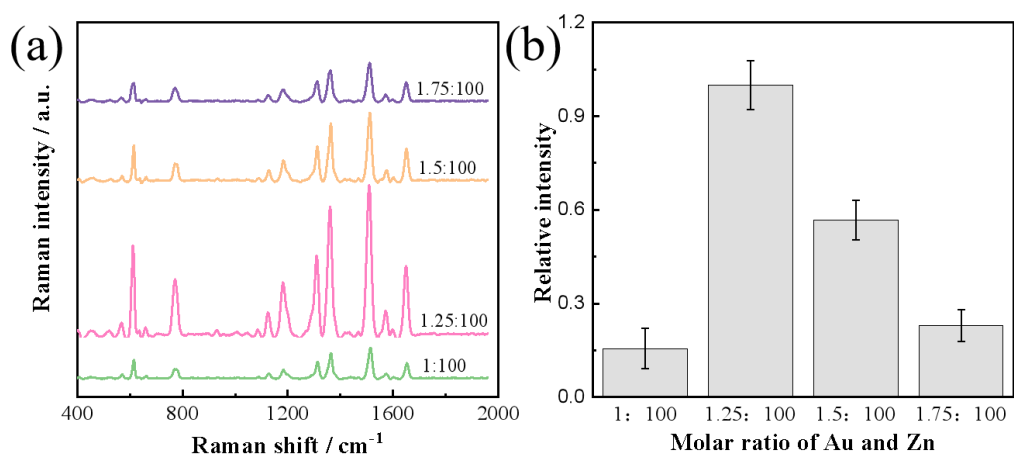


Fig. S4 (a) Raman spectra of R6G (10^{-7} M) detected on ZnO/Au/cys fabricated at different Au:Zn ratios. (b) The corresponding peak intensity at 1510 cm^{-1} .

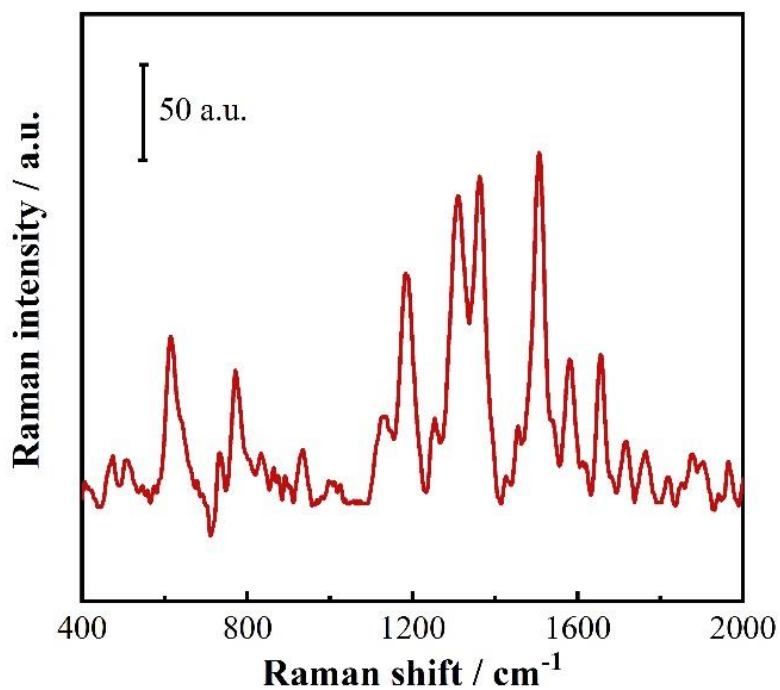


Fig. S5 Normal Raman spectrum of 10^{-4} M R6G solution on a quartz glass slide.

Table S1 Comparison of detection ability for R6G on different Raman substrates.

SERS substrate	R6G LOD ^{a)} /(nM)	R6G detection range /(M)	EF	Reference
Gold nanorod array	1	10 ⁻⁴ -10 ⁻⁹	5.6×10 ⁷	[1]
Au/DW	100	10 ⁻³ -10 ⁻⁷	2.8×10 ⁶	[2]
MWNTs-AuNPs	0.1	10 ⁻⁵ -10 ⁻¹⁰	2.4×10 ⁷	[3]
AuNPs@ZnO	0.1	10 ⁻⁴ -10 ⁻¹⁰	4.96×10 ⁵	[4]
Gold HMNs/ZnO	0.1	N.D. ^{b)}	N.D.	[5]
ZnO/Ag nanosheets	0.1	N.D.	N.D.	[6]
Au/ZnONRs/G	1	10 ⁻³ -10 ⁻⁹	2.3×10 ⁶	[7]
ZnO/Au/cys	0.01	10 ⁻⁶ -10 ⁻¹¹	1.44×10 ⁸	This work

a) LOD means limit of detection.

b) N.D. means this information was not demonstrated in the reference.

Table S2 Comparison of the enhancement factor (EF), storage stability and homogeneity of different Raman substrates.

SERS substrate	EF	Storage stability	Homogeneity	Reference
Au/ZnO nano urchins	1.9×10 ⁸	N.D. ^{a)}	5.4%	[8]
3D ZnO/Ag	7×10 ⁵	At least 6 months	N.D.	[9]
AuNPs/PET	2×10 ⁶	At least 2 months	9.5%	[10]
Mg-doped ZnO@Ag	2.41×10 ⁷	At least 6 months	<13%	[11]
g-C ₃ N ₄ @Ag	3.21×10 ⁶	N.D.	16.1%	[12]
ZnO-Ag nanorods	4.3×10 ⁸	At least 1 months	25%	[13]
Cu ₂ O/Ag nanoflower	10 ⁸	At least 7 days	<9.7%	[14]
ZnO/Au/cys	1.44×10 ⁸	At least 2 months	<9.68%	This work

a) N.D. means this information was not demonstrated in the reference.

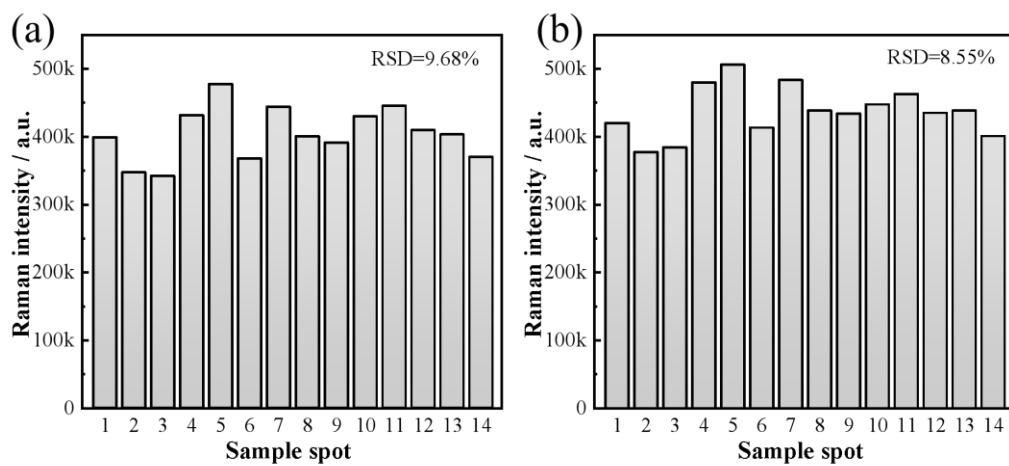


Fig. S6 Raman intensities at 1361 cm⁻¹ (a) and 1510 cm⁻¹ (b) obtained from 14 randomly selected spots on ZnO/Au/cys.

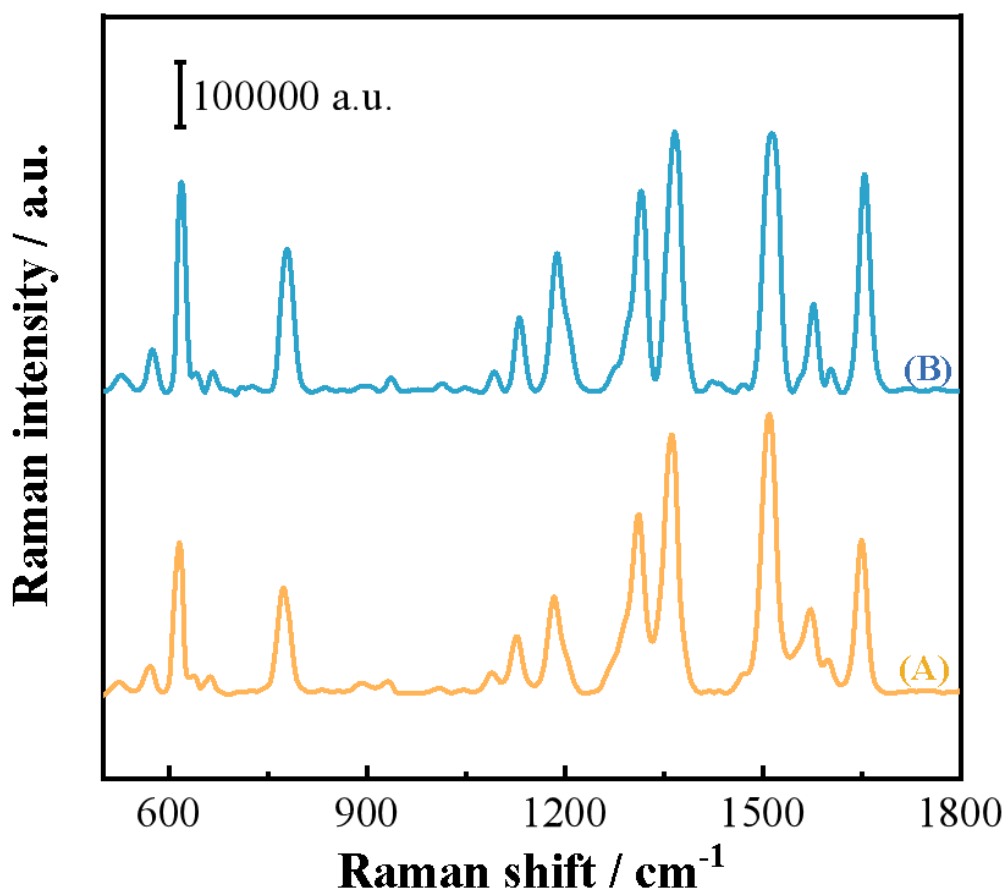


Fig. S7 SERS spectra of 10⁻⁶ M R6G detected on ZnO/Au/cys. Freshly fabricated (A) and after 2 months of storage (B).

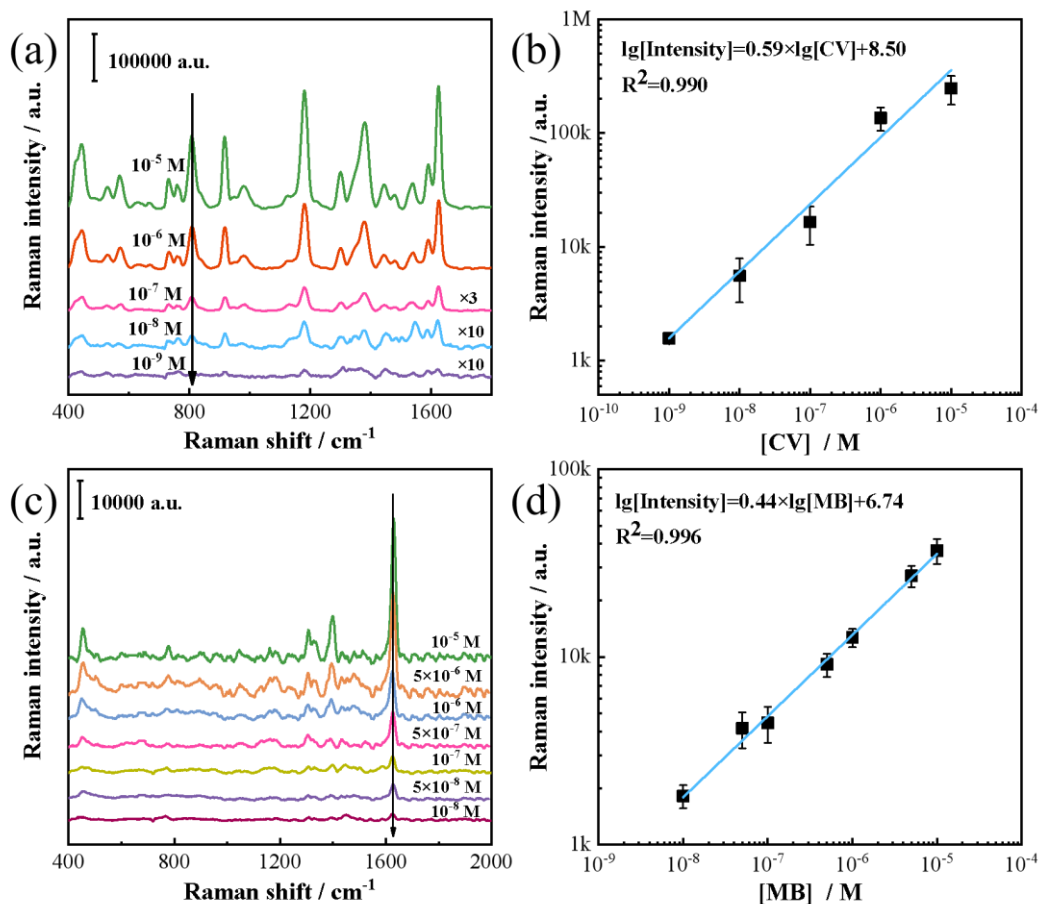


Fig. S8 (a) SERS spectra of different concentrations of CV (from 10^{-5} M to 10^{-9} M). (b) The linear relationship between Raman intensity at 1180 cm^{-1} and the concentrations of CV (logarithmic concentration and intensity). (c) SERS spectra of different concentrations of MB (from 10^{-5} M to 10^{-8} M). (d) The linear relationship between Raman intensity at 1625 cm^{-1} and concentrations of MB (logarithmic concentration and intensity).

Table S3 Comparison of detection ability for CV and MB on different substrates.

Analyte	SERS substrate	Detection range (M)	LOD ^{a)} /(nM)	Reference
CV	Ag@ZIF-8 nanowires	N.D. ^{b)}	10	[15]
	AuNPs/ZnONRs/C chip	10^{-3} - 10^{-10}	0.1	[16]
	ZnO/Ag	10^{-7} - 10^{-9}	1	[17]
	Ag nanoparticles/porous polymer	10^{-4} - 10^{-8}	10	[18]
	ZnO/Au/Cys	10^{-5} - 10^{-9}	1	This work
MB	g-C ₃ N ₄ @Ag	10^{-3} - 10^{-7}	100	[12]
	Cu ₂ O/Ag nanoflower	10^{-3} - 10^{-8}	10	[14]
	ZnO/Ag	10^{-6} - 10^{-8}	10	[19]
	ZnO nanowire-AuNPs	10^{-5} - 10^{-7}	100	[20]
	ZnO/Au/cys	10^{-5} - 10^{-8}	10	This work

a) LOD means limit of detection.

b) N.D. means this information was not demonstrated in the reference.

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