

Supporting Information

Multifunctional open-droplet microfluidic chemosensing of ractopamine in real sample: A user-oriented flexible nano-architecture for *on-site* food and pharmaceutical analysis

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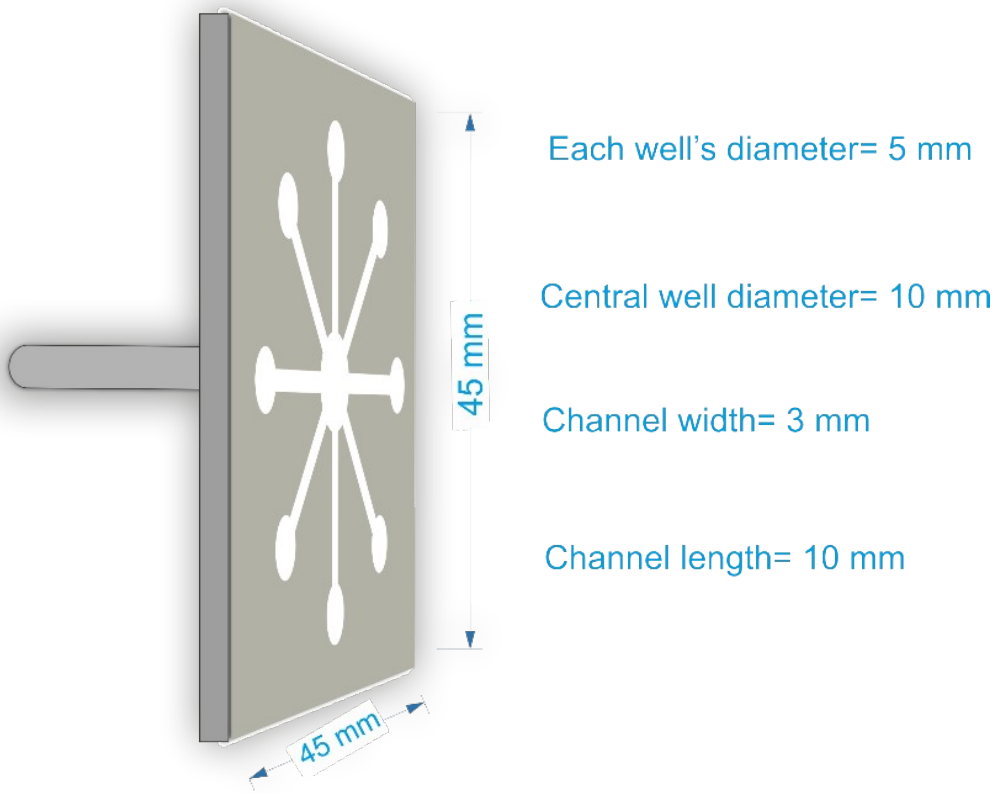
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Scheme. S1. Dimensional figures of the iron stencil.

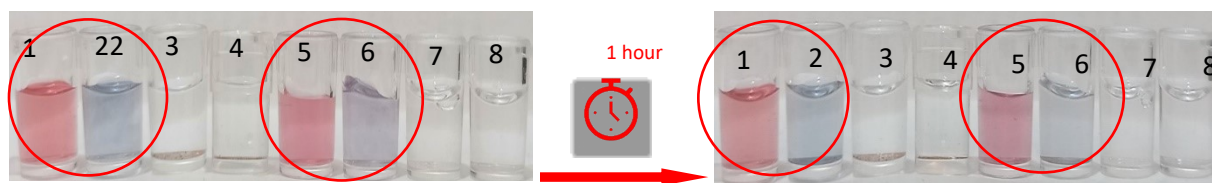


Fig. S1. Photographic images of **1.** AuNPs-CysA, **2.** AuNPs-CysA+ RAC (1:1), **3.** Positively charged AuNPs, **4.** AuNPs Black+ RAC (1:1), **5.** AuNPs-DDT, **6.** AuNPs-DDT+ RAC (1:1), **7.** GNSs, **8.** Gold nano-stars (GNSs) + RAC (1:1) at the moment of reaction and one hour later.

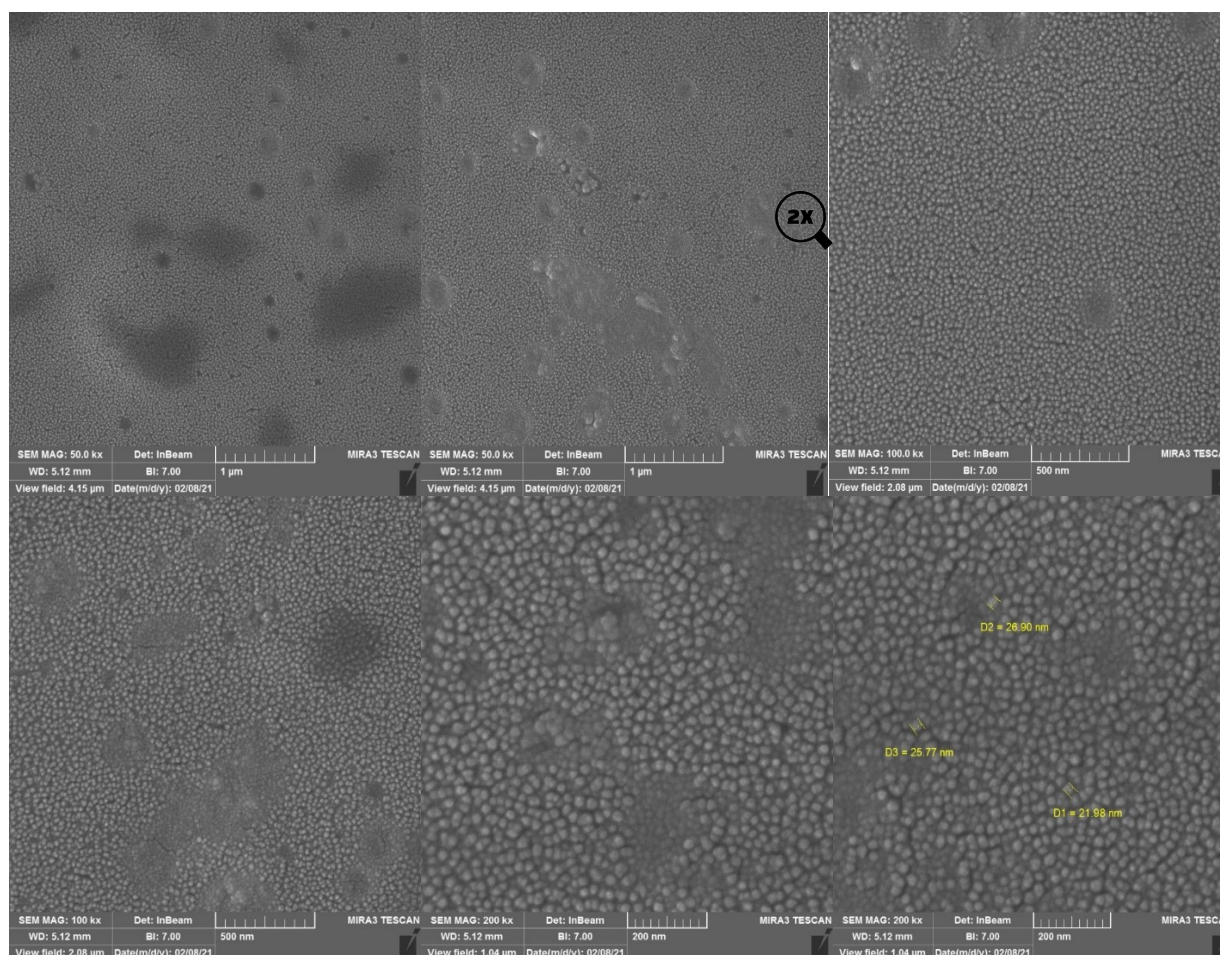


Fig. S2. FE-SEM graphs of AuNPs-CysA from a view field of 4.15 μm to 1.04 μm .

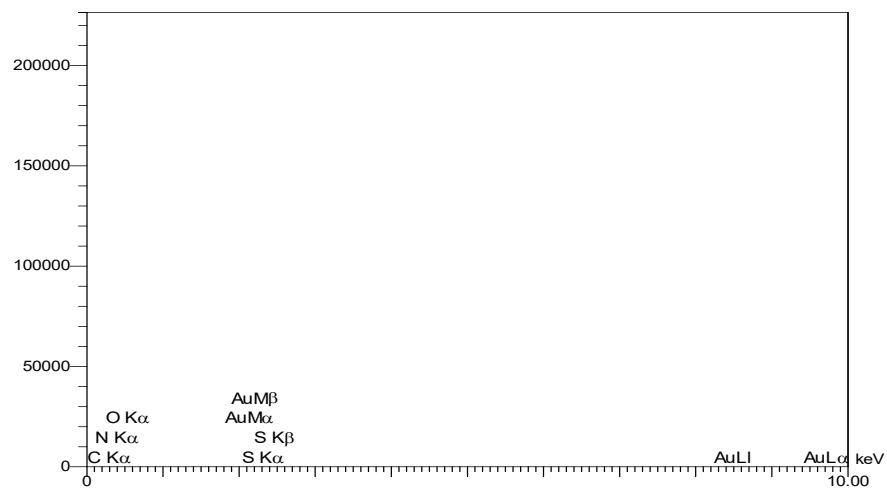


Fig. S3. EDAX-EDS diagram for AuNPs-CysA.

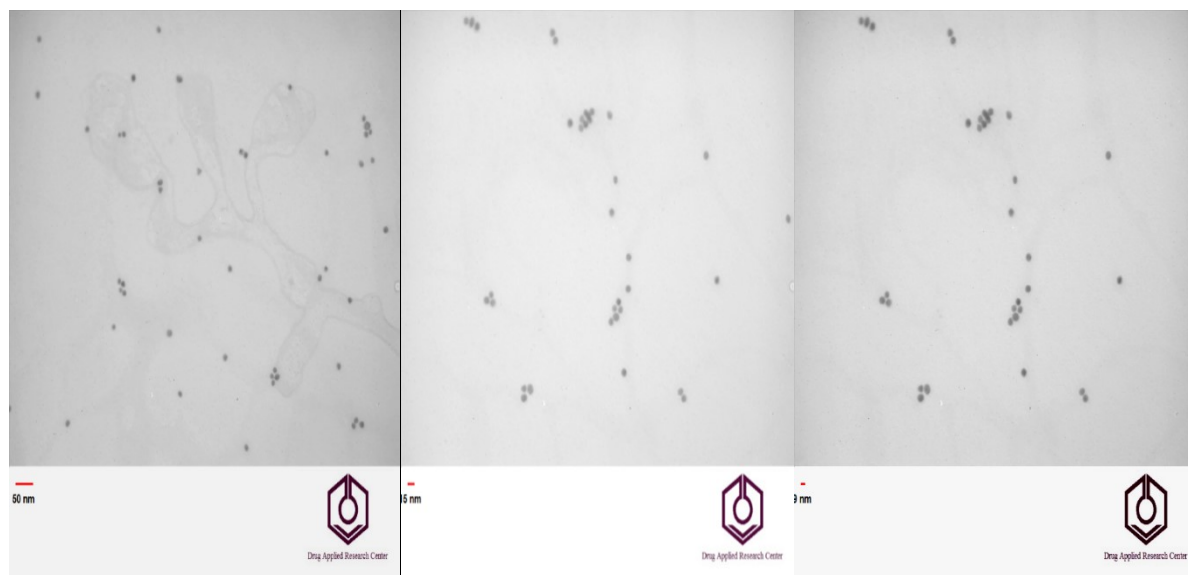


Fig. S4. TEM images of AuNPs-CysA in three different magnifications.

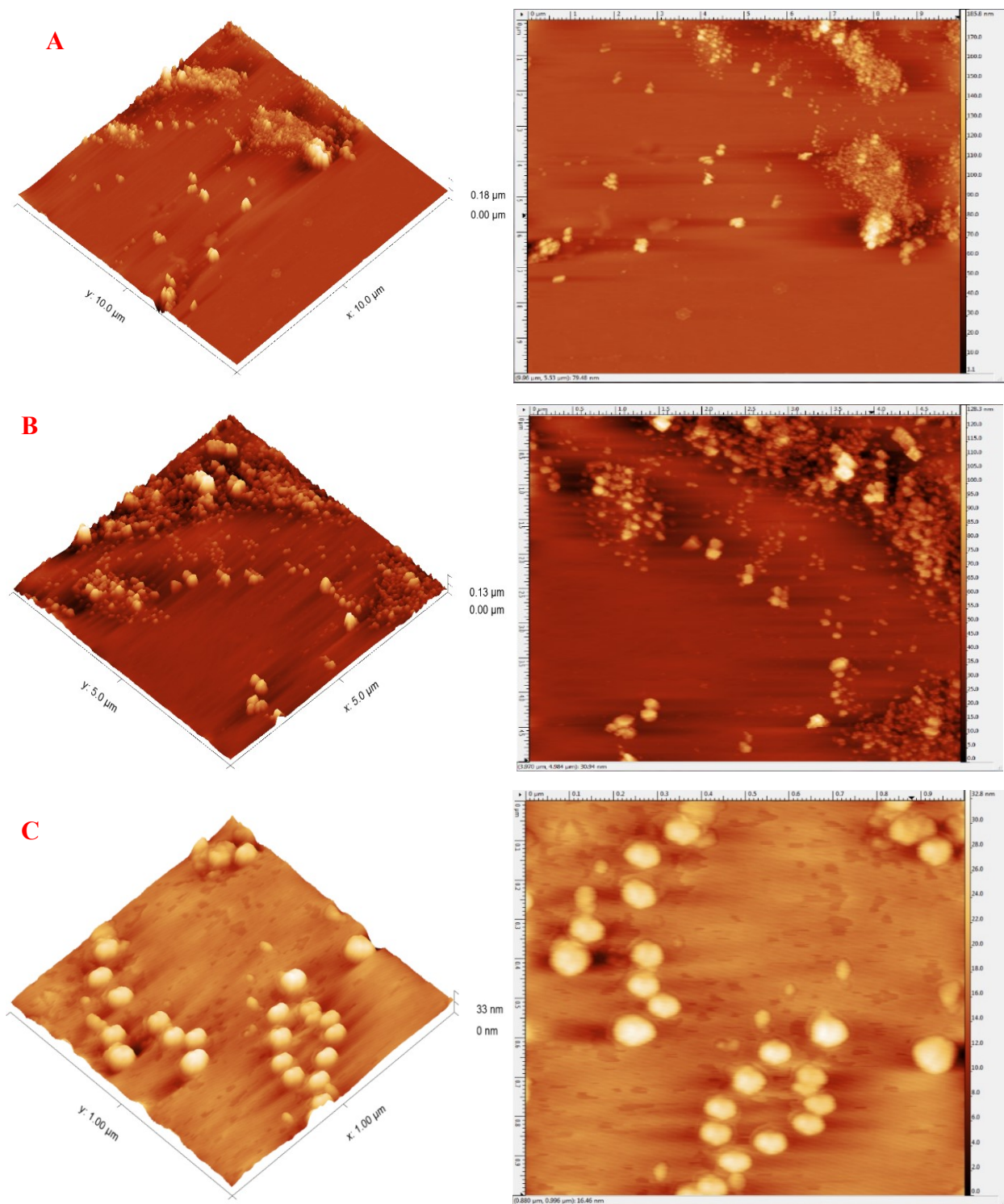


Fig. S5. Topographic 3D and 2D AFM figures of Au NPs-CysA in square view fields of **A)** 10 μm^2 , **B)** 5 μm^2 , and **C)** 1 μm^2 .

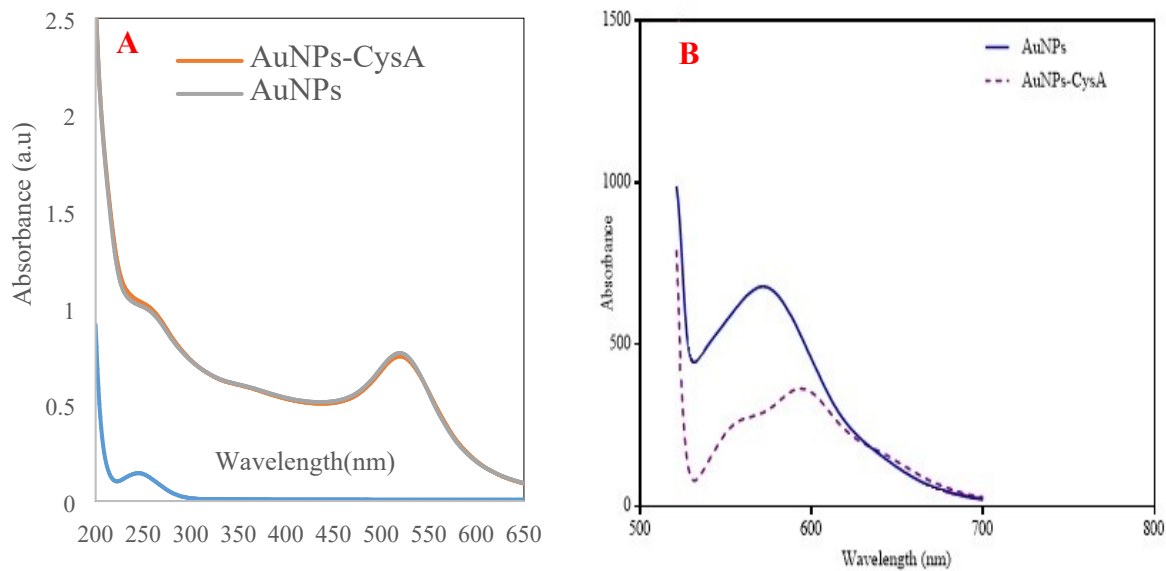


Fig. S6. A) Spectrophotometric of AuNPs, AuNPs/CysA, and B) fluorometric spectra of AuNPs, AuNPs/CysA.

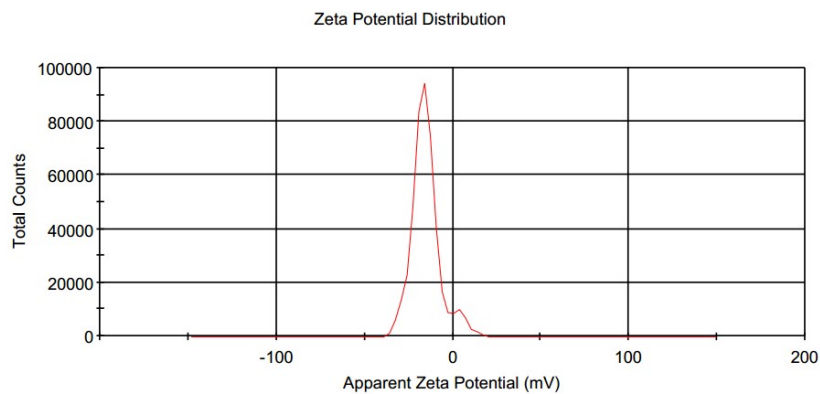


Fig. S7. Zeta potential distribution of AuNPs-CysA.

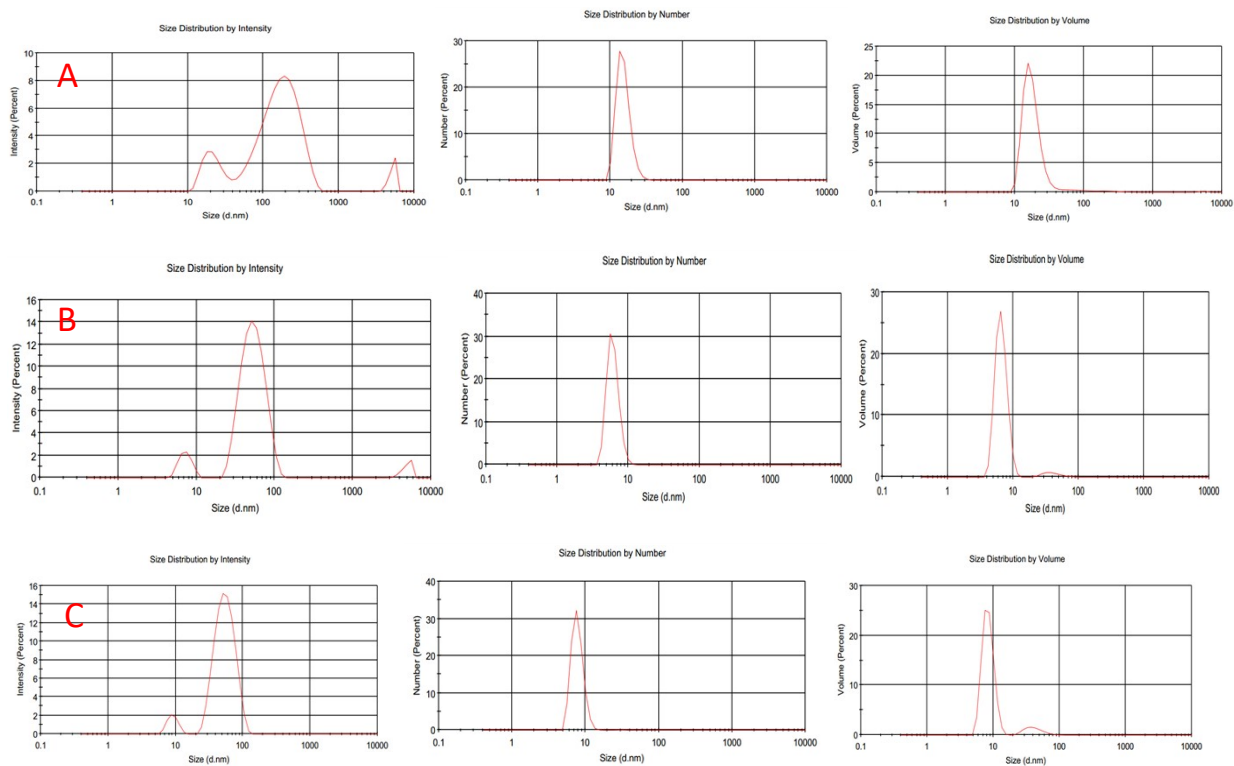
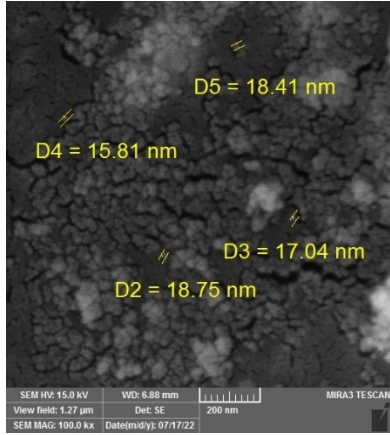
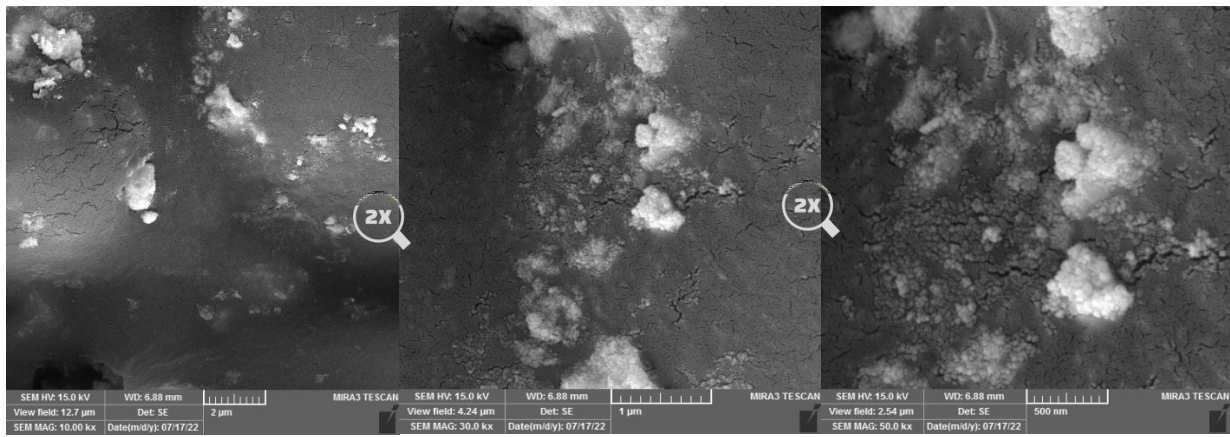
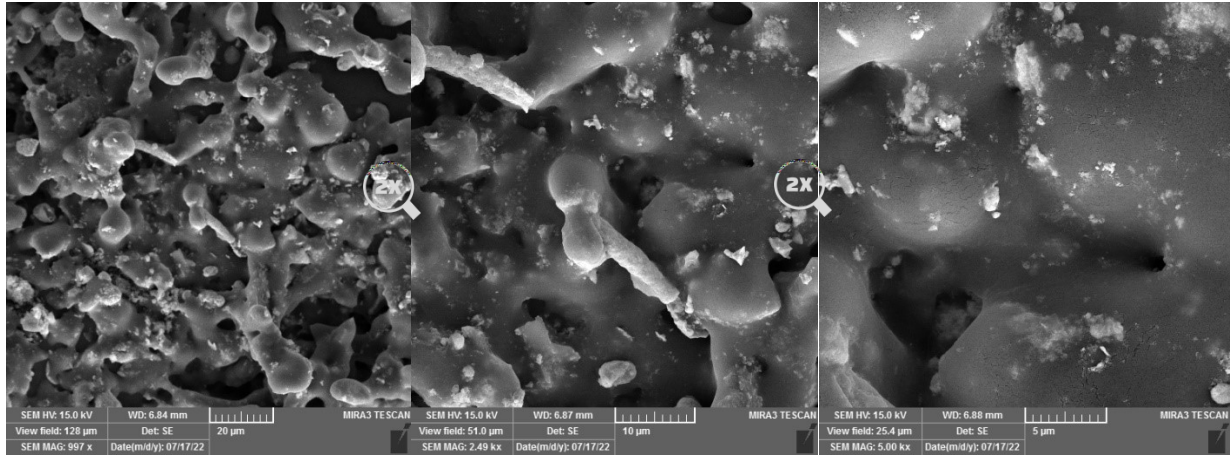


Fig. S8. Size distribution of A) AuNPs-CysA, B) AuNPs-CysA after adding RAC (at the first minute), and C) AuNPs-CysA after adding RAC (after 20 minutes) by intensity, number, and volume.



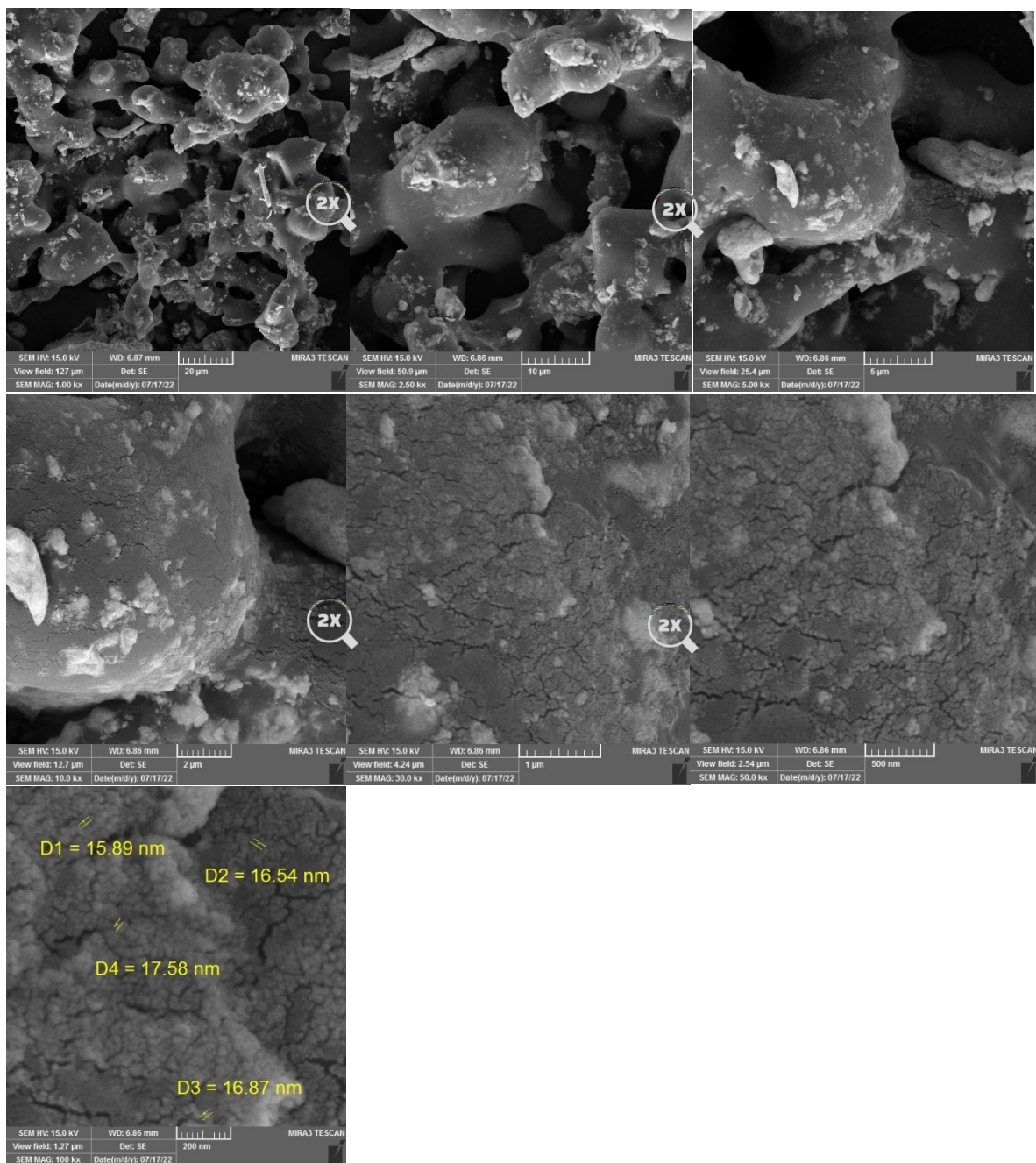


Fig. S9. FE-SEM images of AuNPs-CysA from two different places of the sample with various magnitudes.

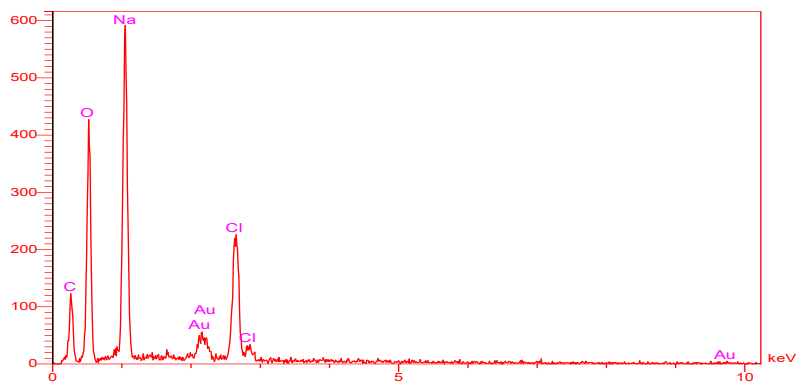


Fig. S10. EDAX spectra of AuNPs-DDT.

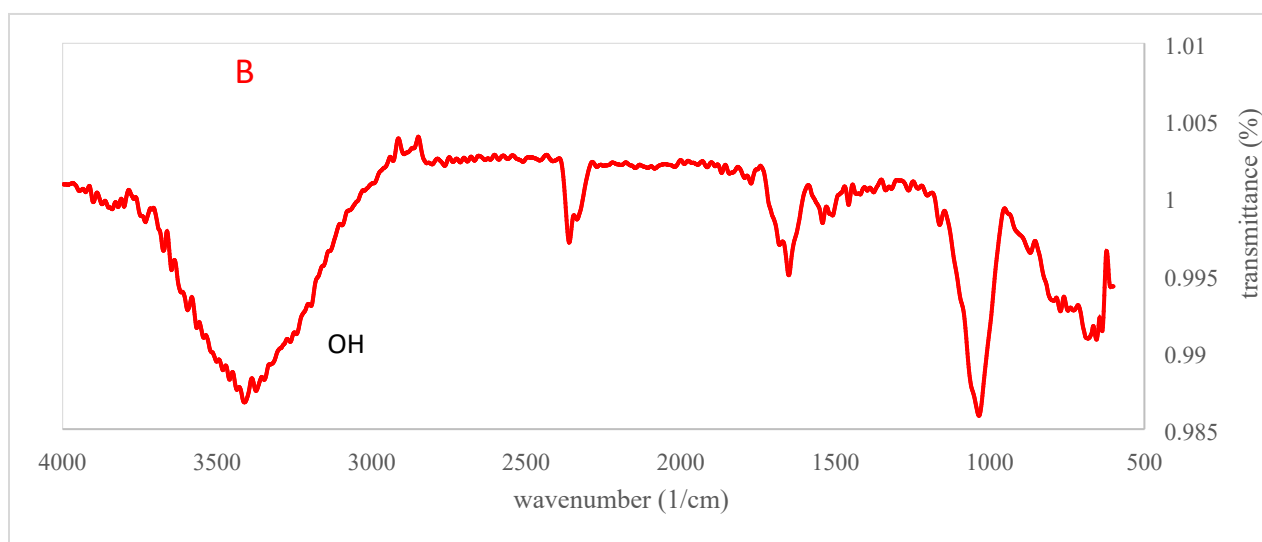
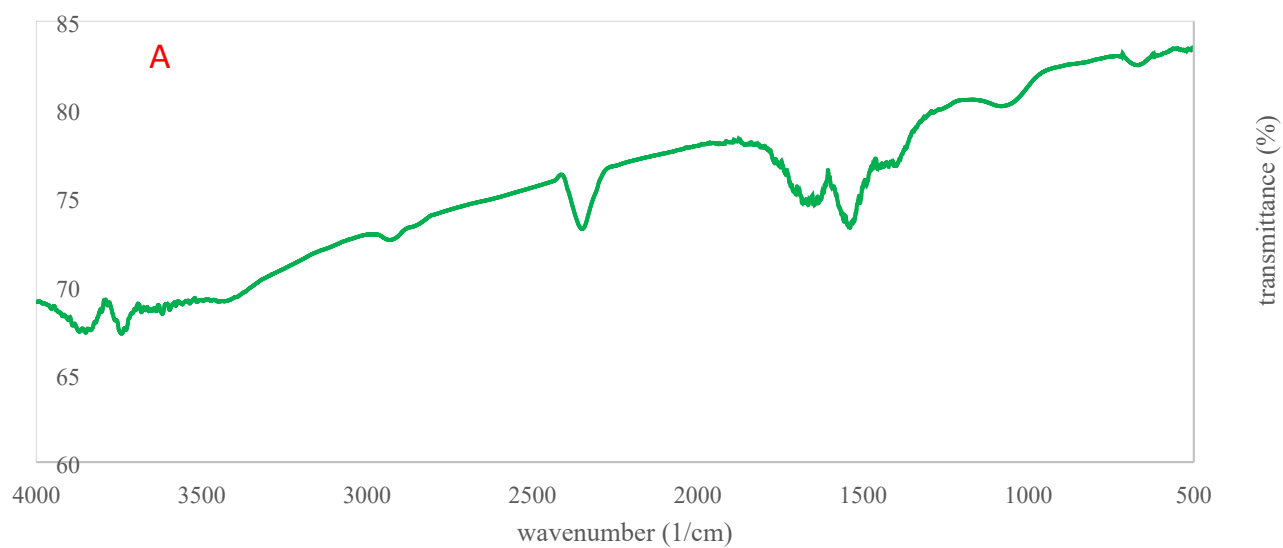


Fig. S11. FTIR spectra of (A) AuNPs, and B) AuNPs-DDT.

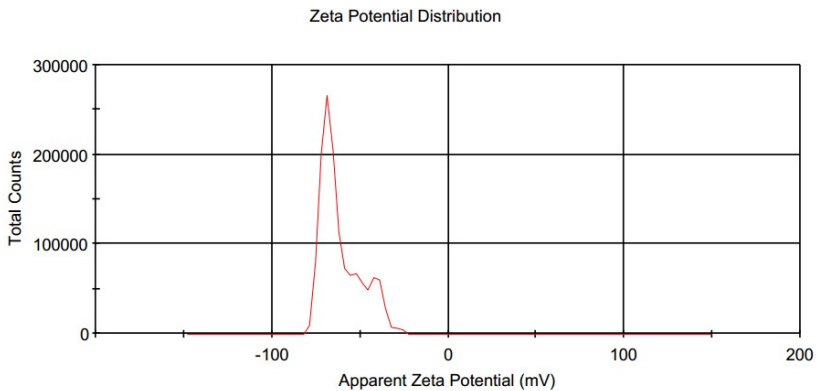


Fig. S12. Zeta potential distribution of AuNPs-CysA.

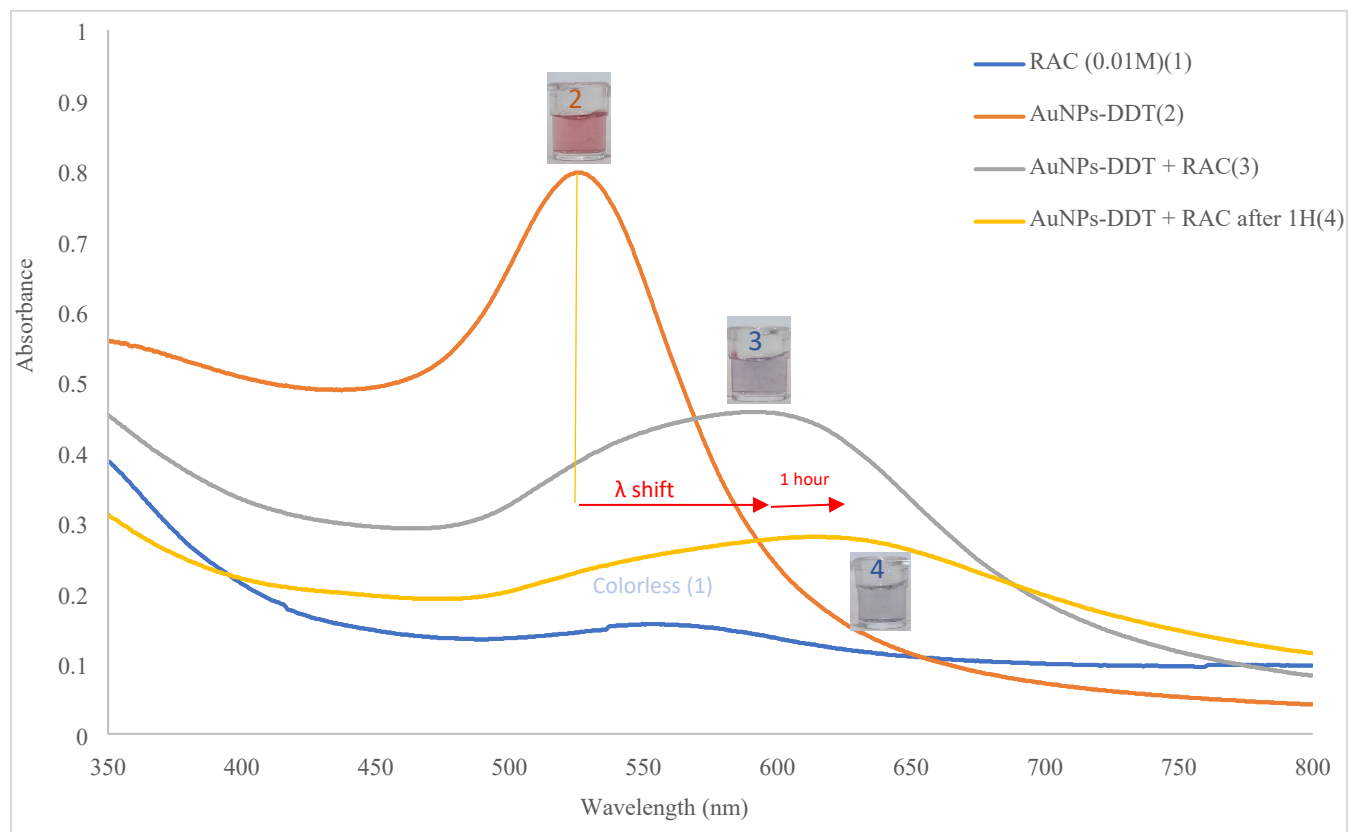


Fig. S13. UV-Vis absorption responses for RAC (0.01 M), AuNPs-DDT, AuNPs-DDT + RAC (0.01 M), and AuNPs-DDT + RAC (0.01 M) after an hour.

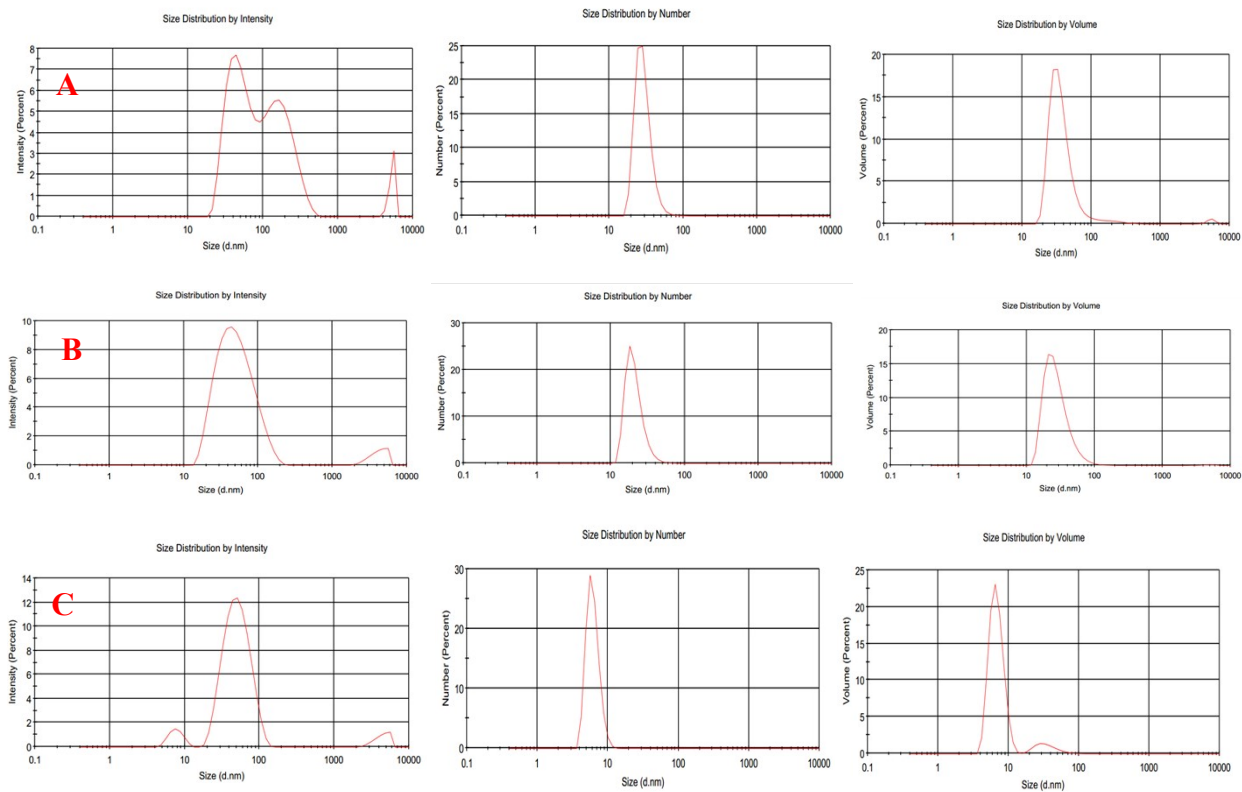


Fig. S14. Size distribution of A) AuNPs-DDT, B) AuNPs- DDT after adding RAC (at the first minute), and C) AuNPs- DDT after adding RAC (after 20 minutes) by intensity, number, and volume.

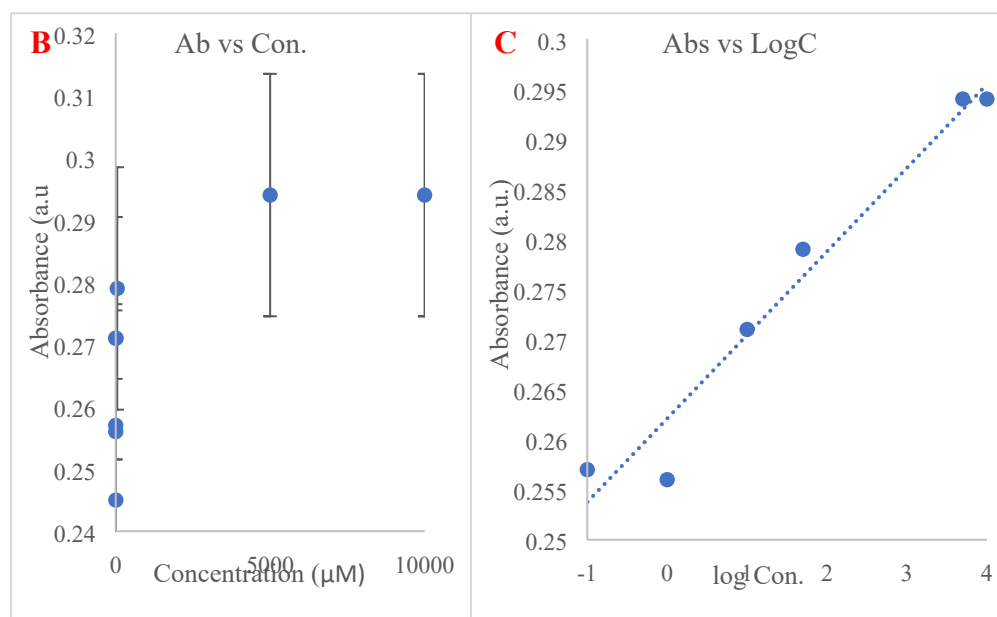
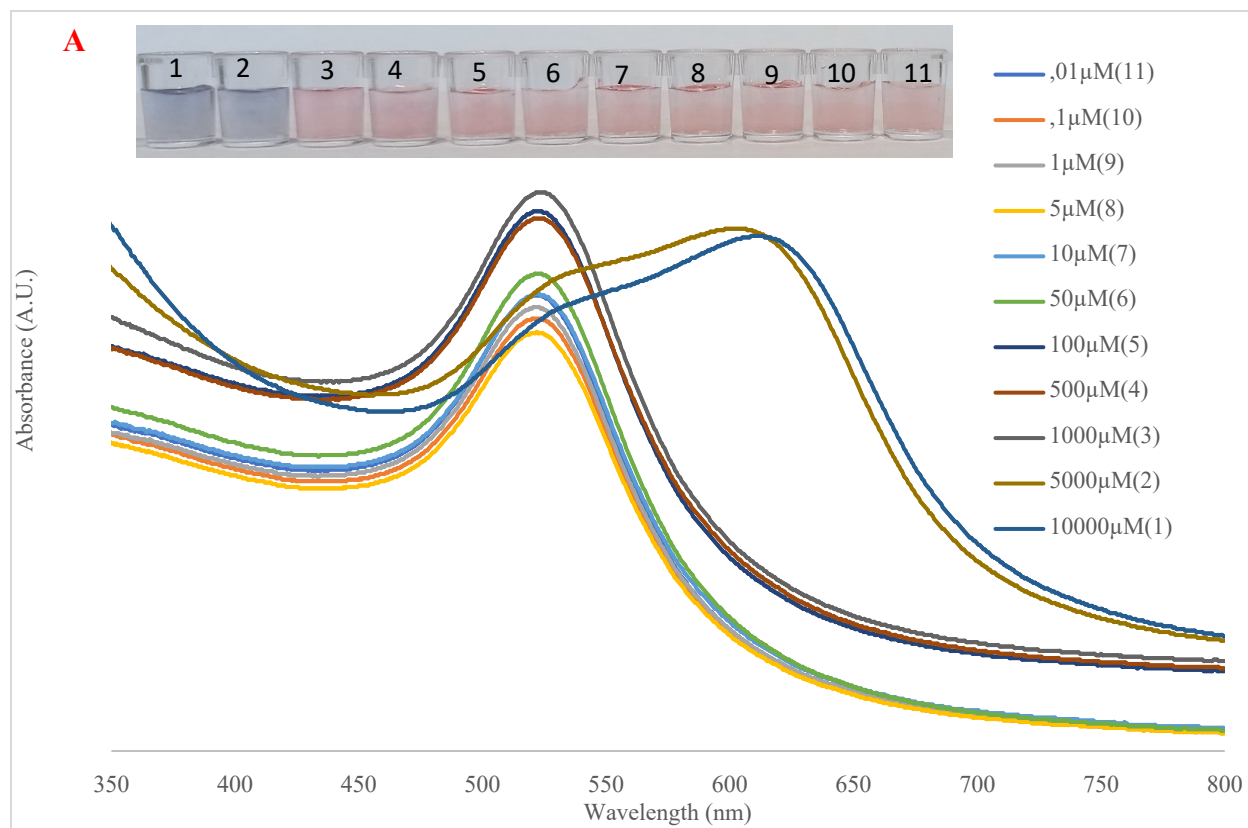


Fig. S15. A) UV-Vis of optical probe 1 (AuNPs-CysA) in the presence of various concentrations of RAC (1:1 V/V ratio). Inset: related photographic picture, **B)** Peak intensity versus RAC concentration, **C)** Calibration curve of absorbance versus the logarithm of RAC concentration.

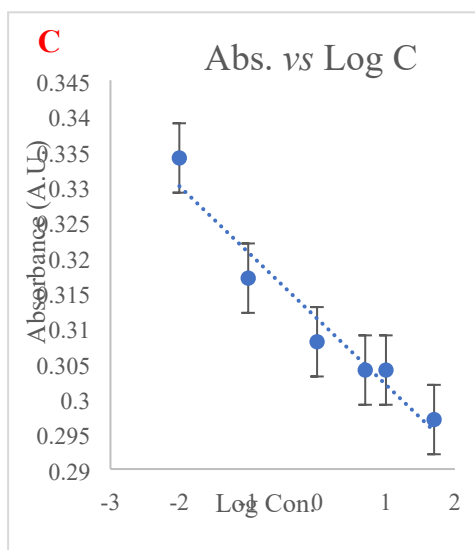
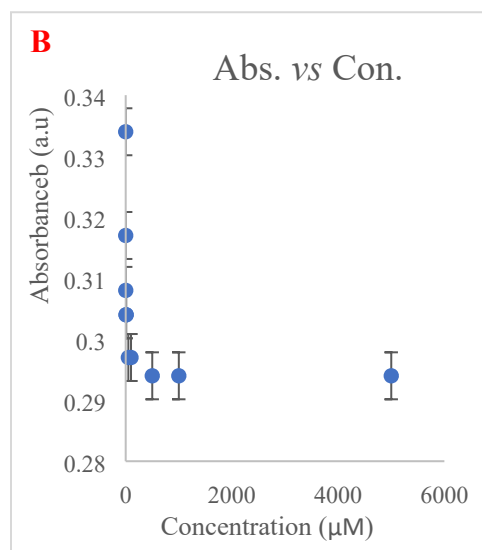
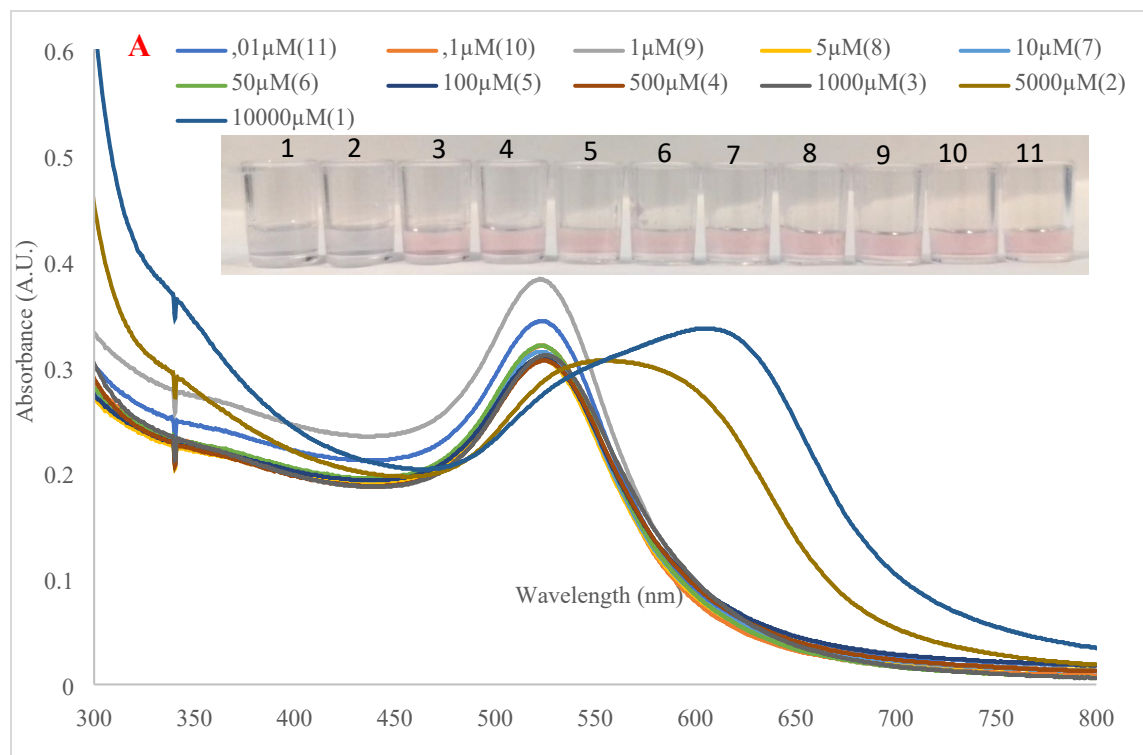


Fig. S16. A) UV-Vis of optical probe 2 (AuNPs-DDT) in the presence of various concentrations of RAC (1:1 V/V ratio). Inset: related photographic image, **B)** peak intensity versus RAC concentration, **C)** Calibration curve of absorbance versus the logarithm of RAC concentration.

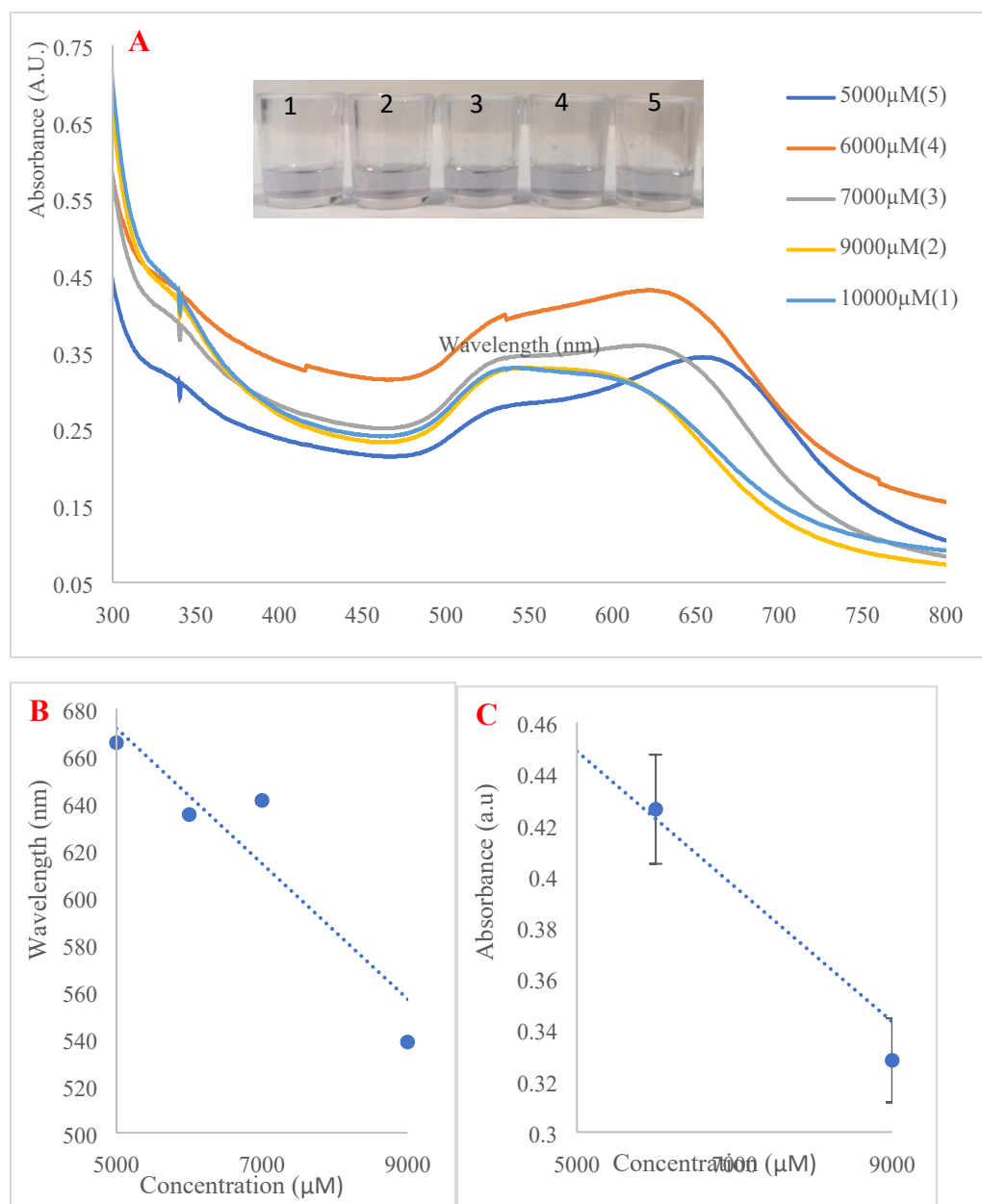


Fig. S17. A) UV-Vis of optical probe 2 (AuNPs-DDT) in the presence of various concentrations of RAC. Inset: related photographic image, **B)** Calibration curve of absorption band wavelength versus RAC concentration, **C)** Calibration curve of absorbance versus RAC concentration.

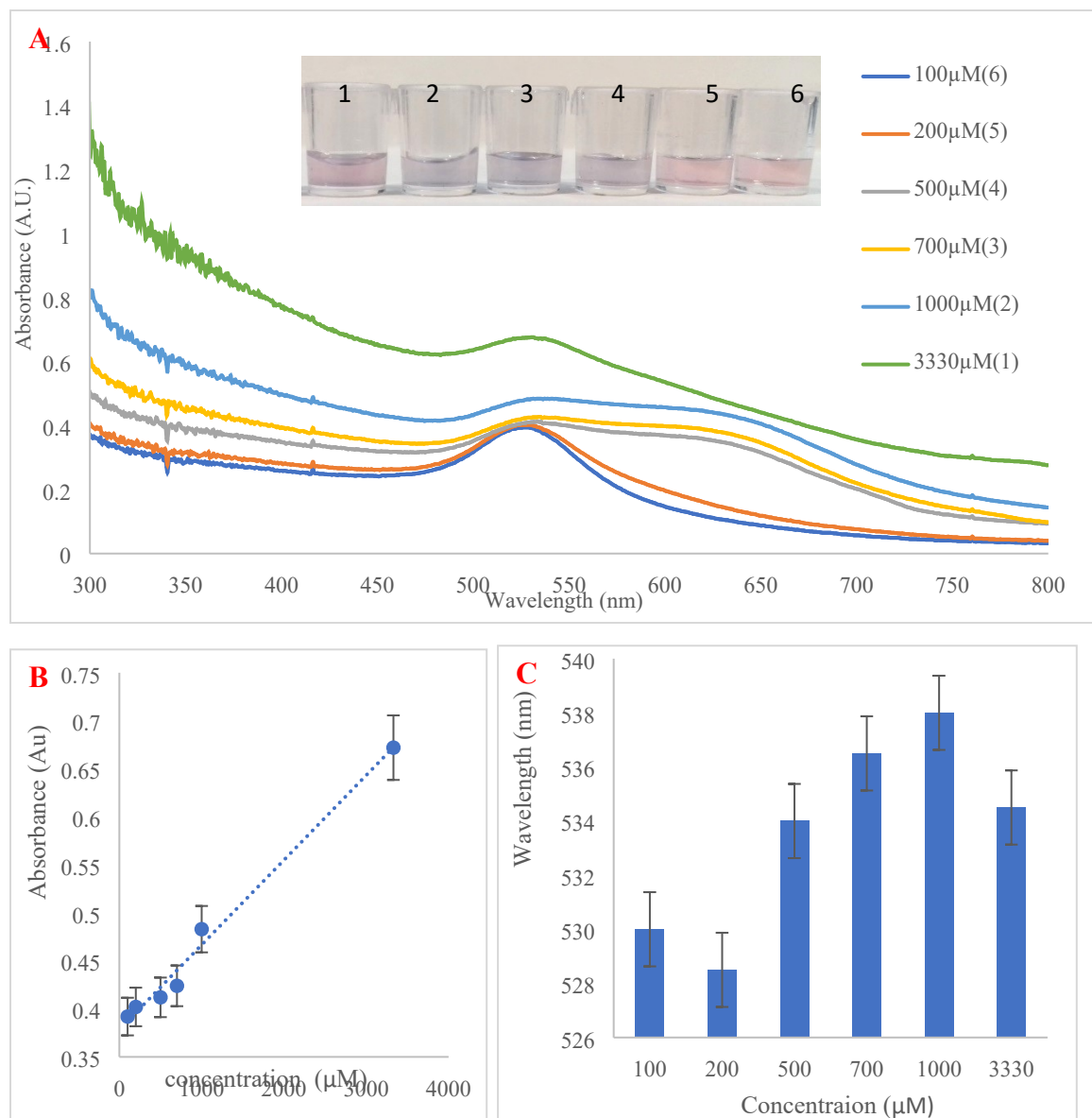


Fig. S18. **A)** UV-Vis spectrophotometry of various RAC concentrations spiked in real sample added into AuNPs-CysA with 1:1 V/V ratio. Inset: related colorimetric test, **B)** calibration curve of absorbance versus concentration **C)** Histogram of absorbance band wavelength versus different concentrations.

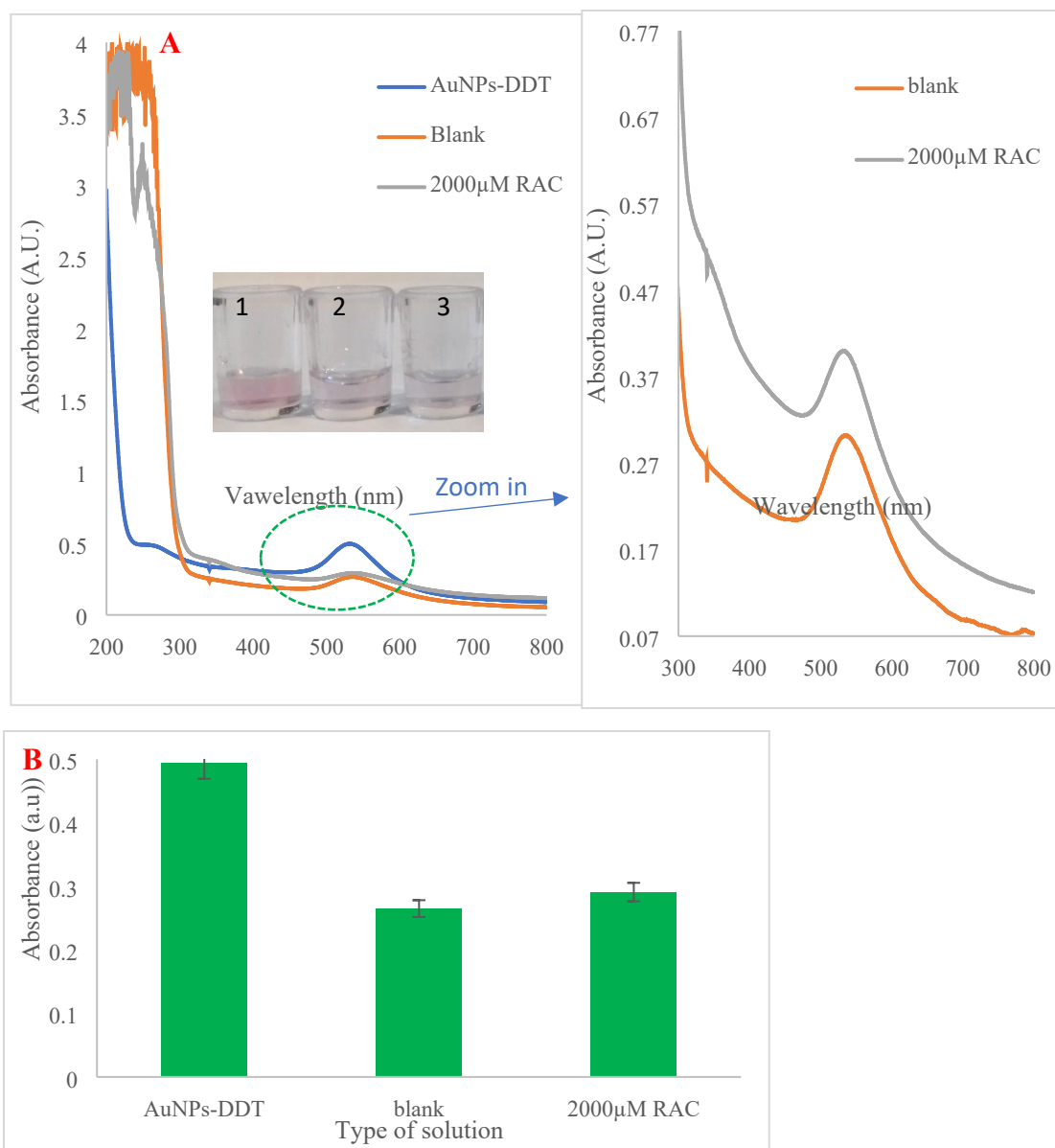


Fig. S19. A) UV-Vis spectra of **1.** AuNPs-DDT, **2.** Real sample (Blank)/AuNPs-DDT, and **3.** AuNPs-DDT /RAC 2000 μM spiked in the real sample. Inset: related digital image, **B)** histogram of corresponding absorbance band intensity.

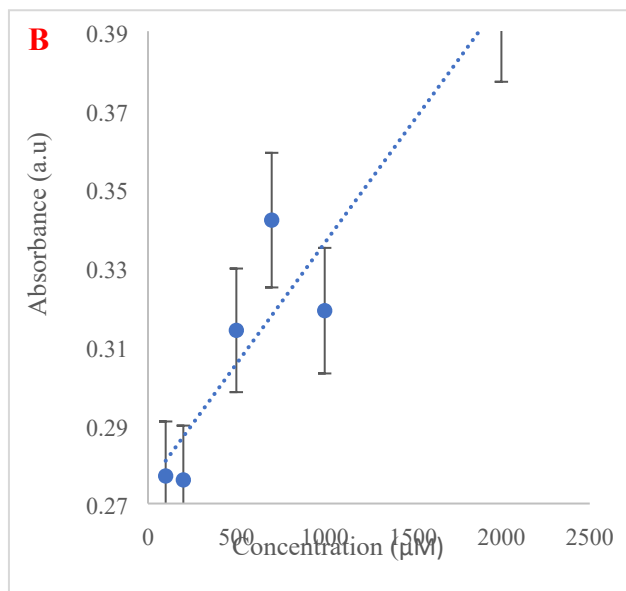
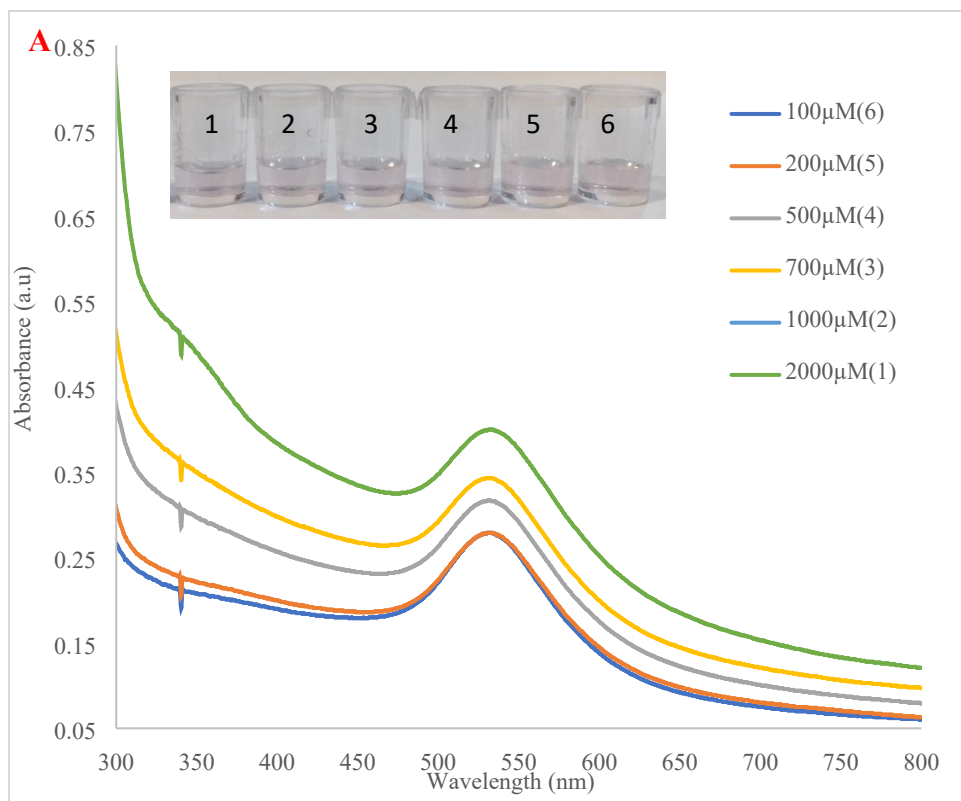


Fig. S20. A) UV-Vis spectrophotometry of various RAC concentrations in real sample added into AuNPs-DDT (optical probe) with 1:1 V/V ratio. Inset: related colorimetric test, **B)** Calibration curve of absorbance versus concentration.

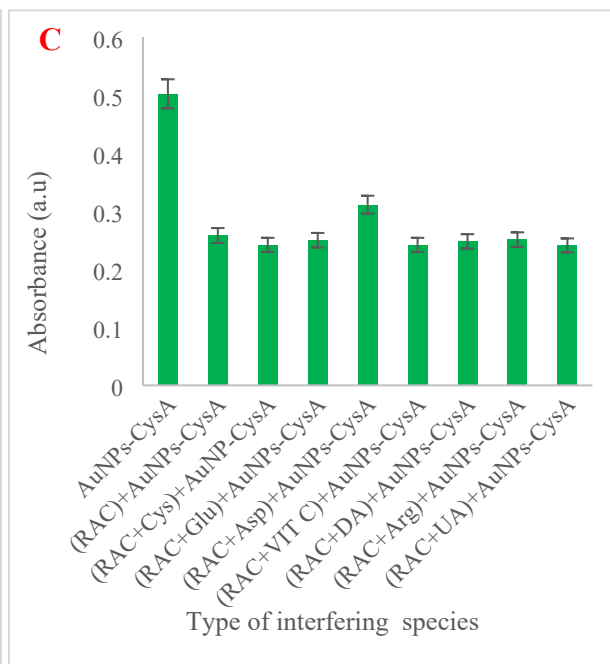
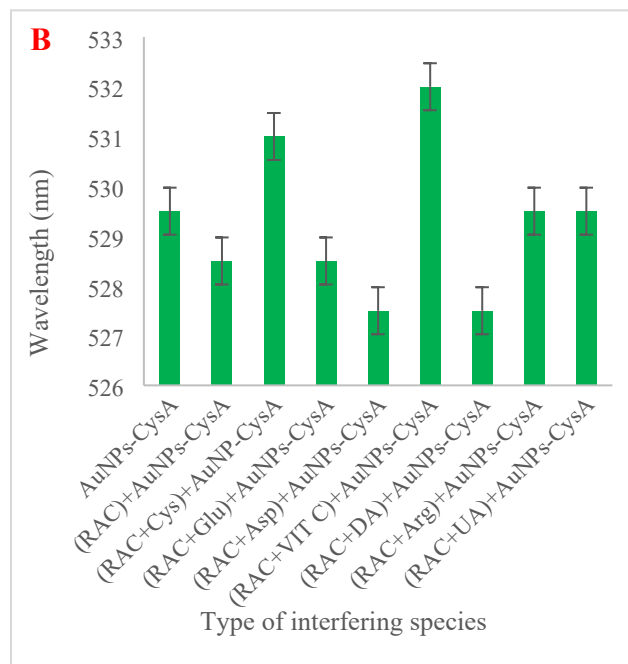
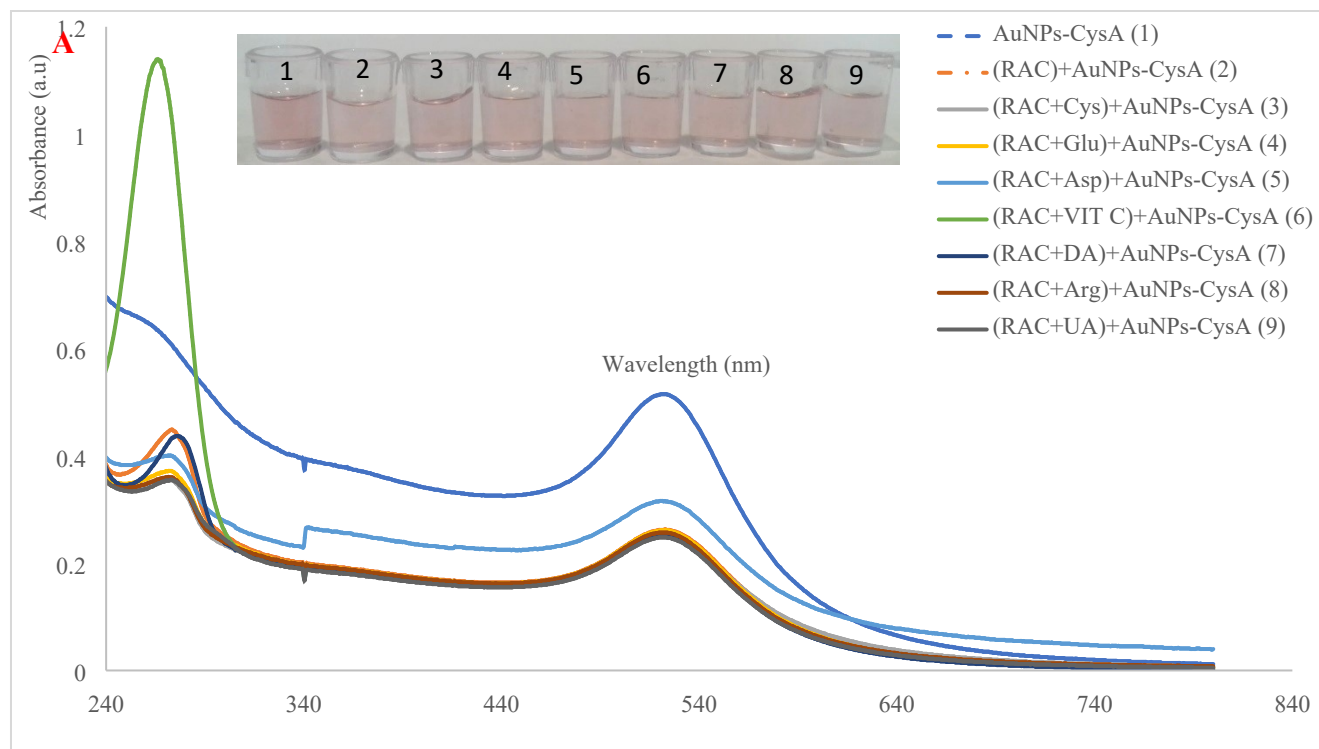


Fig. S21. A) The UV-Vis spectrophotometry of **1.** AuNPs-CysA, **2.** AuNPs-CysA/RAC (1:1 V/V ratio), **3.** AuNPs-CysA/(RAC+Cys), **4.** AuNPs-CysA/(RAC+Glu), **5.** AuNPs-CysA/(RAC+Asp), **6.** AuNPs-CysA/(RAC+VIT C), **7.** AuNPs-CysA/(RAC+DA), **8.** AuNPs-CysA/(RAC+Arg), **9.** AuNPs-CysA/(RAC+UA); from No. 3 to No. 9, there were 200 μ L of each solution, with the ratio of AuNPs-CysA/potential interference + RAC being 1:0.5:0.5 V/V/V, inset: related digital photo; the histograms for comparison of **B)** the Wavelength, and **C)** the strength of the related absorbance bands. The RAC concentration was 0.1 mM, as were any possible interferences.

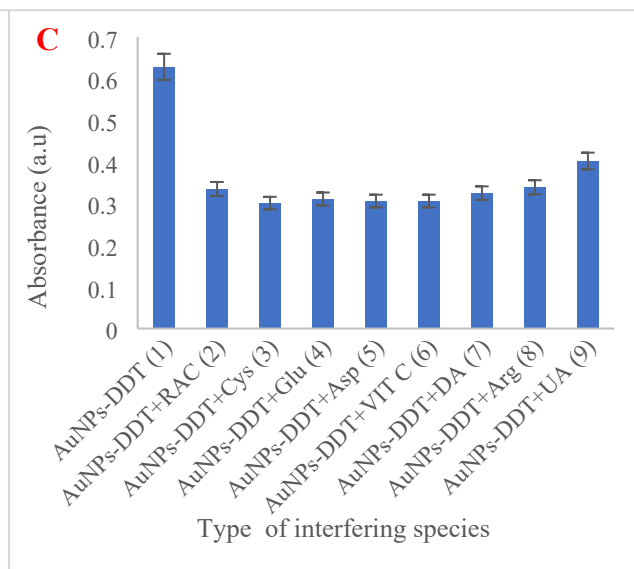
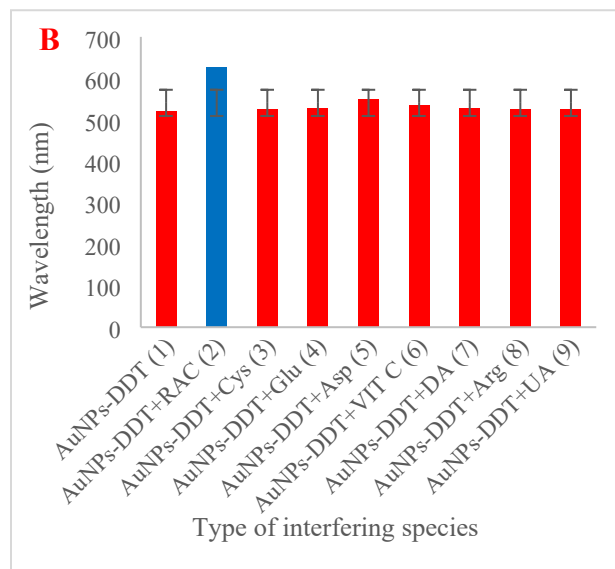
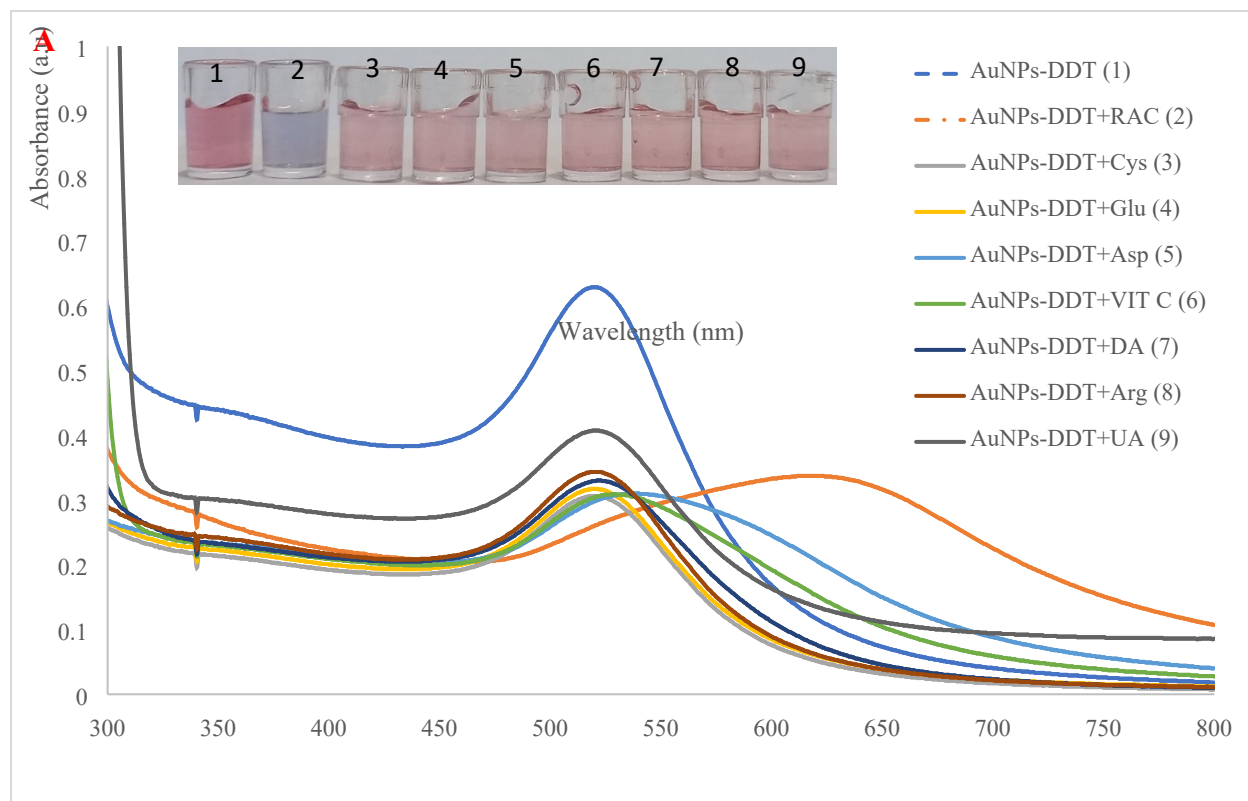


Fig. S22. UV-Vis spectroscopy of **1.** AuNPs-DDT, **2.** AuNPs- DDT/RAC, **3.** AuNPs- DDT/Cys, **4.** AuNPs- DDT/Glu, **5.** AuNPs- DDT/Asp, **6.** AuNPs- DDT/ VIT C, **7.** AuNPs- DDT/DA, **8.** AuNPs- DDT/Arg, **9.** AuNPs- DDT/UA. Each cell contained 200 μ L of the mixture and had a 1:1 V/V ratio of AuNPs- DDT to an analyte. Inset: related digital photo; the histograms for comparison of **B)** the Wavelength, and **C)** the strength of the related absorbance bands. The RAC concentration was 0.005 M, as were any possible interferences.

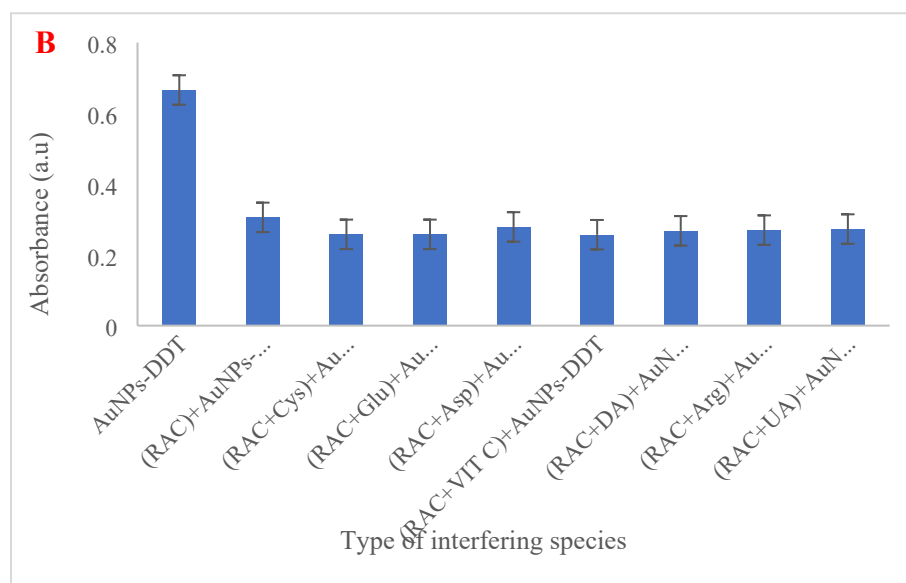
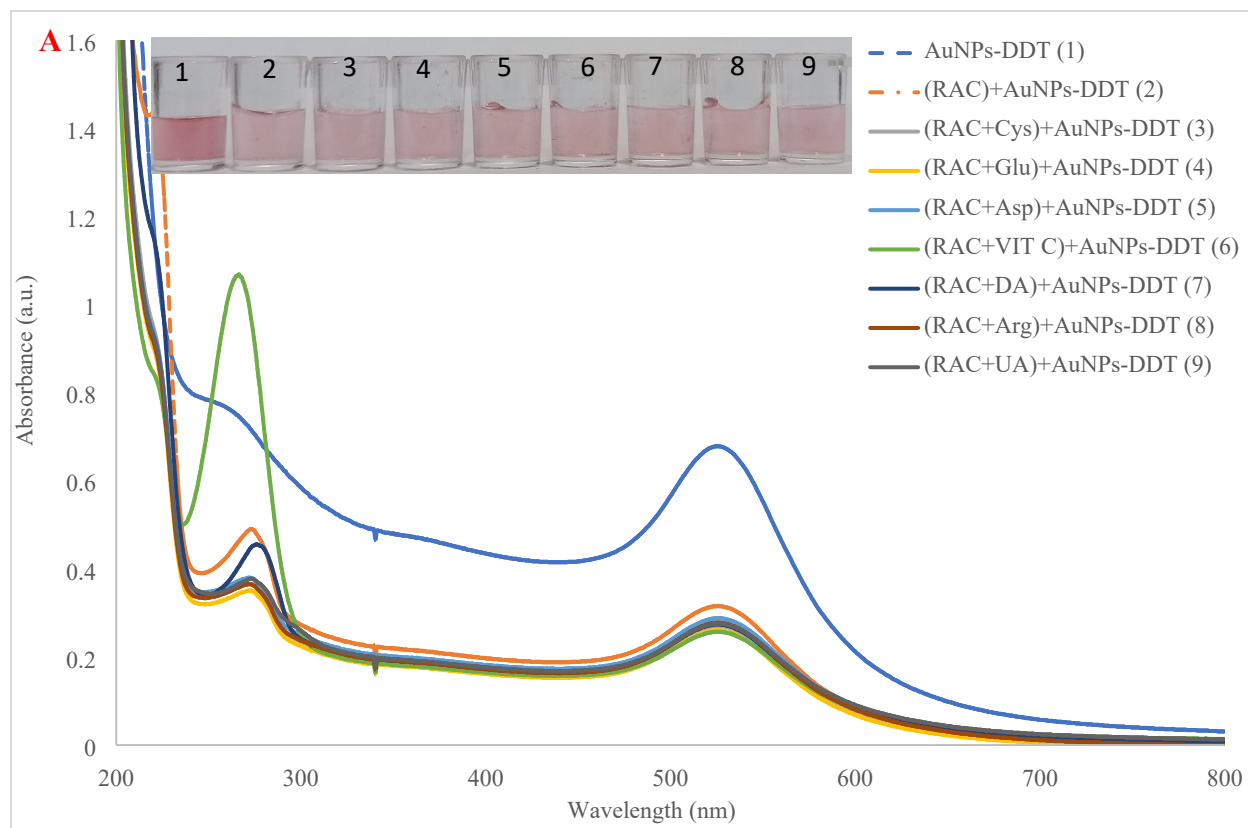


Fig. S23. A) The UV-Vis spectrophotometry of **1.** AuNPs-DDT, **2.** AuNPs- DDT/RAC (1:1 V/V ratio), **3.** AuNPs- DDT/(RAC+Cys), **4.** AuNPs- DDT/(RAC+Glu), **5.** AuNPs- DDT/(RAC+Asp), **6.** AuNPs- DDT/(RAC+VIT C), **7.** AuNPs- DDT/(RAC+DA), **8.** AuNPs- DDT/(RAC+Arg), **9.** AuNPs- DDT/(RAC+UA); from No. 3 to No. 9, there were 200 μ L of each solution, with the ratio of AuNPs-DDT/potential interference + RAC being 1:0.5:0.5 V/V/V, inset: related digital photo; **B)** the histograms for comparison of the related absorbance band strengths. The RAC concentration was 0.1 mM, as were any possible interferences.

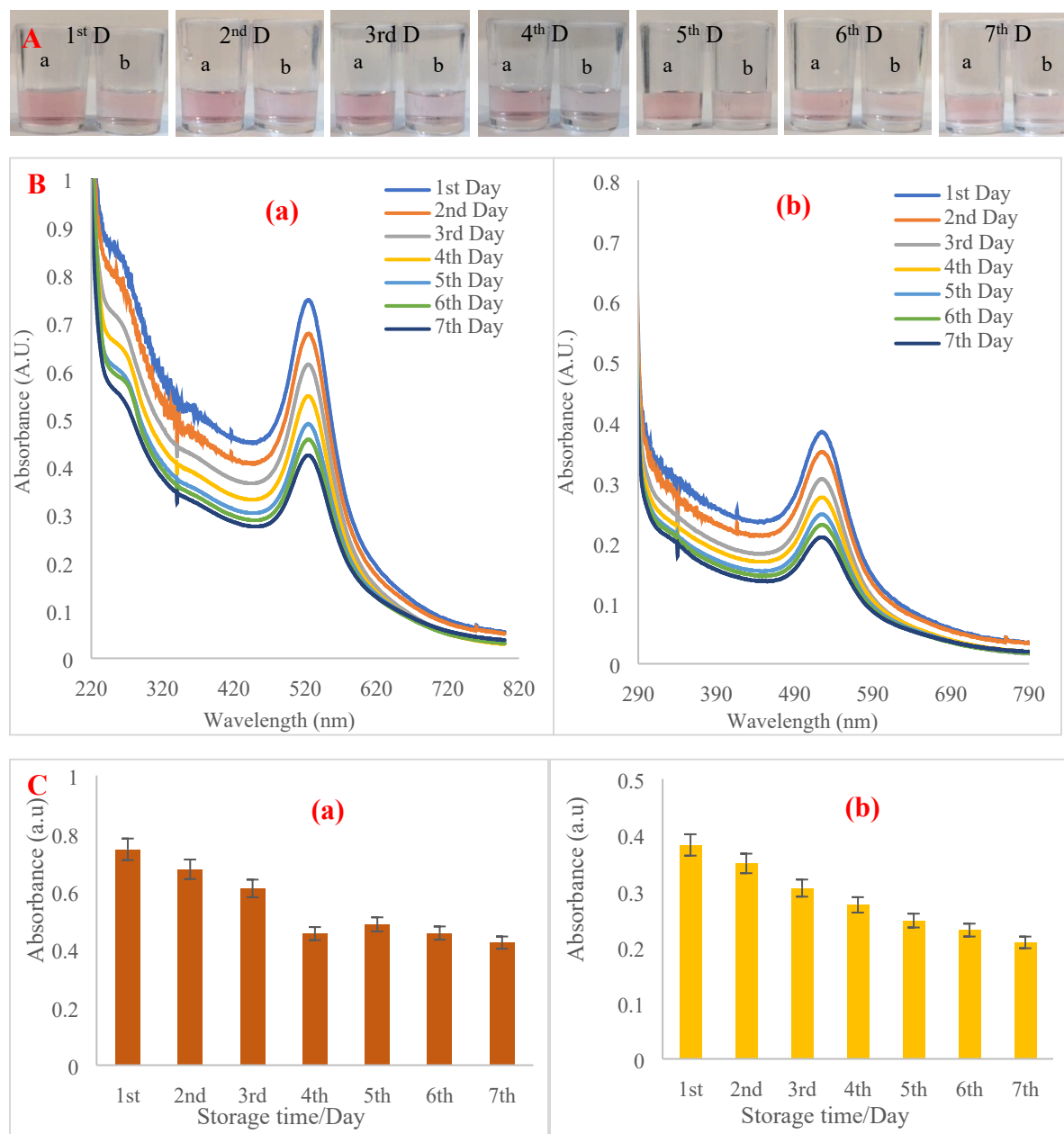


Fig. S24. **A)** Daily photographic images of **a) AuNPs-CysA**, **b) AuNPs-CysA/RAC (1000 μ M)** (1:1 V/V ratio) in a week. **B)** UV-Vis of AuNPs-CysA and AuNPs-CysA/RAC (1000 μ M) in different storage times (1-7 days). **C)** The related histogram of absorbance band intensity versus storage time.

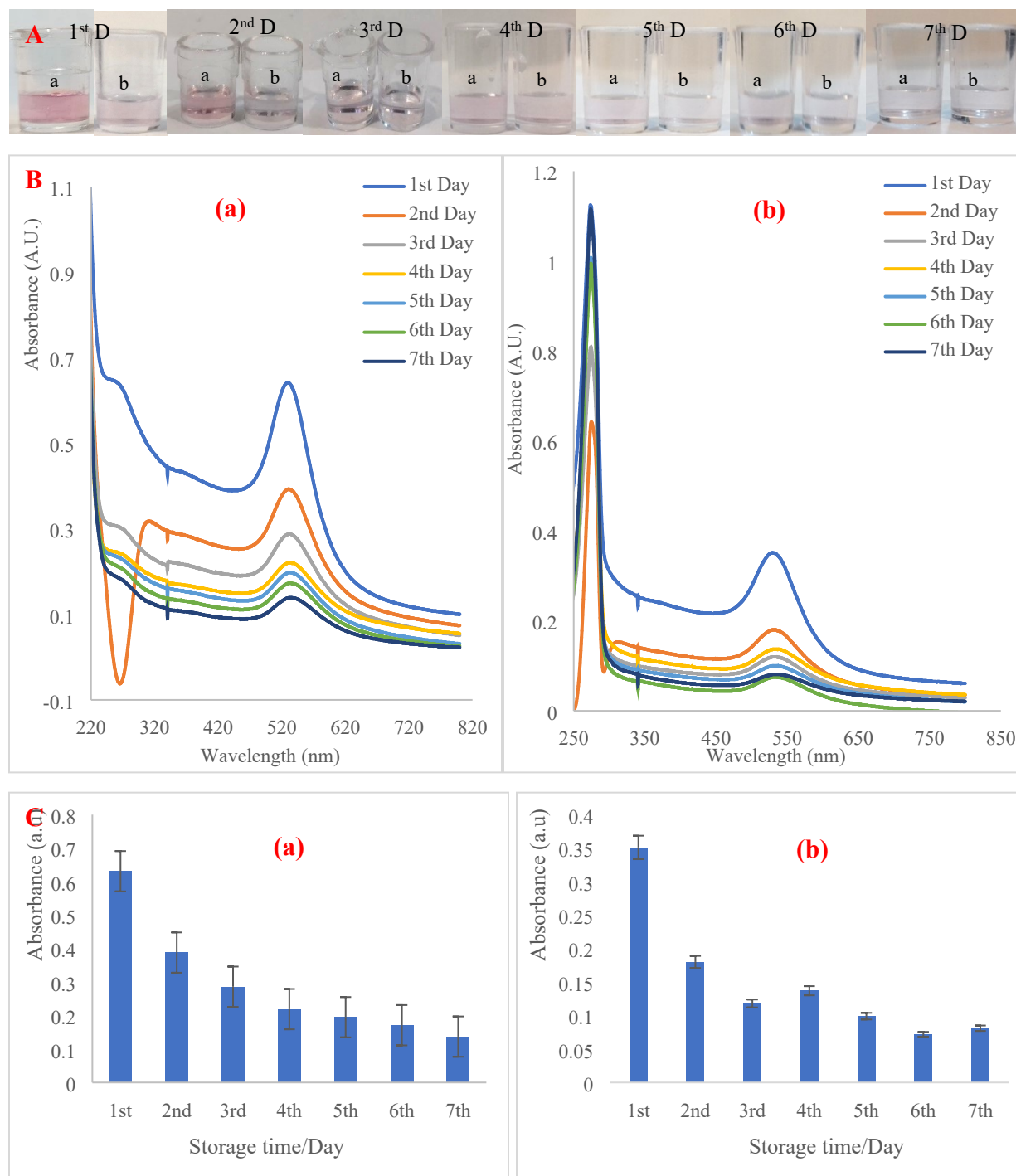


Fig. S25. **A)** Daily photographic images of **a)** AuNPs-DDT, **b)** AuNPs-DDT/RAC (5 μ M) (1:1 V/V ratio) in a week. **B)** UV-Vis of AuNPs-DDT and AuNPs-DDT/RAC (5 μ M) in different storage times (1-7 days). **C)** The related histogram of absorbance band intensity versus storage time.

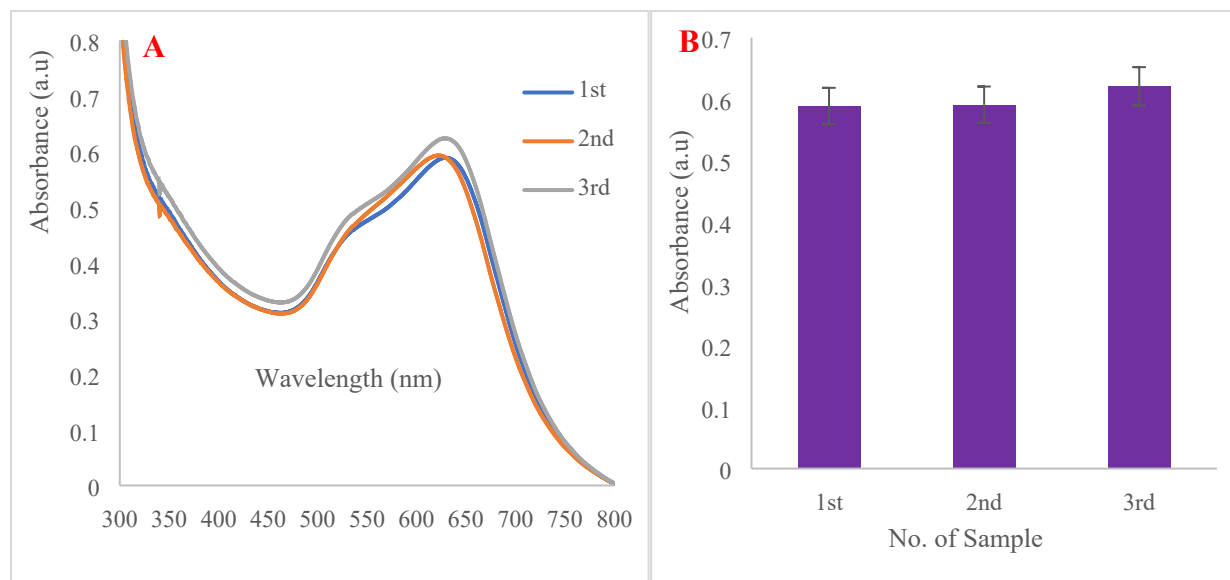


Fig. S26. A) UV-Vis of three solutions of AuNPs-CysA/RAC (0.01M) (1:1 V/V ratio) in the constant time of analysis, and **B)** Histogram of absorbance versus the number of samples.

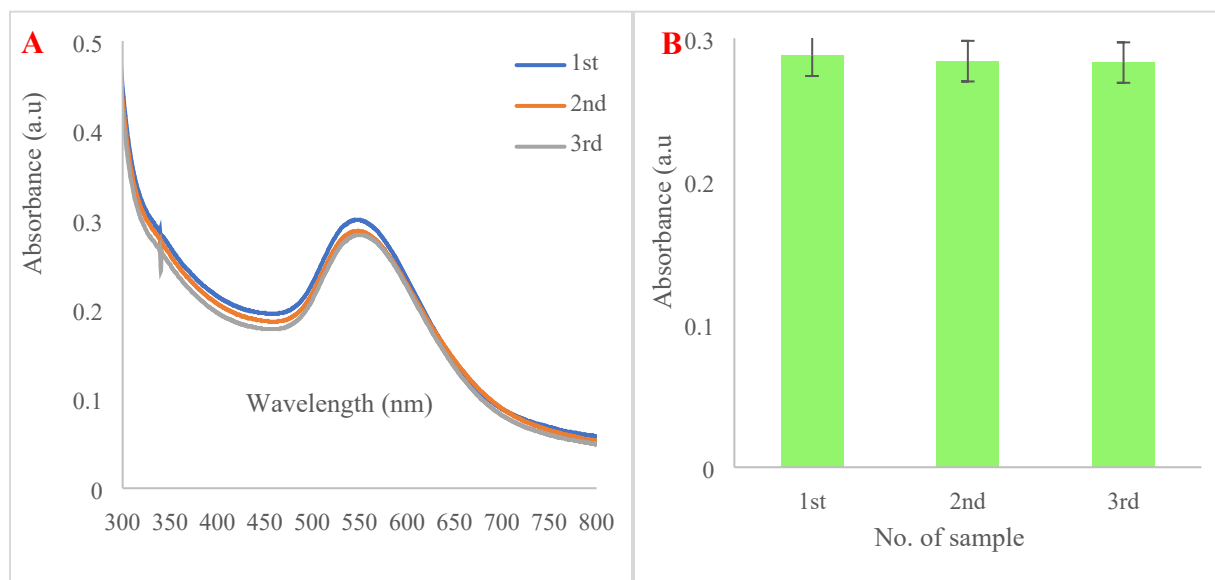


Fig. S27. A) UV-Vis of three solutions of AuNPs-DDT/RAC (0.01M) (1:1 V/V ratio) in the constant time of analysis, and **B)** Histogram of absorbance versus the number of samples.

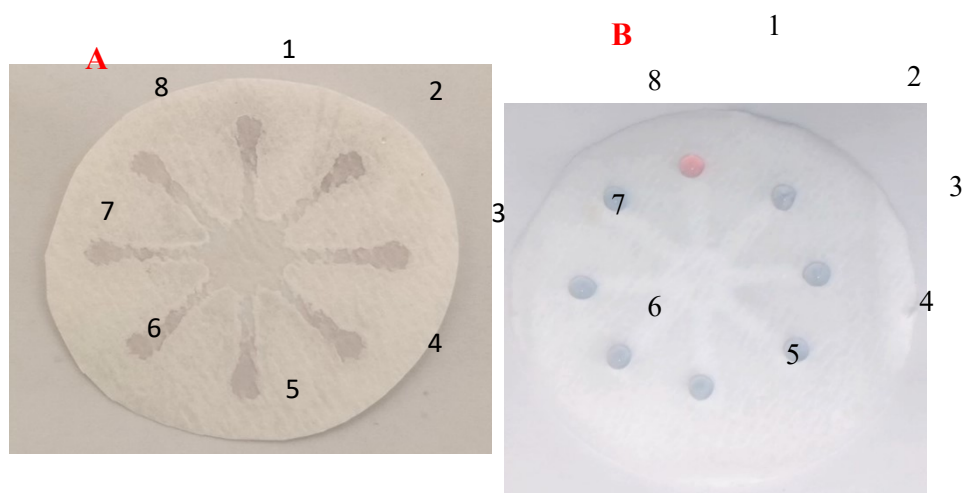


Fig. S28. The taken digital photos at the first minute of **A)** Traditional microfluidic fiberglass sheet that had been infused with **1.** AuNPs-CysA/5mM RAC, **2.** AuNPs-CysA/1mM RAC, **3.** AuNPs-CysA/0.1mM RAC, **4.** AuNPs-CysA/0.05mM RAC, **5.** AuNPs-CysA/0.01mM RAC, **6.** AuNPs-CysA/1 μ M RAC, **7.** AuNPs-CysA/0.1 μ M RAC, **8.** AuNPs-CysA/0.01 μ M RAC; **B)** a new type of microfluidic fiberglass sheet with a semi-hydrophobic network infused with **1.** AuNPs-CysA, **2.** AuNPs-CysA/0.01 M RAC, **3.** AuNPs-CysA/0.008 M RAC, **4.** AuNPs-CysA/0.006 M RAC, **5.** AuNPs-CysA/0.005 M RAC, **6.** AuNPs-CysA/0.004 M RAC, **7.** AuNPs-CysA/0.003 M RAC, **8.** AuNPs-CysA/0.002 M RAC. AuNPs-CysA/RAC was combined with a 1:1 V/V ratio and each well contains 10 μ L of the mixture.

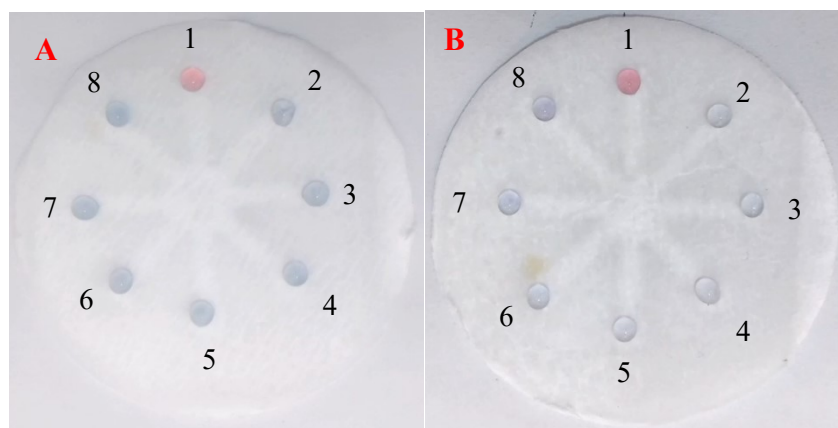


Fig. S29. Photographs of modified fiberglass microfluidic sheets with **A)** AuNPs-CysA, and **B)** AuNPs-DDT **1.** Without RAC, and with 5 μ L RAC concentrations of **2.** 0.01 M, **3.** 0.008 M, **4.** 0.006 M, **5.** 0.005 M, **6.** 0.004 M, **7.** 0.003 M, **8.** 0.002 M (the combination ratio was 1:1 V/V). Each well contains a 10 μ L mixture.

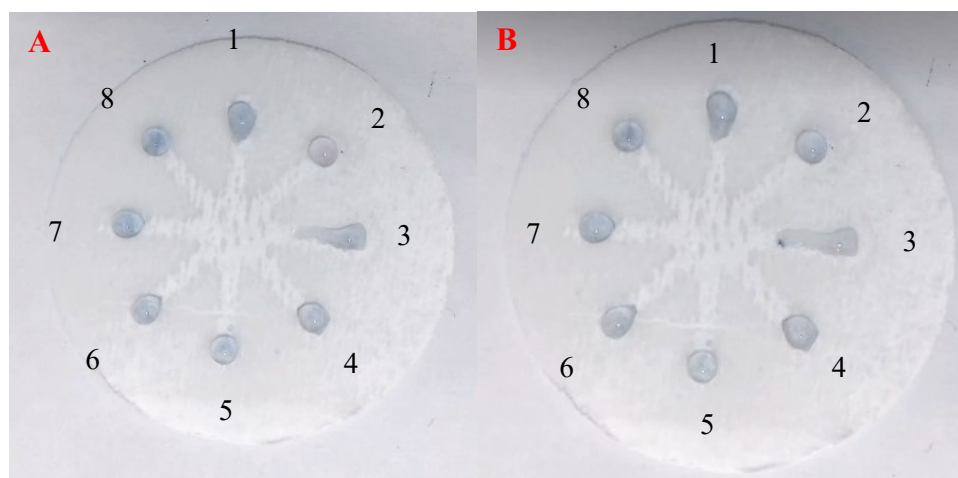


Fig. S30. Fiberglass microfluidic sheets' digital images contain: **1.** AuNPs-CysA/RAC 0.01M (1:1) **2.** AuNPs-CysA/RAC/Cys 0.01M (1:0.5:0.5) **3.** AuNPs-CysA/RAC/Glu 0.01M (1:0.5:0.5) **4.** AuNPs-CysA/RAC/Asp 0.01M (1:0.5:0.5) **5.** AuNPs-CysA/RAC/VIT C 0.01M (1:0.5:0.5) **6.** AuNPs-CysA/RAC/DA 0.01M (1:0.5:0.5) **7.** AuNPs-CysA/RAC/Arg 0.01M (1:0.5:0.5) **8.** AuNPs-CysA/RAC/UA 0.01M (1:0.5:0.5) after **A)** 6 min **B)** 10 min.

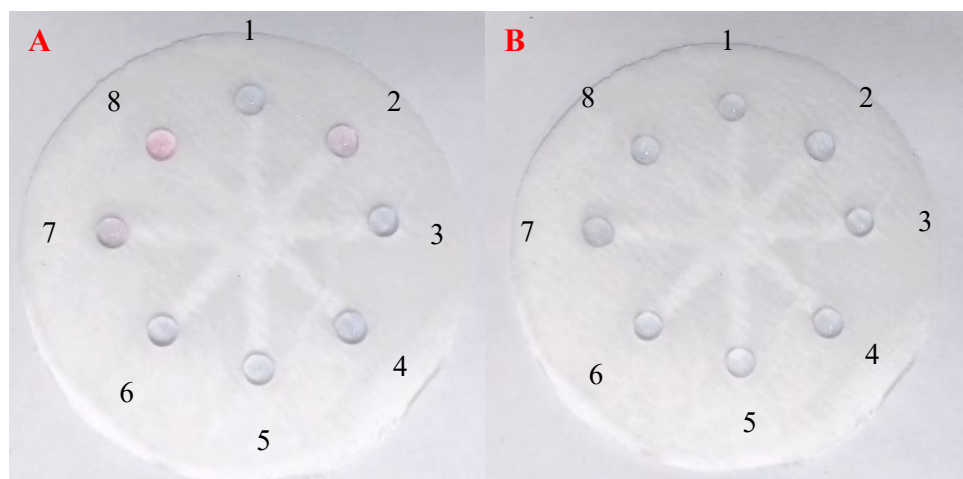


Fig. S31. Fiberglass microfluidic sheets' digital images contain **1.** AuNPs-DDT/RAC 0.01M (1:1) **2.** AuNPs-DDT/RAC/Cys 0.01M (1:0.5:0.5) **3.** AuNPs-DDT/RAC/Glu 0.01M (1:0.5:0.5) **4.** AuNPs-DDT/RAC/Asp 0.01M (1:0.5:0.5) **5.** AuNPs-DDT/RAC/VIT C 0.01M (1:0.5:0.5) **6.** AuNPs-DDT/RAC/DA 0.01M (1:0.5:0.5) **7.** AuNPs-DDT/RAC/Arg 0.01M (1:0.5:0.5) **8.** AuNPs-DDT/RAC/UA 0.01M (1:0.5:0.5) after **A)** 6 min, **B)** 15 min.

Table S1. The related RGB codes and color names for mentioned items in article

fig	item	RGB code	~ color name	fig	item	RGB code	~ color name	fig	item	RGB code	~ color name
S1	1	206, 142, 143	Ruddy Pink	S16. A	4	210, 184, 180	Silver Pink	3. A	6	144, 138, 148	Taupe Gray
	2	157, 163, 171	Quick Silver		5	207, 177, 178			7	182, 145, 148	Rosy Brown
	3	202, 201, 196	Neon Silver		6	208, 180, 178			8	191, 150, 148	Rosy Brown
	4	204, 205, 199	Pastel Gray		7	208, 178, 177			9	189, 163, 163	Silver Pink
	5	195, 132, 140	Old Rose		8	213, 183, 181		1	174, 146, 142	Rosy Brown	
	6	178, 173, 180	Dark Gray		9	211, 178, 179	Pale Chestnut	S21. A	2	181, 163, 160	Silver Pink
	7	208, 207, 204	Neon Silver		10	213, 181, 178	Silver Pink		3	175, 158, 153	
	8	202, 201, 196			11	216, 182, 179	Chilean Pink		4	181, 160, 155	
S1 (lh)	1	198, 146, 150	Rosy Brown	S17. A	1	178, 172, 179	Dark Gray		5	180, 159, 152	
	2	169, 176, 184	Dark Gray		2	170, 163, 168	Quick Silver		6	182, 160, 155	
	3	203, 207, 206	Neon Silver		3	158, 156, 162	Spanish Gray		7	179, 160, 152	
	4	193, 197, 196	Silver		4	157, 155, 161			8	178, 161, 157	
	5	187, 144, 154	Rosy Brown	5	163, 161, 164	Quick Silver	9		175, 162, 160		
	6	179, 184, 188	Medium Gray	2. A	1	202, 156, 157	Rosy Brown	S22. A	1	166, 114, 127	Turkish Rose
	7	197, 198, 200	Neon Silver		2	192, 170, 175	Silver Pink		2	145, 146, 164	Manatee
	8	194, 198, 199	Silver		3	178, 172, 179	Dark Gray		3	182, 151, 154	Rosy Brown
1	2	180, 128, 130	Old Rose		S18. A	1	193, 164, 171		Silver Pink	4	
	3	142, 146, 158	Manatee	2		178, 172, 179	Dark Gray		5	179, 147, 150	
	4	149, 148, 154	Spanish Gray	3		179, 171, 179			6	183, 149, 150	
S13	2	179, 122, 128	Old Rose	4		186, 176, 181	Silver Pink		7	182, 146, 147	
	3	160, 151, 162	Rose quartz	5		219, 187, 184	Chilean Pink		8	187, 153, 152	
	4	160, 159, 167	Quick Silver	6		217, 189, 189			9	183, 150, 151	
S15. A	1	145, 151, 167	Manatee	S19. A	1	180, 152, 158	Lilac Luster	S23. A	1	169, 113, 122	Turkish Rose
	2	147, 154, 170			2	175, 167, 169	Dark Gray		2	177, 151, 154	Rosy Brown
	3	185, 160, 169	Lilac Luster		3	171, 164, 169	Quick Silver		3	176, 150, 153	
	4	186, 158, 162	Silver Pink	S20. A	1	177, 170, 175	Dark Gray		4	178, 152, 154	
	5	187, 157, 159			2	175, 168, 172			5	177, 148, 150	
	6	188, 158, 160			3	179, 171, 179			6	178, 148, 148	
	7	193, 163, 163			4	179, 173, 180			7	178, 148, 148	
	8	192, 162, 161			5	181, 172, 178	8		176, 147, 149		
	9	191, 161, 159			6	186, 174, 178	Silver Pink		9	174, 144, 146	
	10	192, 161, 161		3. A	1	180, 121, 125	Old Rose	S24. A	1st, a	182, 141, 139	Rosy Brown
	11	190, 161, 158	2		144, 142, 153	Manatee	1st, b		184, 161, 160	Silver Pink	
S16. A	1	199, 193, 190	Pale Silver		3	183, 152, 156	Rosy Brown		2nd, a	189, 149, 157	Rosy Brown
	2	195, 188, 188		4	186, 151, 152	2nd, b			194, 179, 188	Silver Pink	
	3	212, 180, 178	Silver Pink	5	147, 149, 158	Manatee	3rd, a		181, 147, 156	Rosy Brown	

fig	item	RGB code	~ color name	fig	item	RGB code	~ color name	fig	item	RGB code	~ color name	
S24.A	3rd, b	185, 172, 182	Silver Pink	S29. B	6	192, 196, 208	Lavender Gray	S30. B	2	170, 180, 192	Cadet Gray	
	4th, a	173, 145, 149	Rosy Brown		7	181, 188, 203			3	179, 184, 193	Medium Gray	
	4th, b	172, 166, 170	Dark Gray		8	179, 180, 196			4	189, 193, 202	Lavender Gray	
	5th, a	185, 151, 147	Rosy Brown	4. A	1	163, 176, 194	Cadet Gray		5	177, 184, 193	Medium Gray	
	5th, b	188, 166, 161	Silver Pink		2	217, 187, 204	Thistle		6	182, 187, 196	Lavender Gray	
	6th, a	193, 160, 156			3	237, 188, 192	Baby Pink		7	174, 183, 196	Light Steel Blue	
	6th, b	194, 176, 172			4	201, 177, 191	Thistle		8	136, 147, 166	Manatee	
	7th, a	196, 167, 168			5	194, 195, 207	Lavender Gray		5. A	1	183, 191, 206	Lavender Gray
7th, b	201, 179, 180	6			178, 192, 217	Light Steel Blue	2	229, 201, 215		Queen Pink		
S25. A	1st, a	198, 155, 163			Rosy Brown	7	207, 190, 207	Languid Lavender			3	230, 198, 210
	1st, b	205, 187, 188			Silver Pink	8	237, 199, 204	Baby Pink		4	213, 180, 195	Queen Pink
	2nd, a	166, 136, 140		Rosy Brown	4. B	1	154, 169, 186	Cadet Gray		5	238, 201, 214	
	2nd, b	158, 152, 154	Spanish Gray	2		182, 173, 186	Lavender Gray	6		200, 201, 214	Lavender Gray	
	3rd, a	179, 162, 162	Silver Pink	3		228, 179, 182	Pale Chestnut	7		233, 201, 213	Queen Pink	
	3rd, b	176, 164, 165		4		174, 161, 175	Rose quartz	8		223, 185, 196	Cameo Pink	
	4th, a	189, 172, 176	Pale Silver	5		172, 178, 194	Lavender Gray	5. B	1	186, 193, 202	Silver	
	4th, b	198, 186, 184	Lavender Gray	6		154, 168, 194	Cadet Gray		2	211, 178, 191	Thistle	
	5th, a	212, 201, 207	Light Gray	7		177, 170, 185	Rose quartz		3	217, 190, 201	Queen Pink	
	5th, b	213, 212, 213	Lavender Gray	8		221, 175, 177	Pale Chestnut		4	197, 183, 194	Languid Lavender	
	6th, a	198, 191, 196	Neon Silver	4. C	1	133, 142, 156	Manatee		5	220, 184, 197	Cameo Pink	
	6th, b	203, 202, 207	Lavender Gray		2	151, 162, 180	Cadet Gray		6	194, 196, 203	Lavender Gray	
7th, a	198, 197, 203	Lavender Gray	3		224, 173, 178	Pale Chestnut	7		219, 193, 204	Queen Pink		
7th, b	201, 200, 206		4		156, 161, 173	Cadet Gray	8		216, 183, 195			
S29. A	1	215, 164, 171	Pale Chestnut		5		166, 173, 188	S30. A	S31. A	1	191, 193, 202	Lavender Gray
	2	165, 173, 185	Cadet Gray		6	166, 171, 188	Lavender Gray			2	209, 195, 210	Languid Lavender
	3	178, 187, 201	Light Steel Blue		7	156, 161, 177	Manatee			3	198, 199, 211	Lavender Gray
	4	180, 189, 203			8	218, 169, 176	Pale Chestnut			4	207, 208, 223	
	5	186, 197, 207	Pale Aqua	1	151, 162, 183	Cadet Gray	5			215, 218, 227	Gainsboro	
	6	188, 193, 204	Lavender Gray	2	182, 181, 191	Lavender Gray	6			219, 220, 231	Lavender Mist	
	7	181, 188, 202		3	177, 186, 199	Light Steel Blue	7			207, 197, 209	Languid Lavender	
	8	166, 178, 191	Cadet Gray	4	183, 189, 201	Lavender Gray	8			210, 178, 193	Thistle	
S29. B	1	196, 143, 155	Puce	S30. A	5	171, 181, 196	Light Steel Blue	S31. B	1	190, 191, 199	Lavender Gray	
	2	184, 186, 196	Lavender Gray		6	176, 185, 199			6	193, 194, 204		
	3	194, 199, 209			7	161, 177, 194	Cadet Gray		3	200, 201, 211		
	4	195, 197, 206			8	139, 152, 173	Cool Gray		4	205, 207, 217		
	5	201, 203, 215			1	168, 177, 191	Cadet Gray		5	222, 222, 230		Gainsboro

fig	item	RGB code	~ color name
S31. B	6	215, 218, 227	Gainsboro
	7	195, 195, 203	Lavender Gray
	8	201, 202, 212	