Electronic Supplementary Material (ESI) for Analyst.


# A Luminescent and Colorimetric Probe Based on Functionalization of Gold Nanoparticles by Ruthenium(II) Complexes for Heparin Detection

Jing Li, Meng Cheng, and Mei-Jin Li*

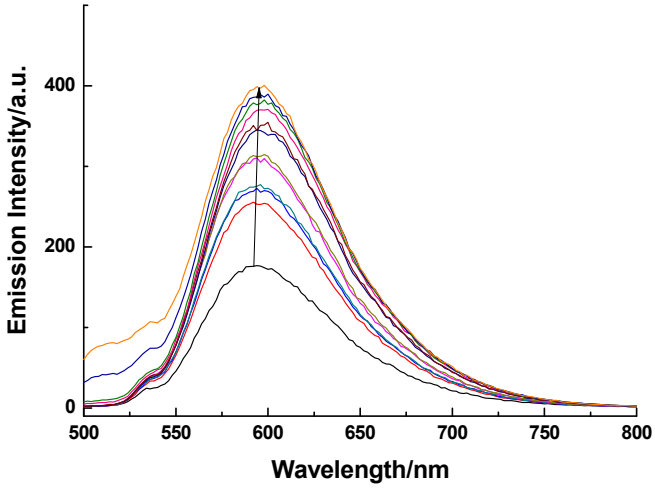
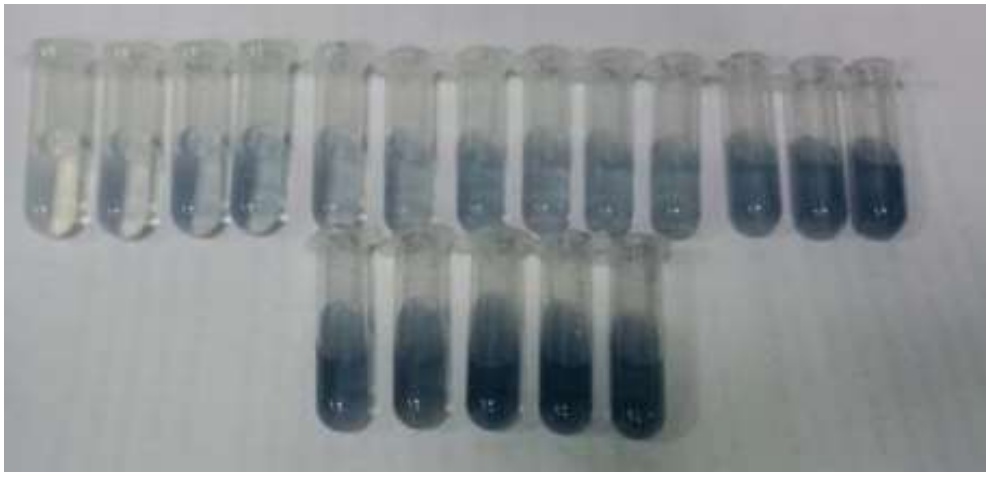



Fig. S1 Emission spectra of the binding of $Ru(phen)_3Cl_2$ (0.8 μM) to different concentrations of heparin (0-$10^{-3}$M) (in buffer solution).



**0μL 100μL 200μL 300μL 400μL 500μL 600μL 700μL 800μL 900μL 1000μL 1200μL 1400μL**

**1600μL 1800μL 2000μL 2200μL 2400μL**

**Increase the concentration of AuNPs**

Fig. S2 Images of mixtures contain $[Ru(phen)_2np]^{2+}$ (0.8 μM) and AuNPs (0-2400 μL).

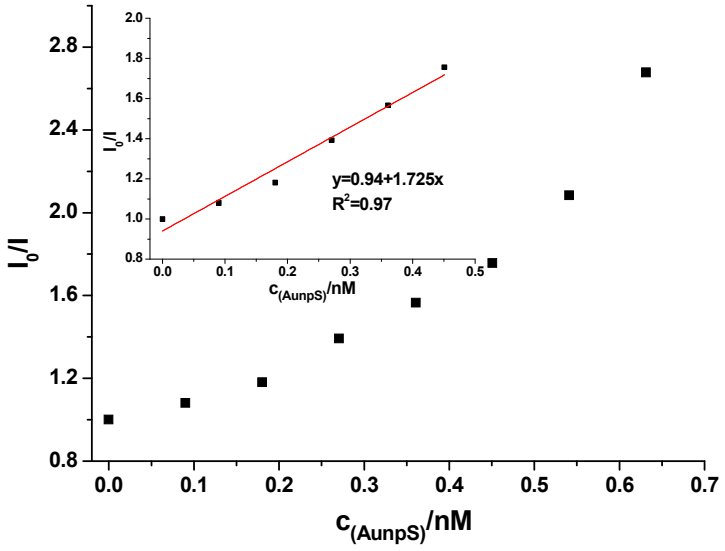



Fig. S3 Stern-Volmer plot of quenching of 0.8 μM $[Ru(phen)_2np]^{2+}$ by AuNPs. Inset shows linear range in the low quencher concentration regime.

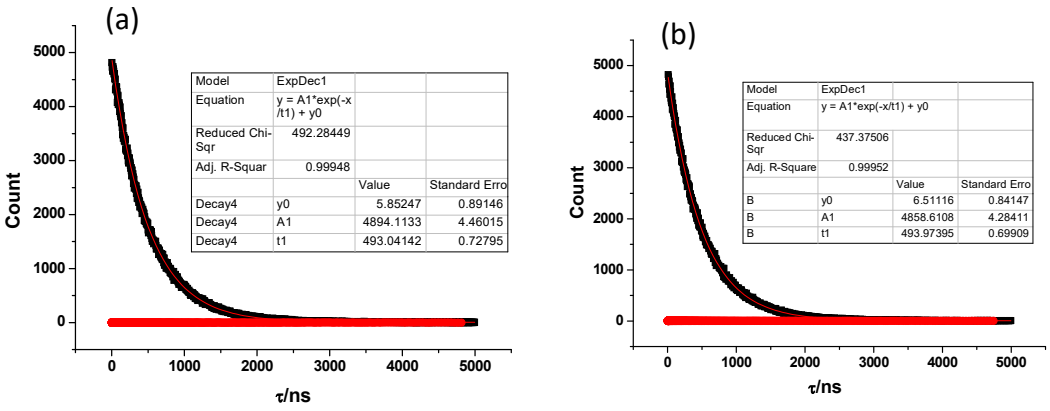



Fig. S4 Decay curves of $[Ru(phen)_2np]^{2+}$ (a) and Au-Ru (b) excited by EPL405 at room temperature (no deoxygenation).

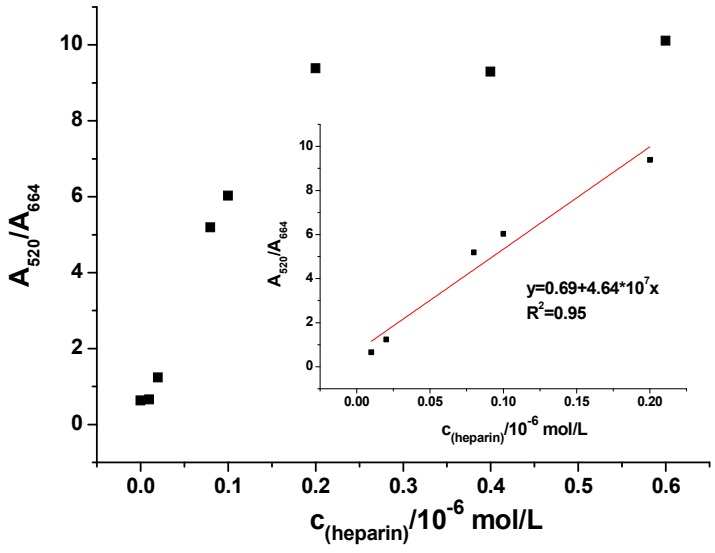



Fig. S5 Plot of $A_{520}/A_{664}$ values versus the concentrations of heparin in 5 mM Tris-HCl (pH 7.4) buffer solution. The different concentrations of heparin were added to $[Ru(phen)_2np]^{2+}$ (0.8 μM) followed by addition of AuNPs (700μL).

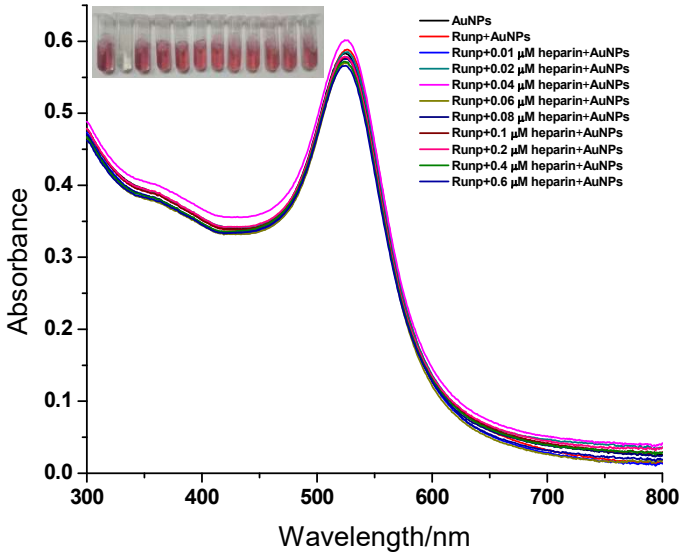



Fig. S6 UV-vis absorption spectra of the binding of $[Ru(phen)_2np]^{2+}$ (0.8 μM) to different concentrations of heparin (0-0.8 μM), followed by addition of AuNPs (700μL). Inset：Images of AuNPs and the mixtures contain $[Ru(phen)_2np]^{2+}$ (0.8 μM)、AuNPs(700μL) and heparin (0-0.6 μM) (in FBS samples).

**Table S1**. Comparisons of various typical methods for heparin detection.

| Method | Linear range | Detection limit | | Ref. |
|---|---|---|---|---|
| Colorimetry | 0 -6.7 U/mL | 0.01 U/mL | water | [1] |
| | 0 -2.2 U/mL | 0.15 U/mL | 10% serum | |
| Colorimetry | 0.6-10 μg/mL | 0.6 μg/mL | buffer | [2] |
| Fluorometry | 5–30 μM | 0.157 μM | buffer | [3] |
| | 0-22.5 μM | 0.53 μM | 5% serum | |
| Fluorometry | 4-1.6 μg/mL | 0.0013 μg/mL | buffer | [4] |
| Fluorometry | 0.002 – 1.4 μg/mL | 0.67 ng/mL | buffer | [5] |
| Colorimetry | 0.06-0.36 μg/mL | 3.0 ng/mL | buffer | [6] |
| | 0-0.8 μg/mL | 1.7 ng/mL | 0.2‰ serum | |
| Colorimetry | 0.09 μg/mL- 3.12 μg/mL | 0.03 μg/mL | buffer | [7] |
| Fluorometry | 10-100 nM | 8.2 nM | buffer | [8] |
| **Fluorometry** | **0.4-100 μM** | **0.22 μM** | **buffer** | **Present work** |
| **Colorometry(naked-eye)** | **0.01-0.2 μM** | **0.02 μM** | **buffer** | **Present work** |
| **Fluorometry** | **0.1-6 μM** | **0.024 μM** | **1% serum** | **Present work** |

## References for supporting information


[1] R. Zhan, Z. Fang and B. J. Liu, *Analytical chemistry*, 2009, **82**, 1326-1333.

[2] B. K. Jena and C. R. Raj, *J. Biosensors and Bioelectronics*, 2008, **23**, 1285-1290.

[3] Q. Dai, W. Liu, X. Zhuang, J. Wu, H. Zhang and P. Wang, *J. Analytical chemistry*, 2011, **83**, 6559-6564.

[4] J. Zhao, Y. Yi, N. Mi, B. Yin, M. Wei, Q. Chen, H. Li, Y. Zhang and S. Yao, *J. Talanta*, 2013, **116**, 951-957.

[5] X. Peng, Q. Long, H. Li, Y. Zhang and S.Yao, *J. Sensors and Actuators B: Chemical*, 2015, **213**,131-138.

[6] X. Fu, L. Chen and J. Li, *J. Analyst*, 2012, **137**, 3653-3658.

[7] R. Cao and B. Li, *J. Chemical Communications*, 2011, **47**, 2865-2867.

[8] R. Wang, X. Wang, Y. Sun, *Michrochim Acta*, 2017, **184**, 187-193.