

Supporting information

for

Highly Stable Surface-enhanced Raman Spectroscopy Assay on Abnormal Thrombin Levels in Blood Plasma of Cancer Patients

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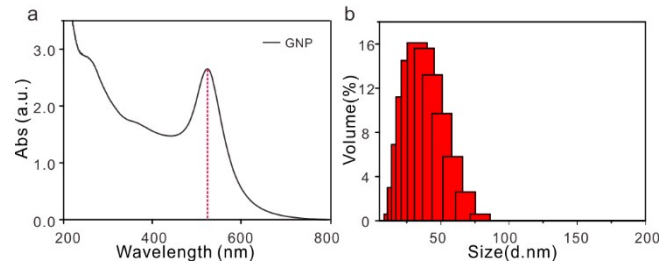


Figure S1. (a) UV-Vis spectra of GNP; (b) The particle sizes of GNPs measured by DLS.

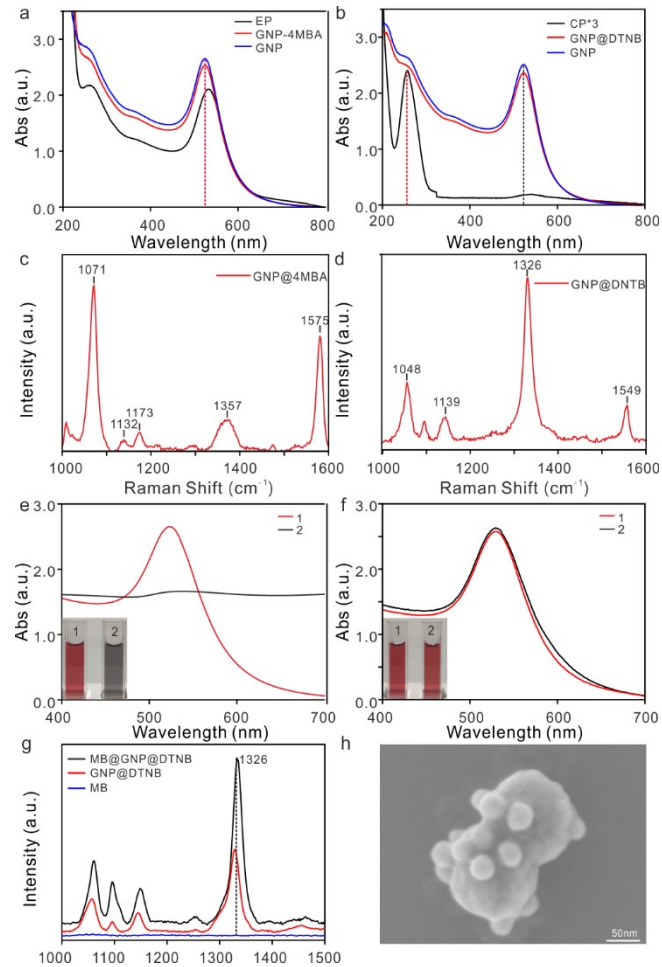


Figure S2. (a and b) UV-Vis spectra of as-prepared GNP, GNP@4MBA, EP, GNP@DTNB, and CP, respectively; (c and d) SERS spectra of the as-prepared GNP@4MBA, GNP@DTNB; (e and f) UV-Vis spectra of the pure GNP sols and the as-prepared EP, respectively, in the absence (1, red line) or presence (2, black line) of 2 M NaCl. The inserts are the photo of corresponding solutions; (g) SERS spectra of the as-prepared MB, GNP@DTNB, and MB@GNP@DTNB; (h) SEM image of CP.

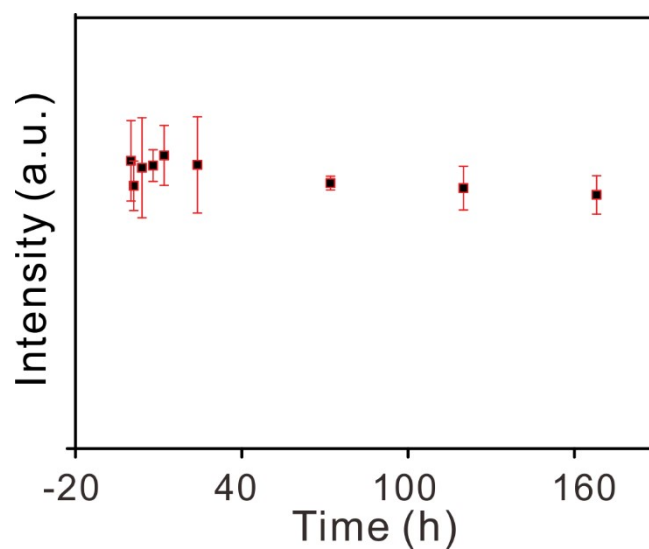


Figure S3. The Raman intensity of CP changes within 7 days, and the error bar represents the error of three measurements.

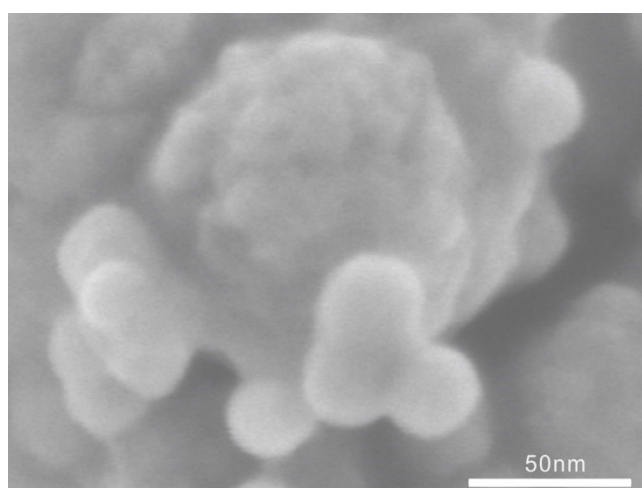


Figure S4. SEM image of EP/TB/CP.

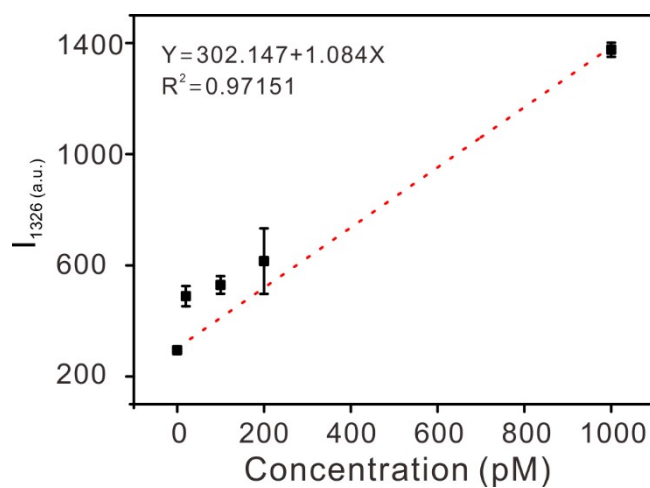


Figure S5. The calibration curve for the SERS intensity at 1326 cm⁻¹ as a linear function of the

concentration of TB ($R^2=0.97151$). Error bars indicate standard deviations from three measurements.

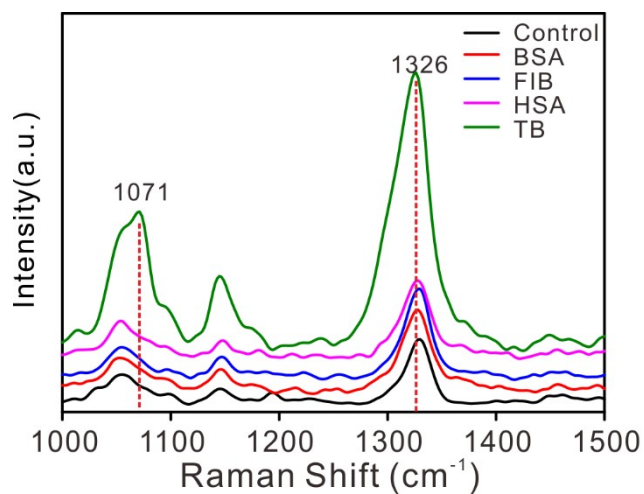


Figure. S6 Raman spectra of different proteins.

Table S1. Functional groups and vibration modes of reporter molecules 4MBA and DTNB. ^{1,2}

Raman Shift 4MBA (cm ⁻¹)	Assignment	Raman Shift DTNB (cm ⁻¹)	Assignment
1071	v(CC) _{ring}	1048	CH ₃ rocking
1132	δ(CH)	1139	v (CN) and δ (CN)
1173	δ(CH)	1326	vs(NO ₂)
1357	vs(COO ⁻)	1549	v (aromatic ring)
1575	v(CC) _{ring}		

Table S2. Statistical analysis of intensity at 1071 cm⁻¹ and 1326 cm⁻¹ in cancer patients, normal and control.

1071cm ⁻¹	<i>p</i>	1326 cm ⁻¹	<i>p</i>
Cancer1- Control	P<0.001	Cancer1- Normal	P<0.001
Cancer2-Control	P<0.001	Cancer2-Control	P<0.001
Cancer3-Control	P<0.001	Cancer3-Control	P<0.001
Cancer1-Normal	0.013	Cancer1-Normal	0.002
Cancer2- Normal	0.003	Cancer2- Normal	0.025
Cancer3- Normal	0.002	Cancer3- Normal	P<0.001
Normal- Control	P<0.001	Normal- Control	0.009

Reference

1. C. J. Orendorff, A. Gole, T. K. Sau and C. J. Murphy, *Analytical Chemistry*, 2005, **77**, 3261-3266.
2. C. C. Lin and C. W. Chang, *Biosensors & Bioelectronics*, 2014, **51**, 297-303.