Supporting information

An ''off–on–off'' sensor for sequential detection of Cu^{2+} and hydrogen sulfide based on naphthalimide-rhodamine B derivative and its application in dual-channel cell imaging

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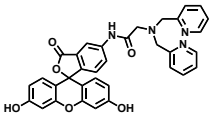
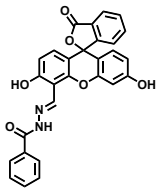
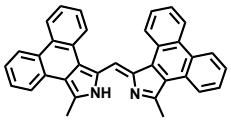
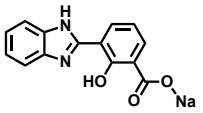
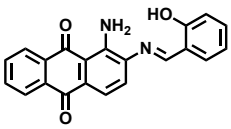
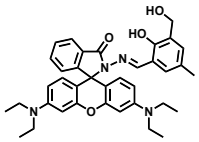
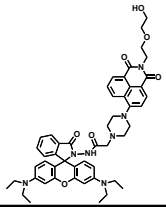
Sensor	$\lambda_{ex}/\lambda_{em}$ (nm)	Selectivity	Approaches	LOD	Ref.
	470/517	Cu^{2+}	Fluorescence quench	1.0×10^{-7} M	*Chem. Commun.*, 2009, **0**, 7390–7392
		S^{2-}	Fluorescence increase	4.2×10^{-7} M	
	494/523	Cu^{2+}	Fluorescence quench	1.08×10^{-5} M	*Dalton Trans.*, 2012, **41**, 5799–5804
		H_2S	Fluorescence increase	1.7×10^{-6} M	
	540/600	Cu^{2+}	Fluorescence quench	no data	*Chem. Commun.*, 2013, **49**, 7510--7512
		HS^{-1}	Fluorescence increase	1.0×10^{-6} M	
	243/436	Cu^{2+}	Fluorescence quench	2.77×10^{-6} M	*Dalton Trans.*, 2014, **43**, 5815–5822
		S^{2-}	Fluorescence increase	2.51×10^{-6} M	
	510/604	Cu^{2+}	Fluorescence quench	8.95×10^{-8} M	*J. Mater. Chem. B,* 2017, **5**, 8957--8966
		S^{2-}	Fluorescence increase	1.36×10^{-7} M	
	530/581	Cu^{2+}	Fluorescence increase	2.43×10^{-8} M	*RSC Adv.*, 2014, **4**, 5718–5725
		S^{2-}	colorimetric	no data	
	325/528,610	Cu^{2+}	Fluorescence increase	2.6×10^{-7} M	This work
		H_2S	Fluorescence quench	2.3×10^{-7} M	

Table 1.

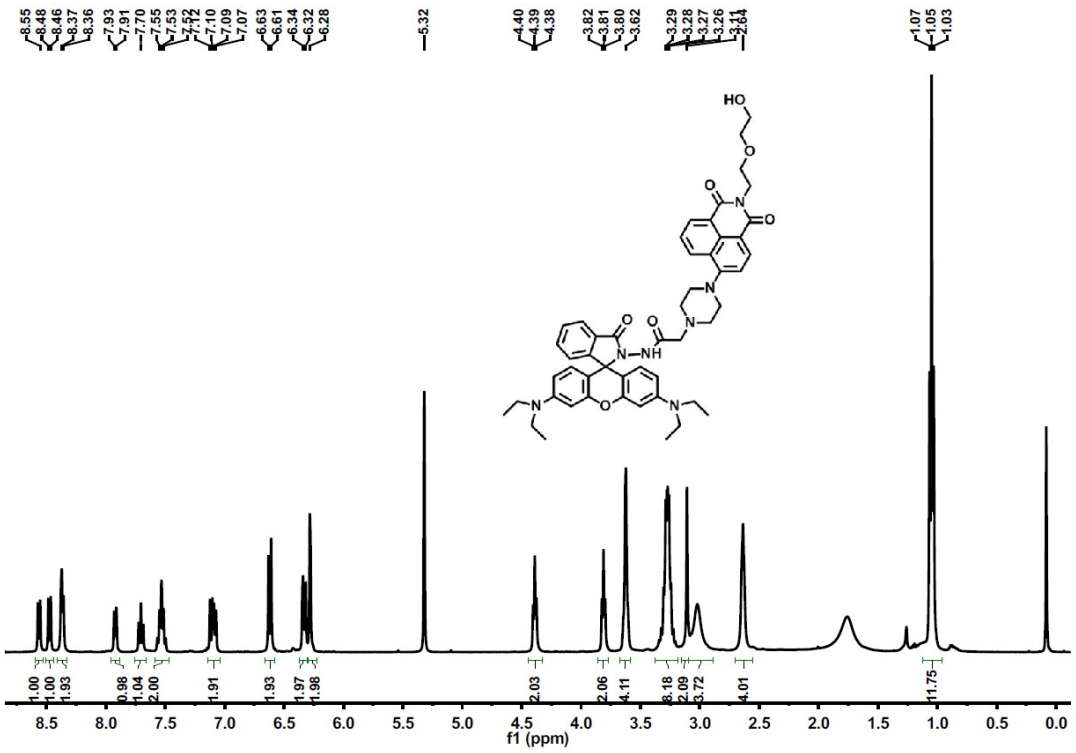

8.55
8.48
8.46
8.37
8.36
7.93
7.91
7.70
7.55
7.53
7.22
7.10
7.09
7.07
6.63
6.61
6.34
6.32
6.28
5.32
4.40
4.39
4.38
3.82
3.81
3.80
3.62
3.29
3.28
3.27
3.26
2.84
1.07
1.05
1.03
HO
O
N
O
O
N
N
O
O
N
N–NH
O
N
N
1.00
1.00
1.93
0.98
1.04
2.00
1.91
1.93
1.97
1.98
2.03
2.06
4.11
8.18
2.09
5.72
4.01
11.75
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

Fig. S1.

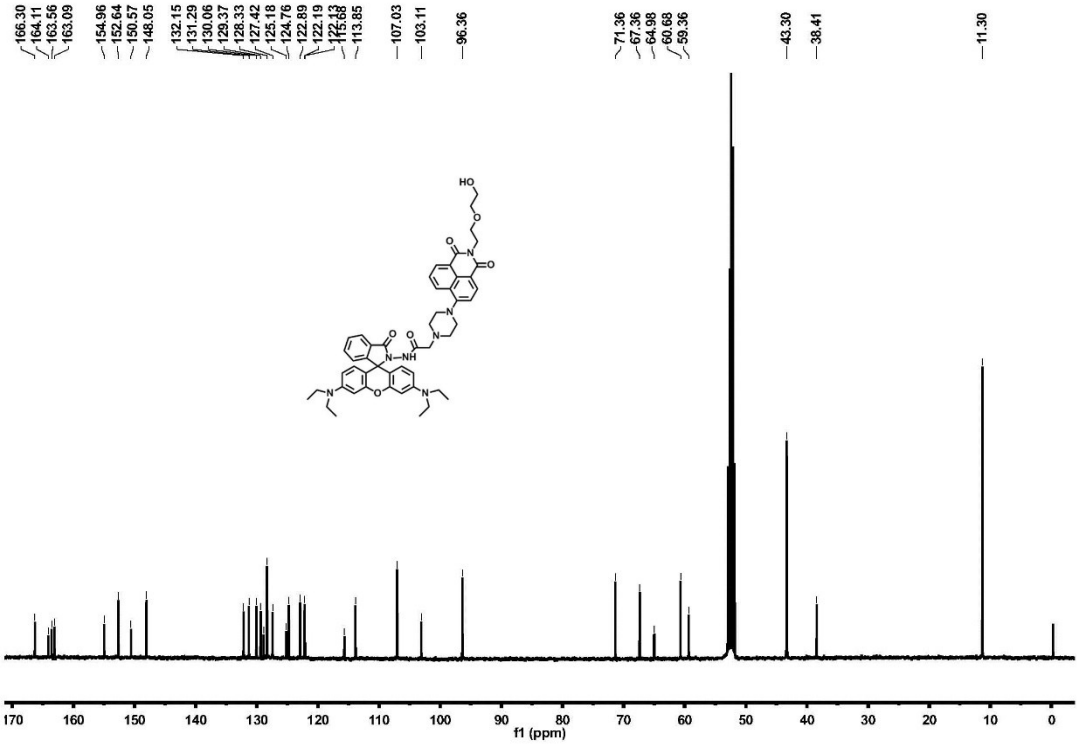

166.30
164.11
163.56
163.09
154.96
152.64
150.57
148.05
132.15
131.29
130.06
129.37
128.33
127.42
125.18
124.76
122.89
122.19
113.85
107.03
103.11
96.36
71.36
67.36
64.98
60.68
59.36
43.30
38.41
11.30
HO
O
N
NH
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

Fig. S2.

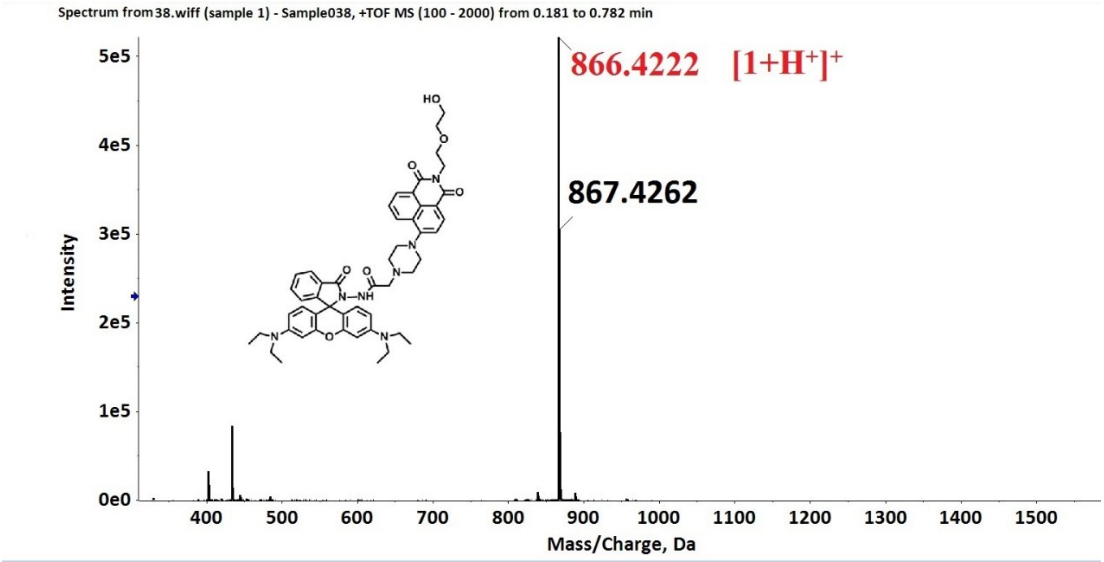

Spectrum from 38.wiff (sample 1) - Sample038, +TOF MS (100 - 2000) from 0.181 to 0.782 min
866.4222 [1+H+]+
867.4262
Intensity
5e5
4e5
3e5
2e5
1e5
0e0
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
Mass/Charge, Da

Fig. S3.

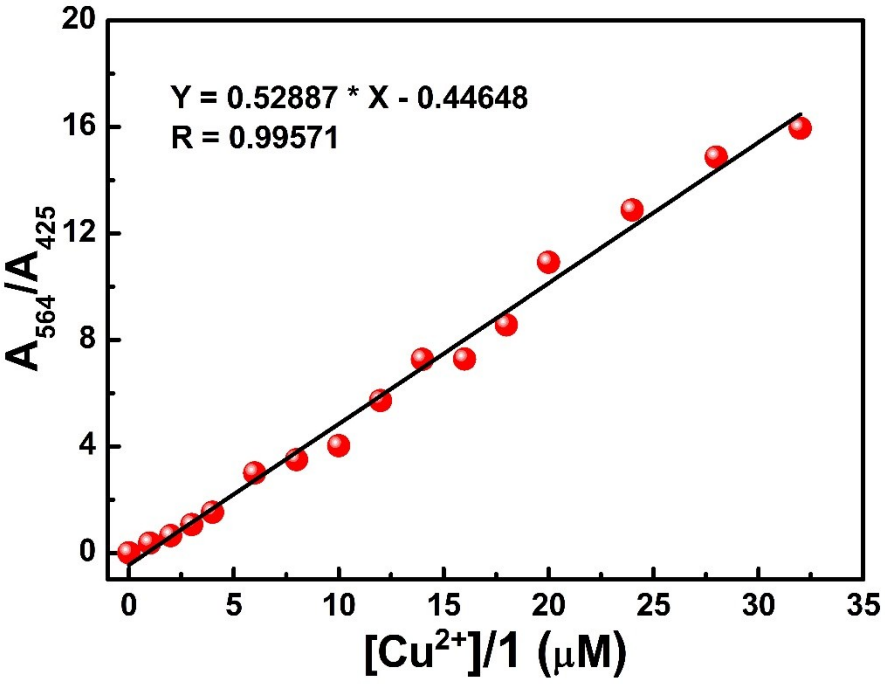

Y = 0.52887 * X - 0.44648
R = 0.99571
A_{564}/A_{425}
$[Cu^{2+}]/1$ (μM)
0
4
8
12
16
20
0
5
10
15
20
25
30
35

Fig. S4.

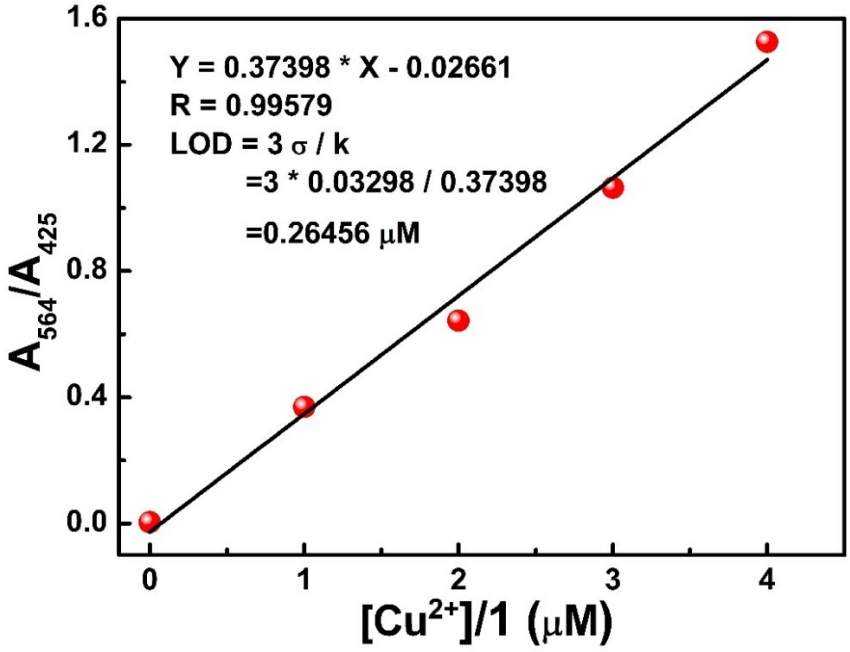

Y = 0.37398 * X - 0.02661
R = 0.99579
LOD = 3 σ / k
=3 * 0.03298 / 0.37398
=0.26456 μM
A564/A425
[Cu2+]/1 (μM)
0.0
0.4
0.8
1.2
1.6
0
1
2
3
4

Fig. S5.

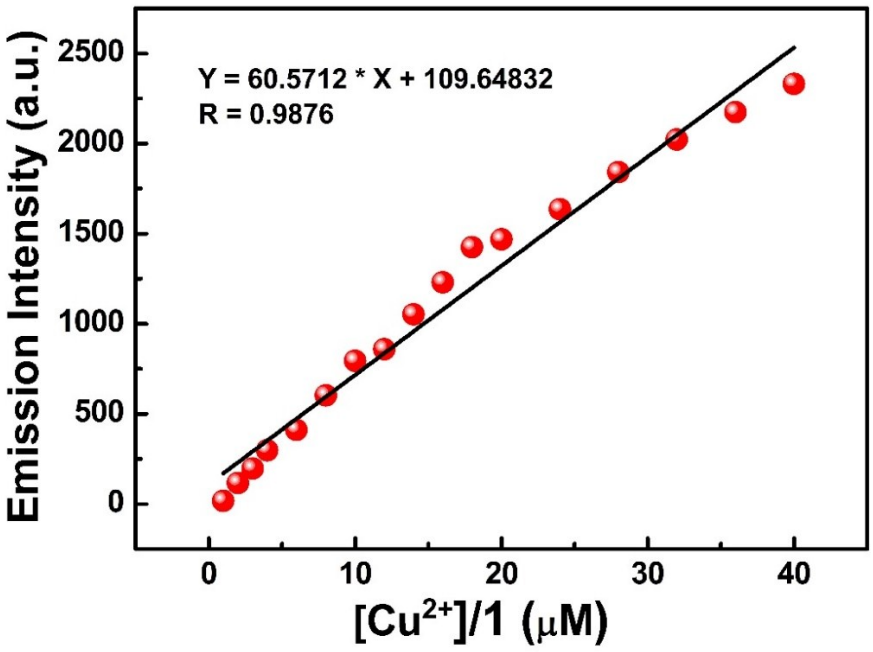

Y = 60.5712 * X + 109.64832
R = 0.9876
Emission Intensity (a.u.)
2500
2000
1500
1000
500
0
0
10
20
30
40
[Cu2+]/1 (μM)

Fig. S6.

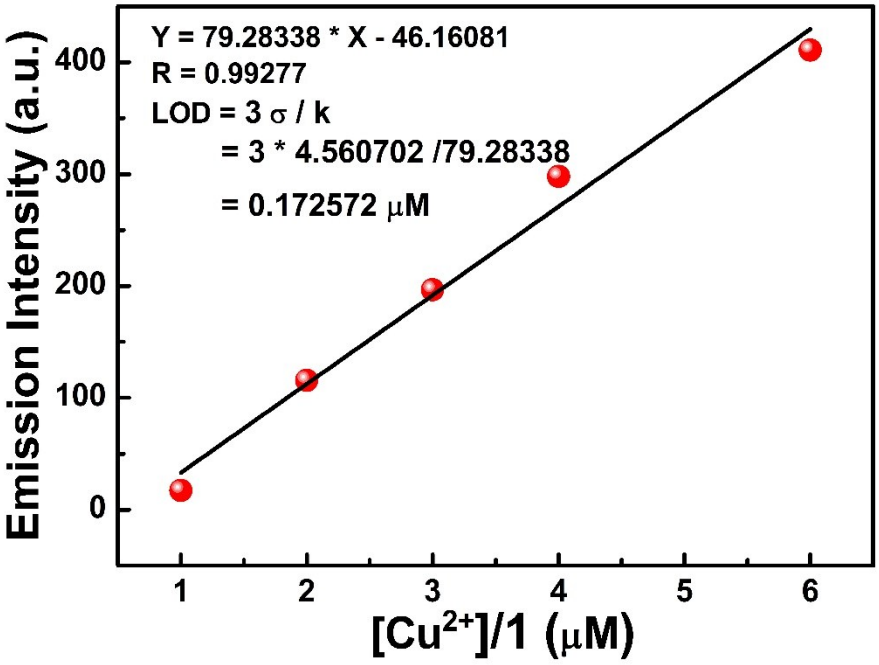

Y = 79.28338 * X - 46.16081
R = 0.99277
LOD = 3 σ / k
= 3 * 4.560702 /79.28338
= 0.172572 μM
Emission Intensity (a.u.)
0
100
200
300
400
1
2
3
4
5
6
[Cu2+]/1 (μM)

Fig. S7.

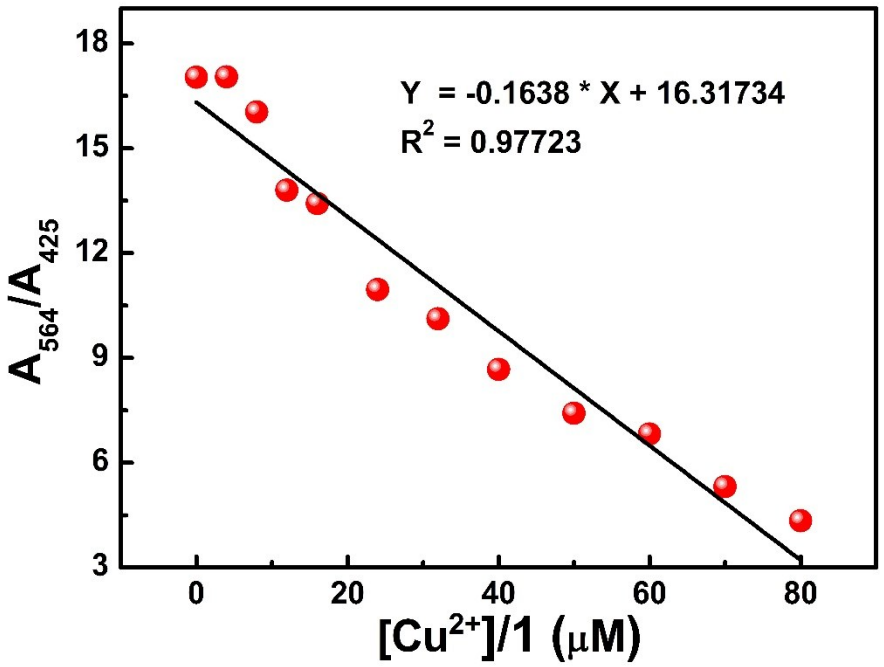

Y = -0.1638 * X + 16.31734
R2 = 0.97723
A564/A425
[Cu2+]/1 (μM)
18
15
12
9
6
3
0
20
40
60
80

Fig. S8.

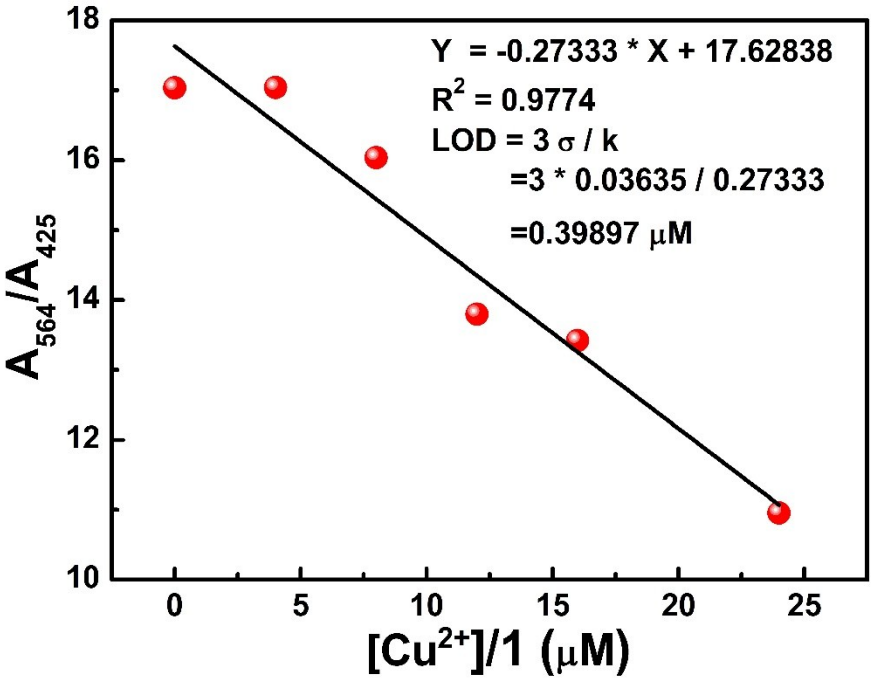

Y = -0.27333 * X + 17.62838
R2 = 0.9774
LOD = 3 σ / k
=3 * 0.03635 / 0.27333
=0.39897 μM
A564/A425
[Cu2+]/1 (μM)
18
16
14
12
10
0
5
10
15
20
25

Fig. S9.

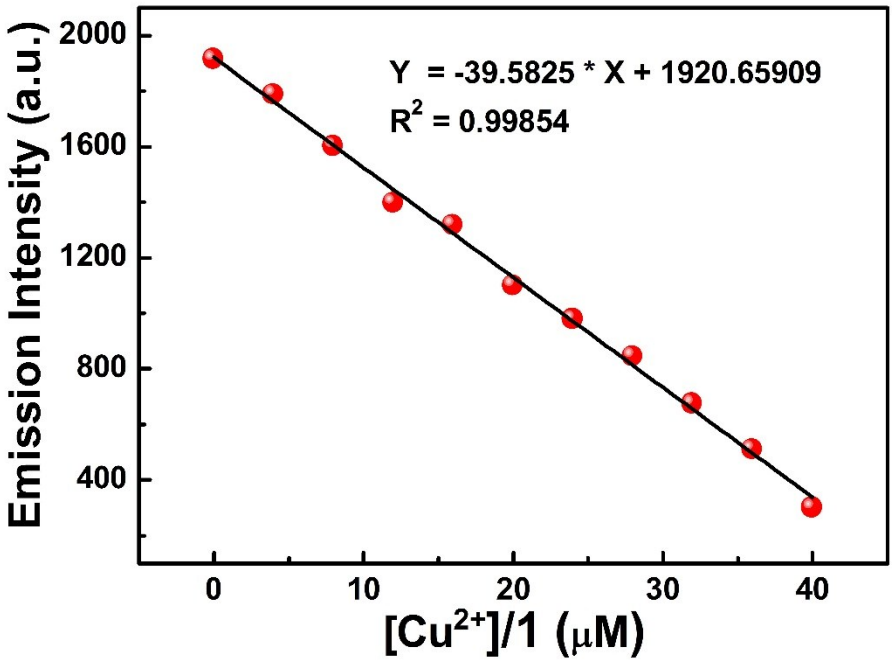

Y = -39.5825 * X + 1920.65909
R2 = 0.99854
Emission Intensity (a.u.)
2000
1600
1200
800
400
0
10
20
30
40
[Cu2+]/1 (μM)

Fig. S10.

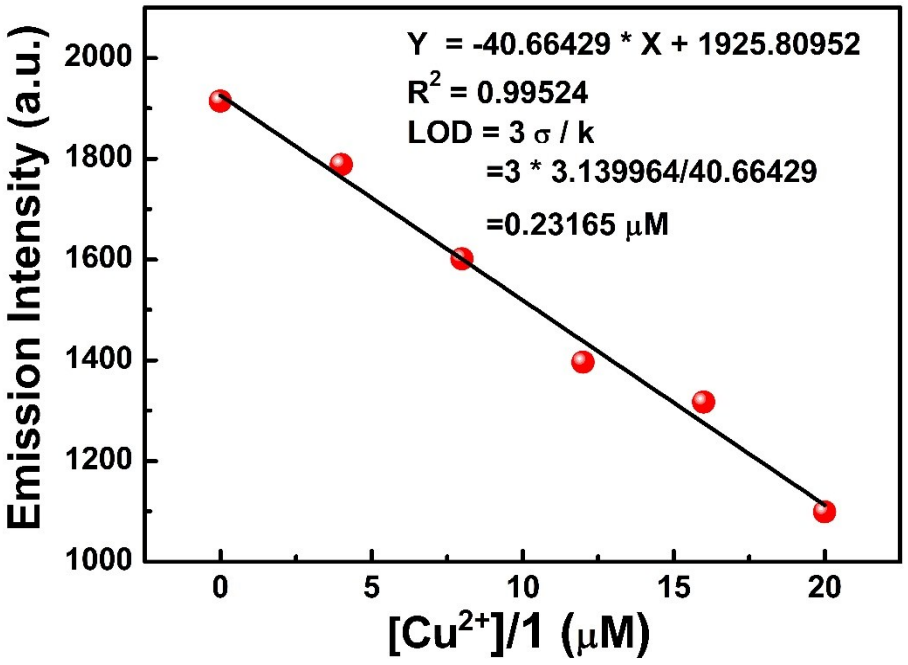

Y = -40.66429 * X + 1925.80952
R2 = 0.99524
LOD = 3 σ / k
=3 * 3.139964/40.66429
=0.23165 μM
Emission Intensity (a.u.)
2000
1800
1600
1400
1200
1000
0
5
10
15
20
[Cu2+]/1 (μM)

Fig. S11.

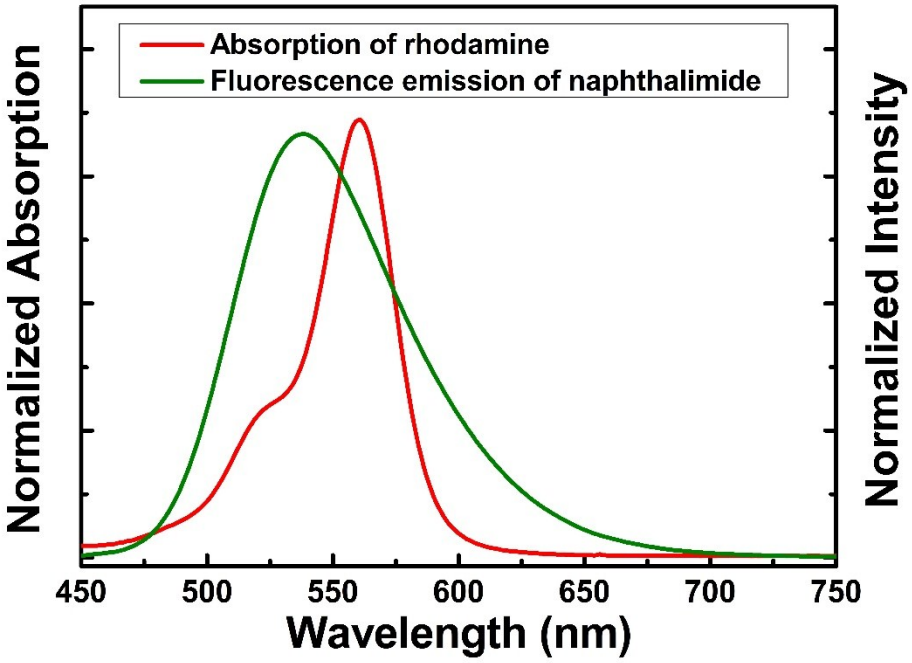

Absorption of rhodamine
Fluorescence emission of naphthalimide
Normalized Absorption
Normalized Intensity
450
500
550
600
650
700
750
Wavelength (nm)

Fig. S12.