About OMICS Group

OMICS Group International is an amalgamation of Open Access publications and worldwide international science conferences and events. Established in the year 2007 with the sole aim of making the information on Sciences and technology 'Open Access', OMICS Group publishes 400 online open access scholarly journals in all aspects of Science, Engineering, Management and Technology journals. OMICS Group has been instrumental in taking the knowledge on Science & technology to the doorsteps of ordinary men and women. Research Scholars, Students, Libraries, Educational Institutions, Research centers and the industry are main stakeholders that benefitted greatly from this knowledge dissemination. OMICS Group also organizes 300 International conferences annually across the globe, where knowledge transfer takes place through debates, round table discussions, poster presentations, workshops, symposia and exhibitions.

About OMICS Group Conferences

OMICS Group International is a pioneer and leading science event organizer, which publishes around 400 open access journals and conducts over 300 Medical, Clinical, Engineering, Life Sciences, Pharma scientific conferences all over the globe annually with the support of more than 1000 scientific associations and 30,000 editorial board members and 3.5 million followers to its credit.

OMICS Group has organized 500 conferences, workshops and national symposiums across the major cities including San Francisco, Las Vegas, San Antonio, Omaha, Orlando, Raleigh, Santa Clara, Chicago, Philadelphia, Baltimore, United Kingdom, Valencia, Dubai, Beijing, Hyderabad, Bangalore and Mumbai.

Fluorescence switch for sequentially and selectively sensing copper (II) and L-histidine in vitro and in living cells

Gaolin Liang （梁高林）, Ph.D.
Professor of Chemistry, Ph.D. Advisor
Department of Chemistry
University of Science and Technology of China
Email: gliang@ustc.edu.cn
Homepage: http://lianglab.ustc.edu.cn

5th ICEABT@Beijing, China
Aug. 18, 2014



Research in our group

1. New “click” condensation reaction and its applications in molecular imaging

Gaolin Liang, Hongjun Ren, and Jianghong Rao*. ***Nat. chem.***. 2010, 2: 54-60.

Deju Ye, **Gaolin Liang**, Manlung Ma, and Jianghong Rao*. ***Angew. Chem. Int. Ed.*** 2011, 50 (10): 2275-2279.

1.1. In magnetic resonance imaging (MRI)

Yue Yuan, et al, and **Gaolin Liang***. ***Submitted.***

Chunyan Cao, et al, and **Gaolin Liang***. ***Sci. Rep.*** 2013, 3, 1024.

Gaolin Liang, et al, and Jianghong Rao*. ***Angew. Chem. Int. Ed.*** 2011, 50 (28): 6283-6286.

1.2. In nuclear imaging

Qingqing Miao, et al, and **Gaolin Liang***. To be submitted.

Qingqing Miao, et al, and **Gaolin Liang***. ***Chem. Commun.*** 2012, 48 (78), 9738-9740.

1.3. In optical imaging

Yue Yuan, et al, and **Gaolin Liang***. ***Biomaterials***. 2014, 35, 7881-86.

Yue Yuan, et al, and **Gaolin Liang***. ***Anal. Chem.***. 2013, 85, 1280-1284.

Rui Huang, et al, and **Gaolin Liang***. ***Anal. Chem.*** 2013, 85, 6203-6207.

Chunyan Cao, et al, and **Gaolin Liang***. ***Chem.Commun.*** 2011, 47 (37), 10320-10322.

Yue Yuan, et al, and **Gaolin Liang***. ***Sci. Rep.***. 2013, 3, 3523.

Xiaojing Wang, et al, and **Gaolin Liang***. ***Org. Biomol. Chem.*** 2012, 10, 8082-8086.

Research in our group

2. Supramolecular hydrogels and their biomedical applications

Anming Tang, et al, **Gaolin Liang*.** ***Sci. Rep.*** 2013, 3, 1848.

Weijuan Wang, et al, **Gaolin Liang*.** ***Anal. Chem.*** 2014, 86, 5955-61.

Xiaoli Zhang, et al, **Gaolin Liang**, and Zhimou Yang*. ***Angew. Chem. Int. Ed.*** 2012, 51, 4388-4392.

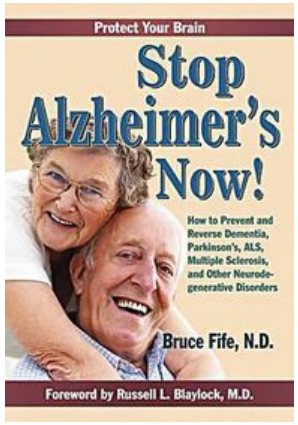
Xingyi Li, et al, **Gaolin Liang**, and Hao Chen*. ***J. Mater. Chem.*** 2012, 22 (41), 21838-21840.

Cooper-related diseases

High:



Wilson's Disease



Alzheimer diseases



Prion diseases

Low:



Menkes diseases



Osteoporosis

. . . !!

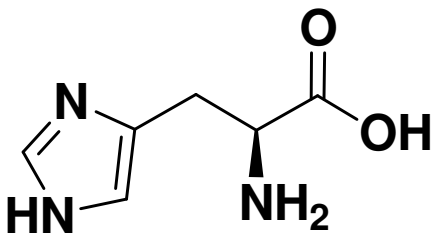
Histidine（$_L$-His）



anemia



Menkes diseases



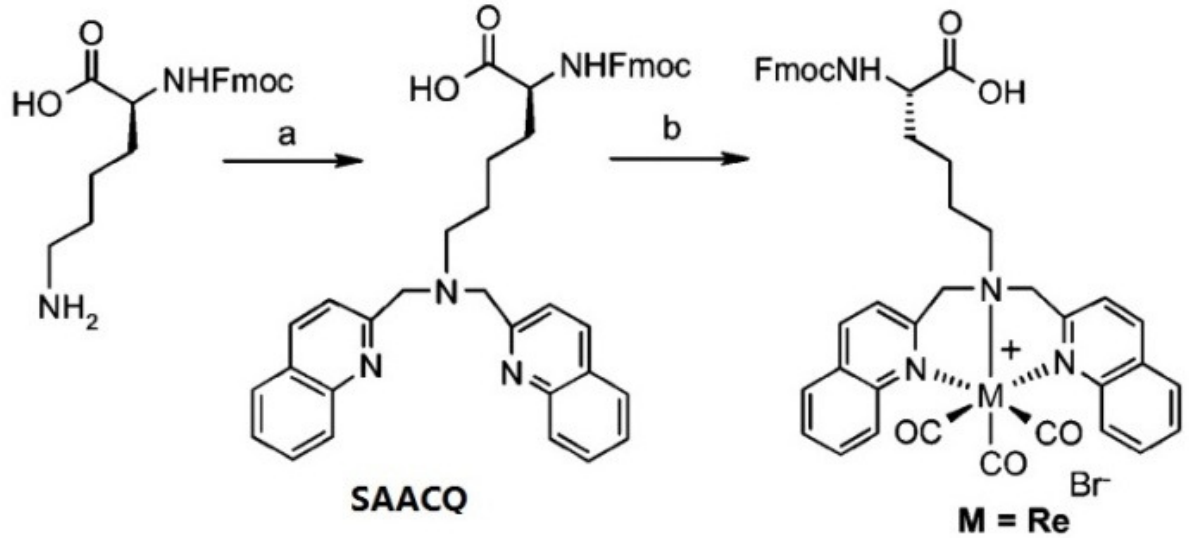
$_L$-His

		Co(II)	Ni(II)	Cu(II)	Zn(II)	Cd(II)
Stability Constants[a]	$\log K_1$	6.9	8.7	10.1	6.6	5.4
	$\log K_2$	5.5	6.9	8.0	5.5	4.3
Enthalpies of formation[a] (kcal/mol)	$-\Delta H_1$	9.6	16.2	21.0	11.6	–
	$-\Delta H_2$	12.3	16.6	21.3	11.7	–

[a] $M + L \rightleftharpoons ML\,(K_1, \Delta H_1)$, $ML + L \rightleftharpoons ML_2\,(K_2, \Delta H_2)$.

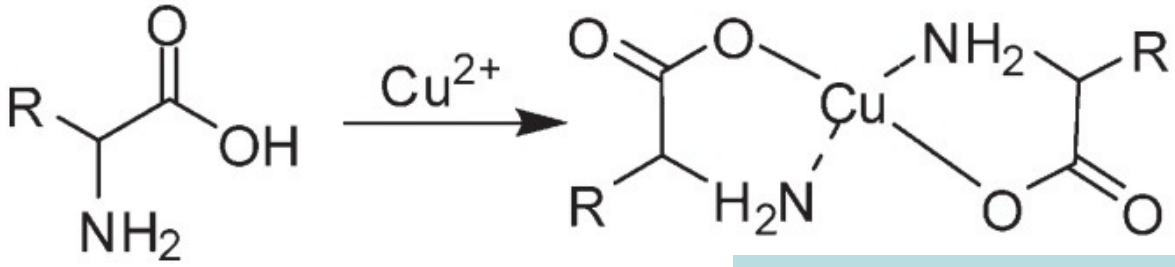
P. Deschamps et al. *Coord. Chem. Rev.*, 2005, **249**, 895-909.

Rational

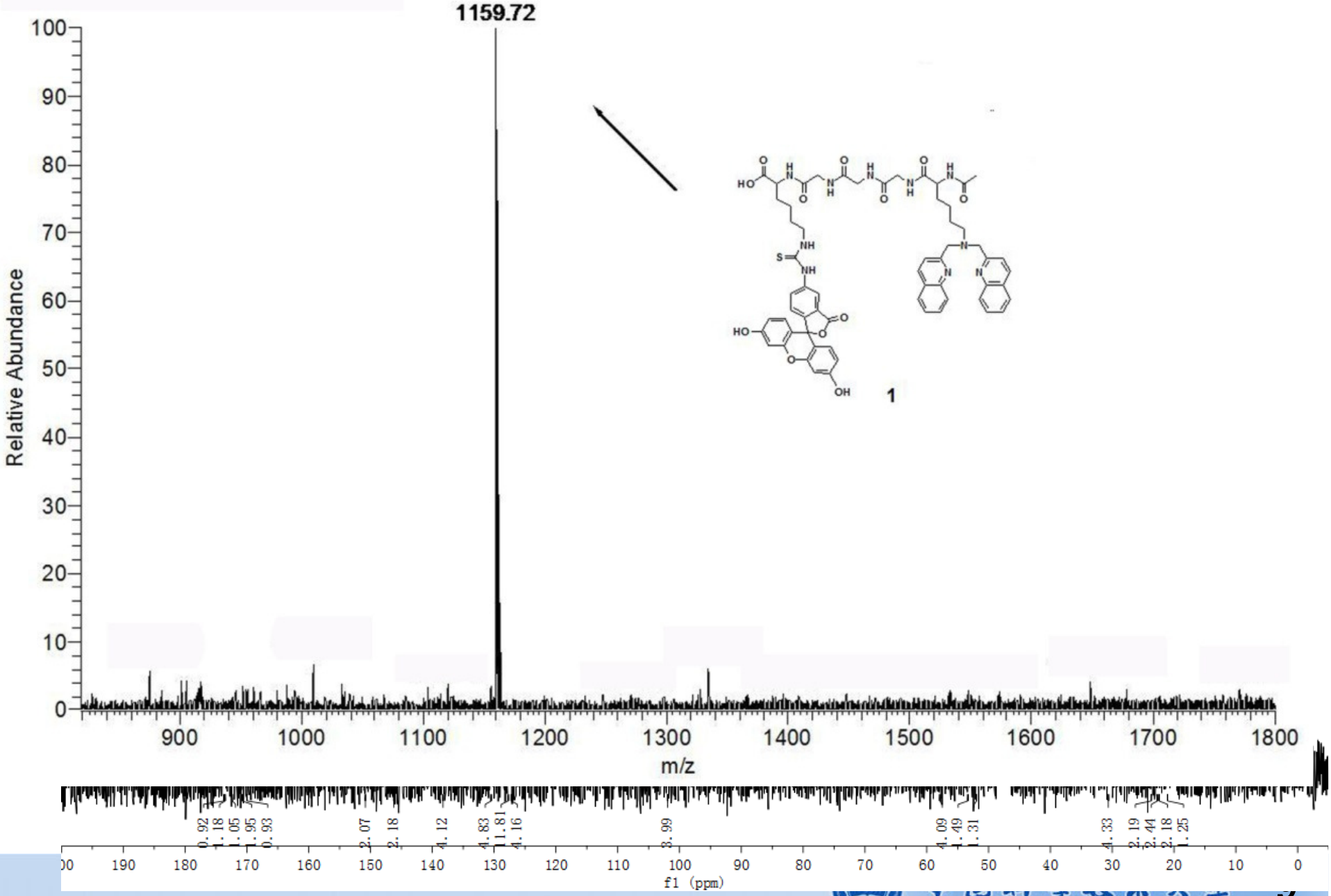


[a] Conditions: a) $NaBH(OAc)_3$, Q2A. b) $[NEt_4]_2[Re(CO)_3Br_3]$.

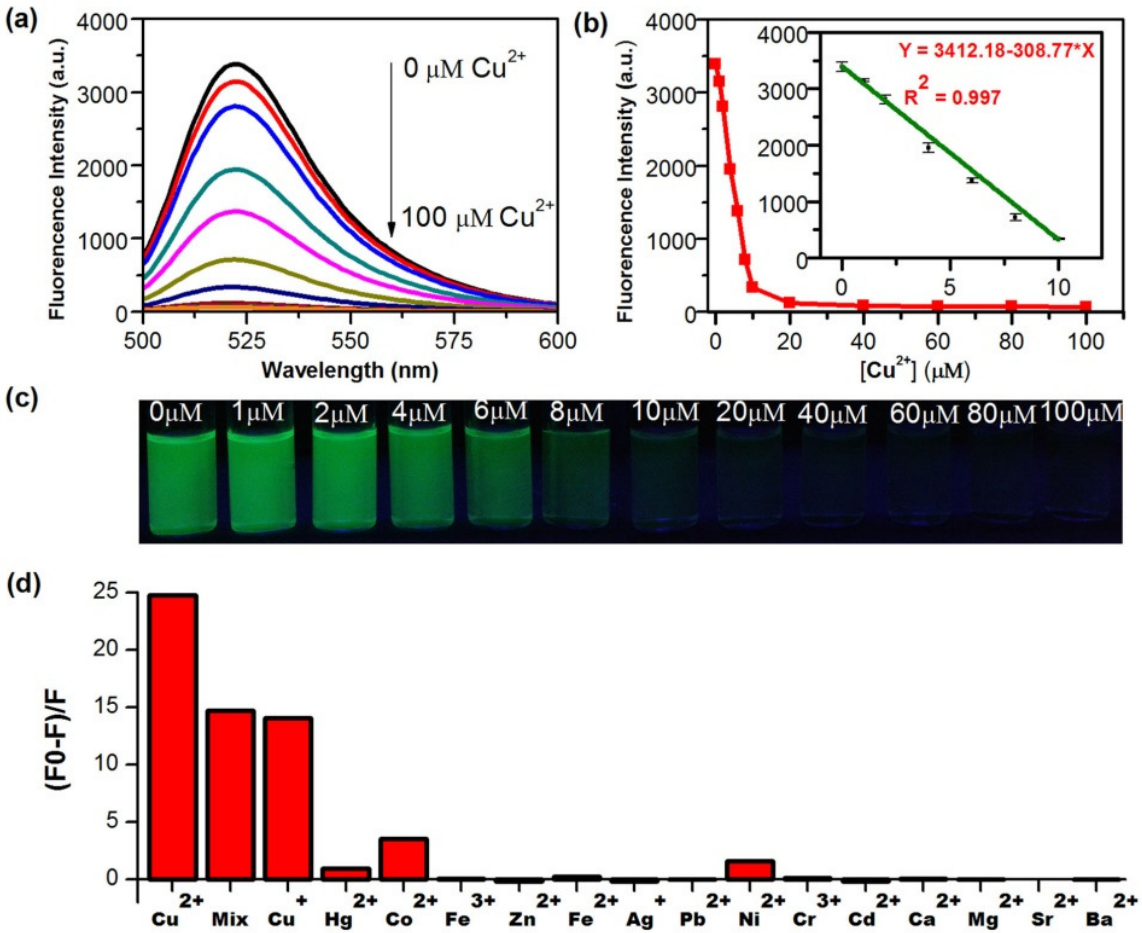
J. Am. Chem. Soc., 2004, 126 (28), 8598-8599



Langmuir, 2010, 26 (3), 1566-1569

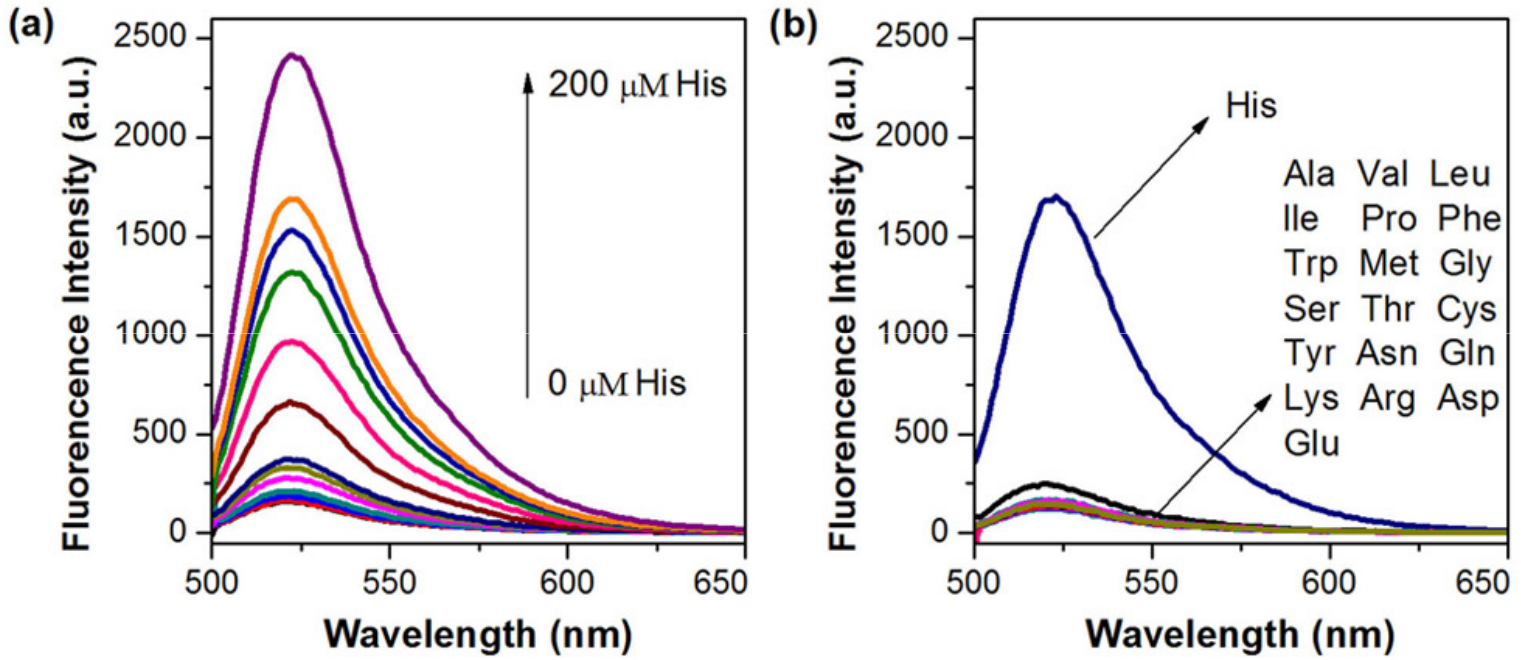

1159.72
Relative Abundance
m/z
1
f1 (ppm)

Using **1** to detect Cu^{2+} in vitro



LOD: 0.24 μM

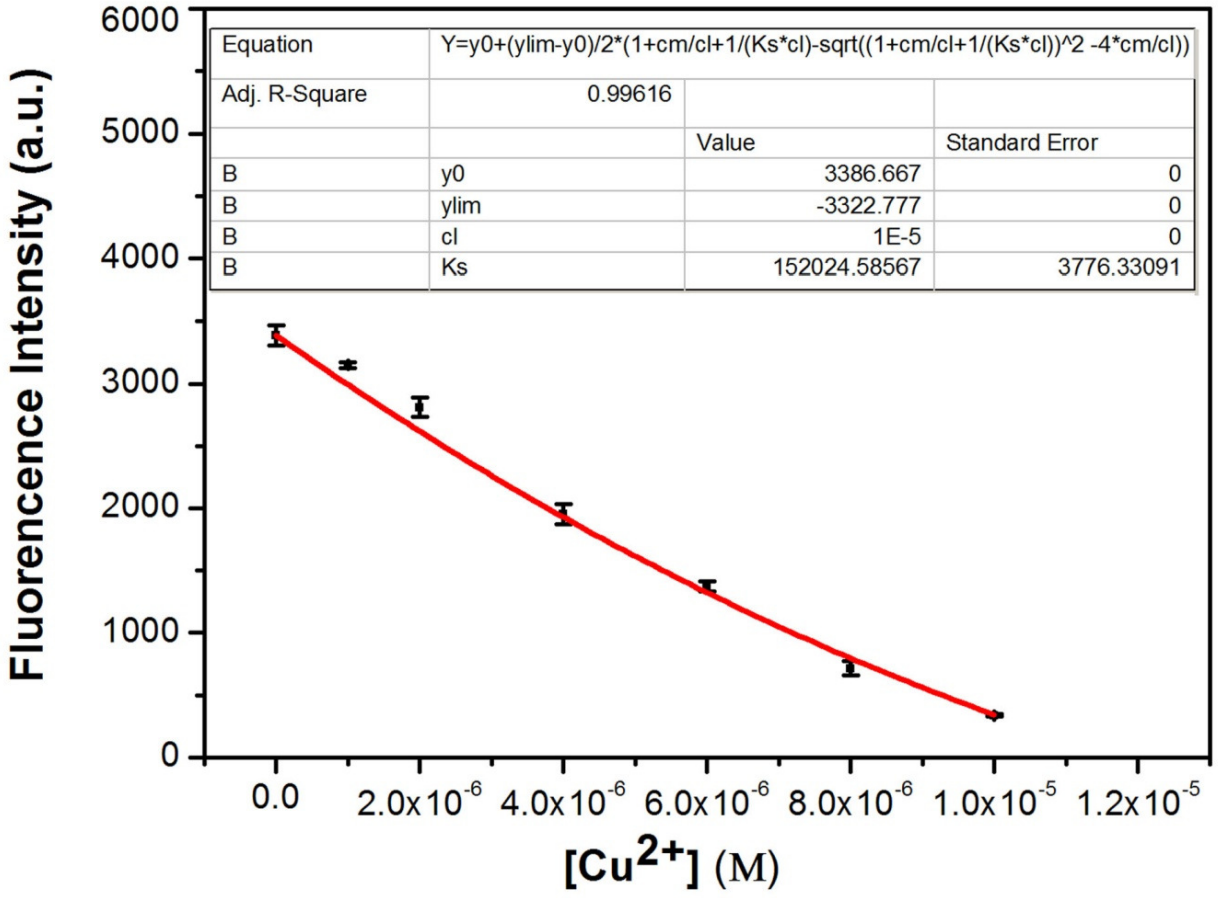
1-Cu^{2+}Complex for the detection of L-His in vitro



L-His: $Y = -0.22301 + 0.13376X$, LOD: 1.6 μM, 1-60 μM

Binding constant (K_s)

$$Y = Y_0 + \frac{Y_{lim} - Y_0}{2}\left\{1 + \frac{c_M}{c_L} + \frac{1}{K_s c_L} - \left[\left(1 + \frac{c_M}{c_L} + \frac{1}{K_s c_L}\right)^2 - 4\frac{c_M}{c_L}\right]^{1/2}\right\} \quad (1.1)$$

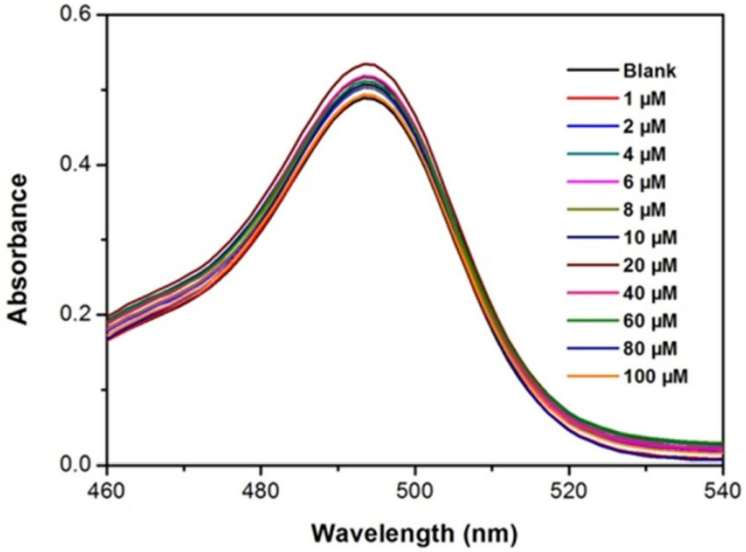


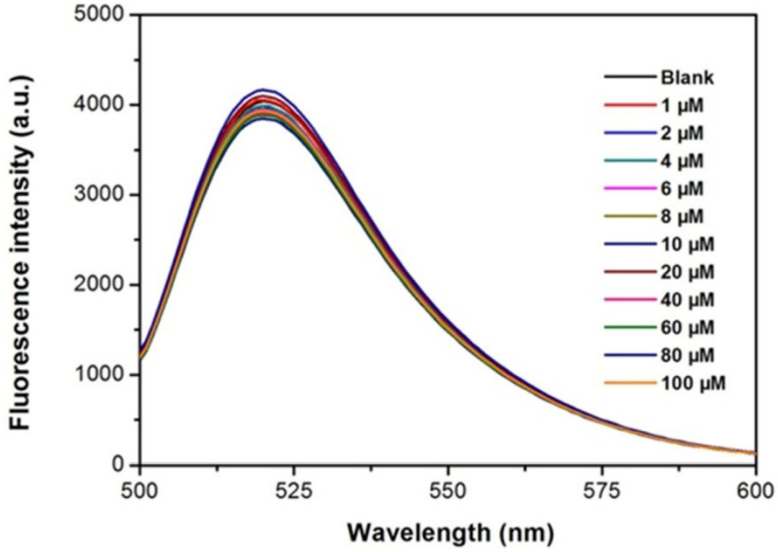
Equation	Y=y0+(ylim-y0)/2*(1+cm/cl+1/(Ks*cl)-sqrt((1+cm/cl+1/(Ks*cl))^2 -4*cm/cl))		
Adj. R-Square	0.99616		
		Value	Standard Error
B	y0	3386.667	0
B	ylim	-3322.777	0
B	cl	1E-5	0
B	Ks	152024.58567	3776.33091

1 with Cu(II)
$1.5 \times 10^5\ M^{-1}$

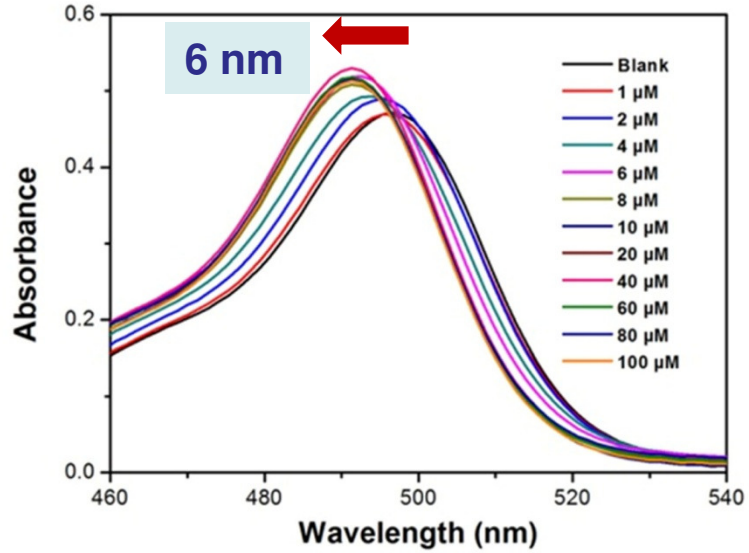
Cu(II) with $_L$-histidine
1×10^8 - $1.3 \times 10^{10}\ M^{-1}$

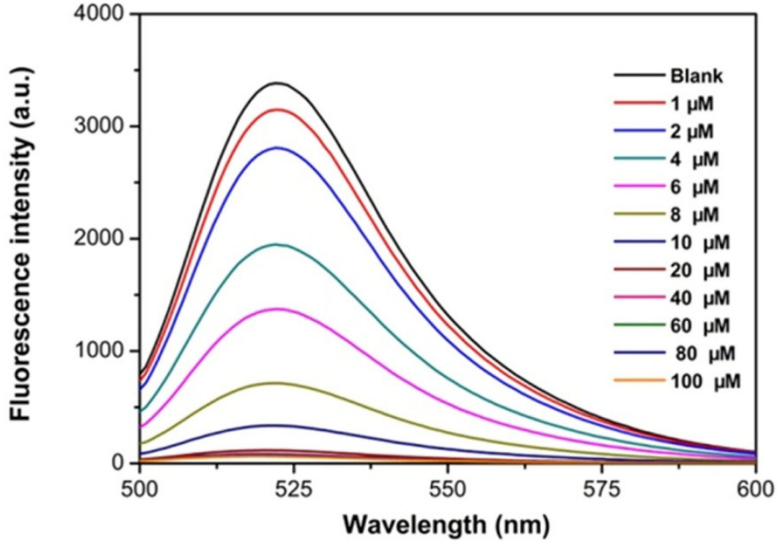
UV and FL of **1** and FITC with Cu^{2+}





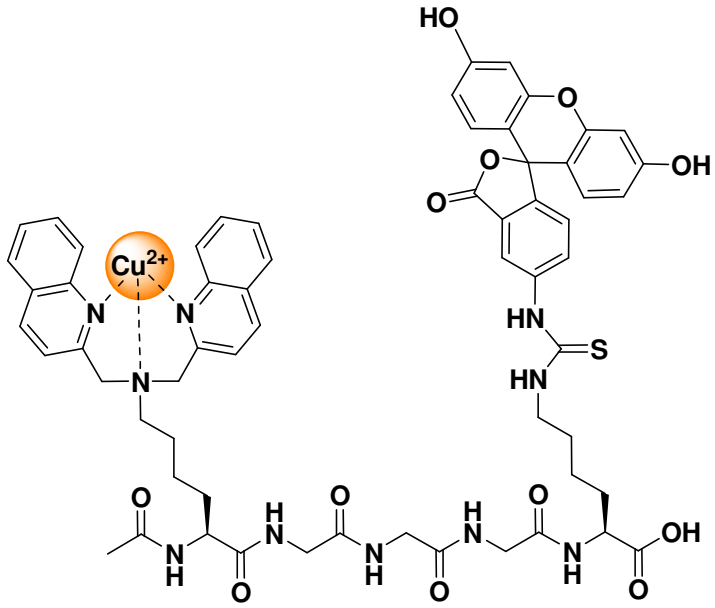
FITC



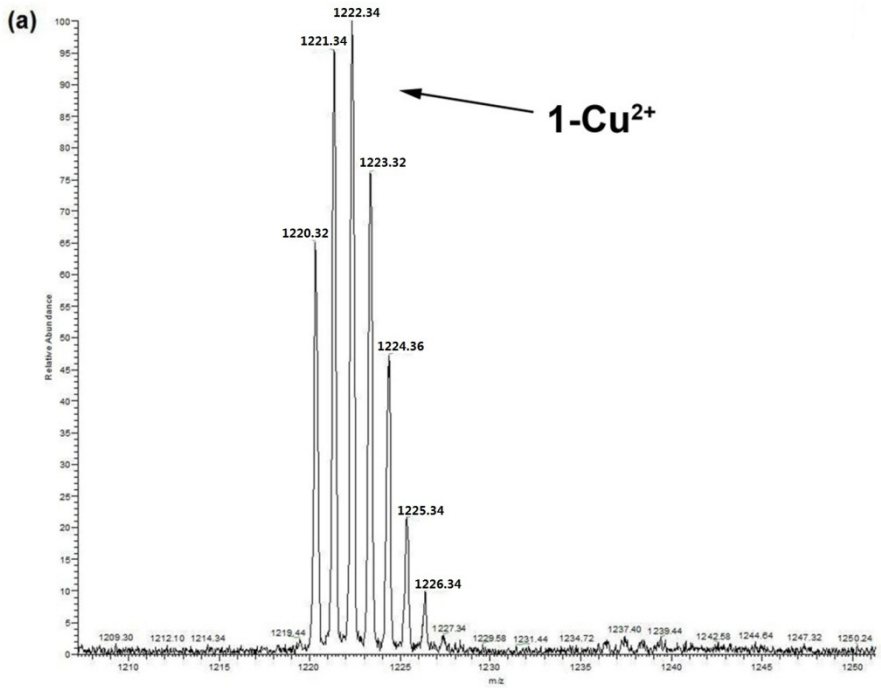


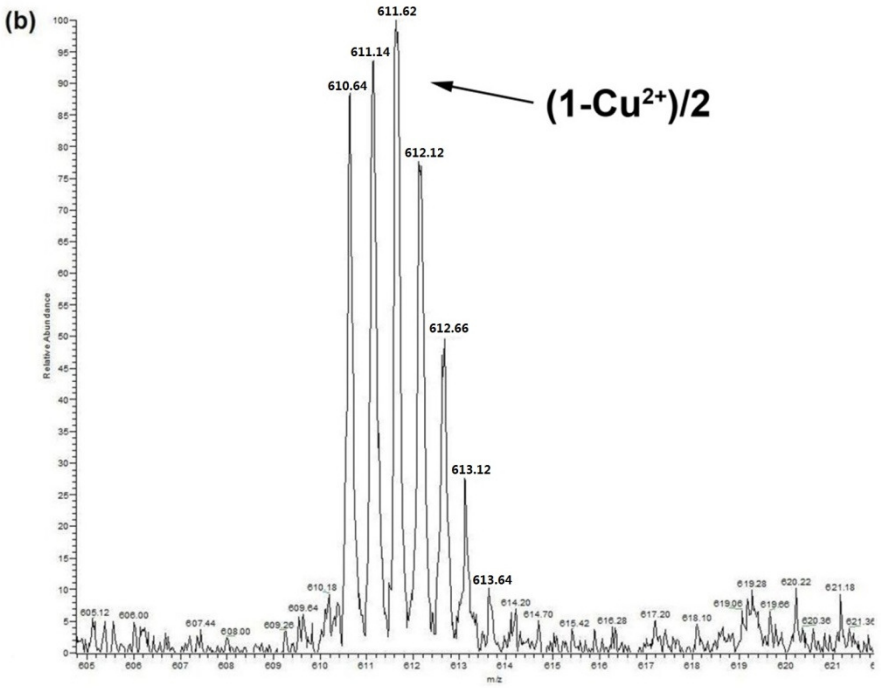
1

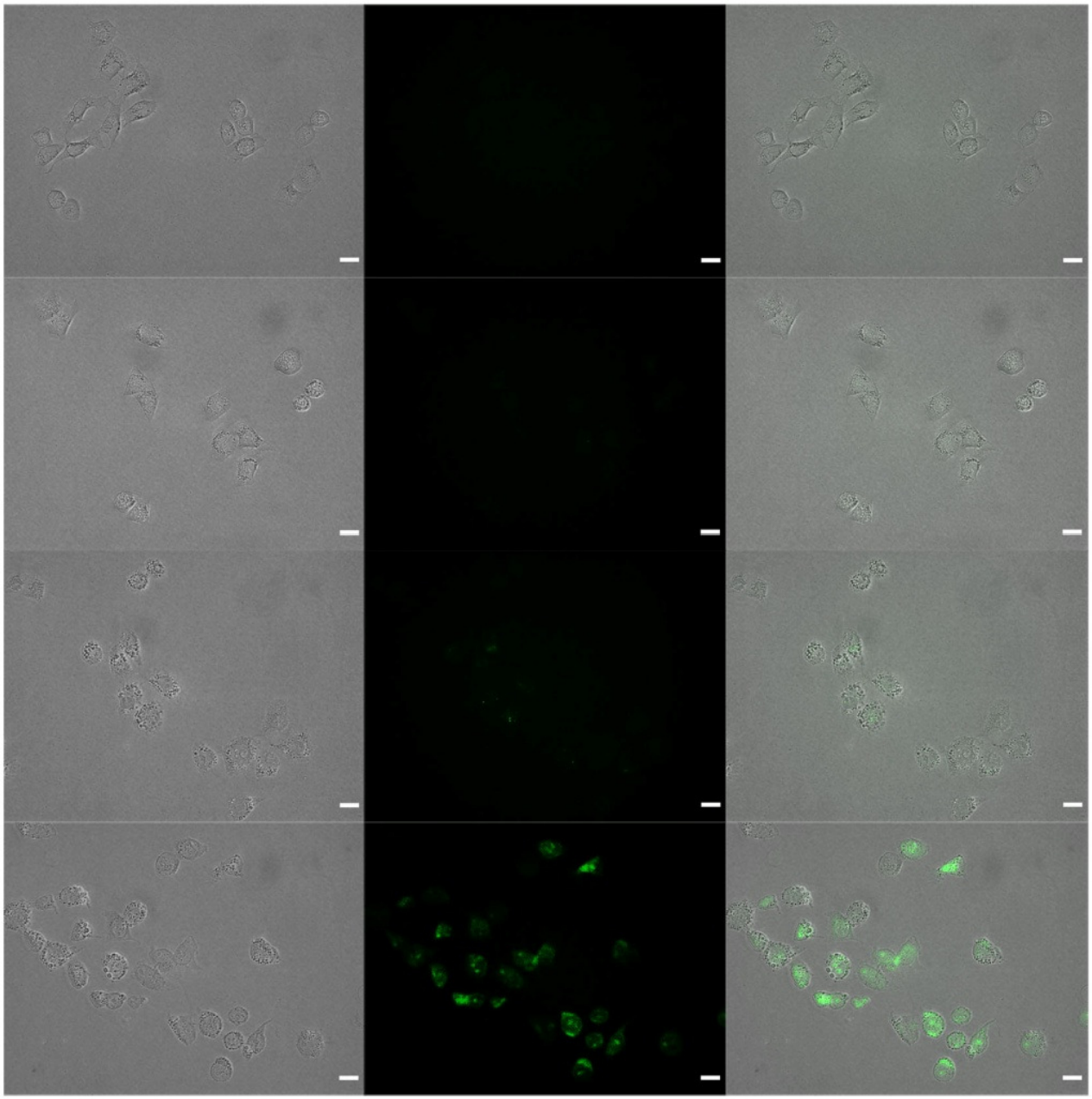
ESI-MS spectra of **1** after adding with Cu^{2+}.



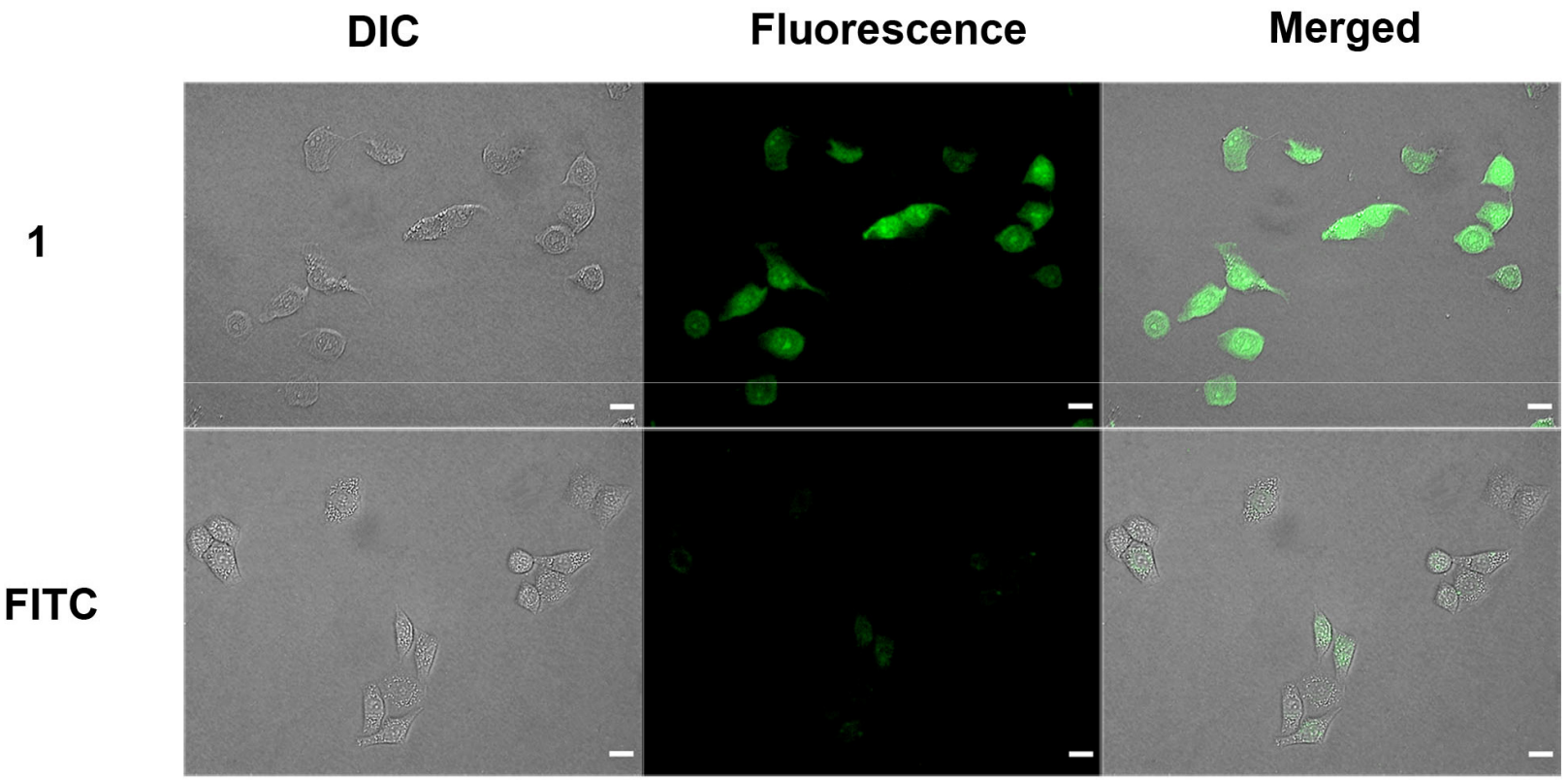
1-Cu^{2+}





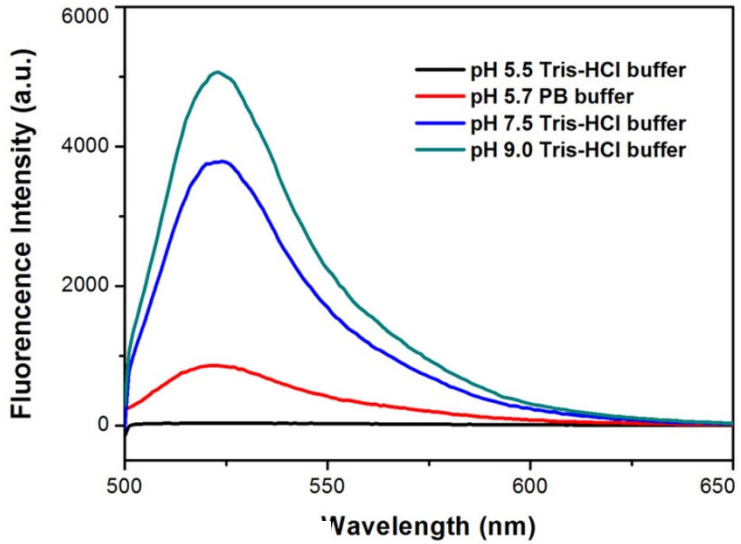

DIC
Fluorescence
Merged
1-Cu2+
1-Cu2+
50 μM His
1-Cu2+
100 μM His
1-Cu2+
200 μM His

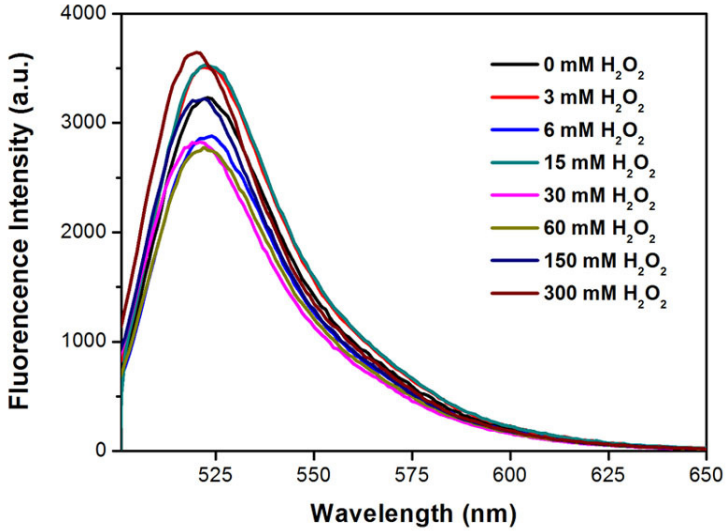
Cell permeability

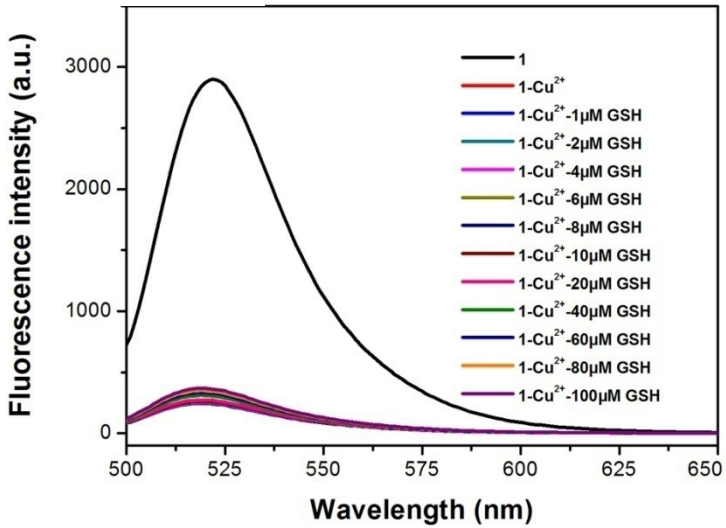


Cell permeability: 1 ＞FITC

Influence of pH and Redox

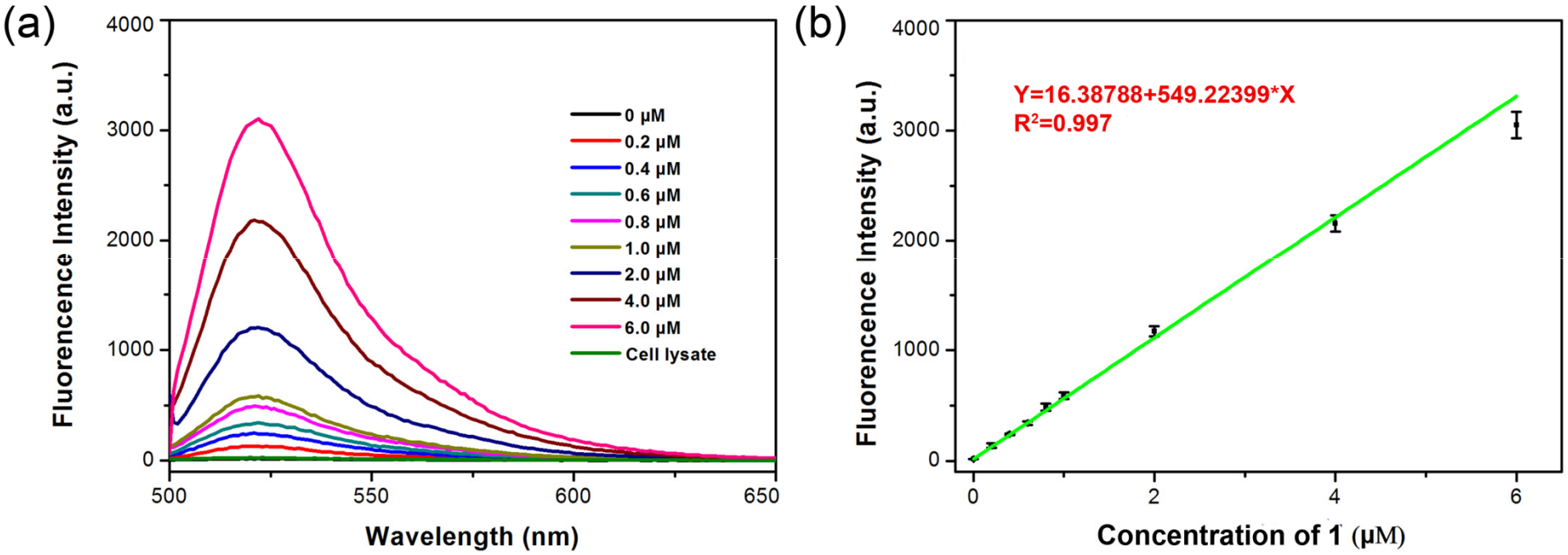






Cell uptake of **1**

10 μM probe **1**



0.00345 fmol/cell

HepG-2 cell lysate, pH 7.4 RIPA buffer

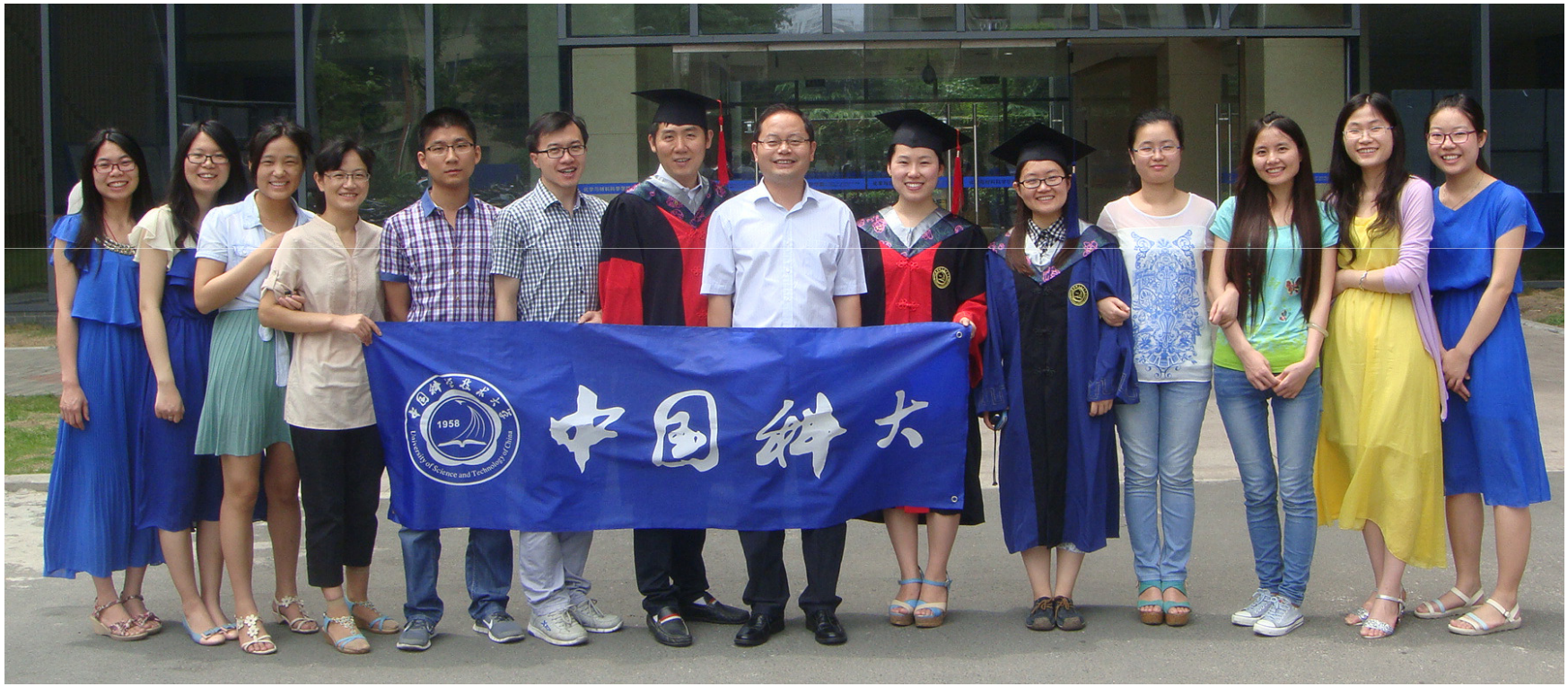
Conclusions

◆New fluorescence probe **1** with good water-solubility and cell-permeability.

◆Sequential and selective detections of Cu^{2+} and $_L$-His in vitro and in living cells.

◆ Might be applied for not only environment monitoring but also biomolecule detections in the future.

Molecular and Cellular Imaging Lab @ USTC



Acknowledgement

Collaborators:

Prof. Jianghong Rao, Ph. D., Stanford University
Prof. Xingyu Jiang (蒋兴宇), NCNT
Prof. Zhimou Yang (杨志谋), Nankai University
Prof. Qigang Wang (王启刚), Tongji University
Prof. Kai Zhong (钟凯), HMFL
Prof. Junfeng Wang(王俊峰), HMFL

Grants:

国家自然科学基金面上基金（21175122, 21375121）
国家自然科学基金“重大研究计划”培育基金（91127036）
2010年教育部“新世纪优秀人才支持计划”
2011年安徽省“杰出青年”科学基金（1108085J17）
2012年安徽省“百人计划”

Thanks for your attention!

