Electronic Supporting Information

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Experimental Section

Materials. All solvents and reagents were commercially available and used without further purification unless otherwise noted. Anhydrous N,N-dimethylformamide (DMF) was dried and distilled over CaH_2 under reduced pressure. All aqueous solutions were prepared with distilled water. β-CD of reagent grade (Shanghai Reagent Factory) was recrystallized twice from water and dried in vacuum at 95°C for 24 h prior to use. Ruthenium(III) chloride hydrate ($RuCl_3 \cdot xH_2O$), imidazole, 1,10-phenanthroline, and bromcacetyl bromide were purchased from Tianjin FuChen Chemical Reagents Factory. Hyaluronan (MW = 100 kDa) was purchased from Shandong Freda Biopharm Co., Ltd. Hyaluronidase (HAase) from bovine testes (Type I-S, lyophilized powder, 400-1000 units/mg solid) was purchased from Sigma-Aldrich. The synthesis of 2-bromo-N-(1,10-phenanthrolin-5-yl)acetamide hydrobromide was following the method reported[S1] and the synthesis of mono-6-Imidazoyl-β-CD was following the method reported[S2]. The prepare of $Ru(DMSO)_4Cl_2$ was following the method reported[S3].

Instruments. NMR spectra were recorded on a Bruker AV 400 spectrometer, and two-dimensional NMR spectra were recorded in D_2O on a Varian Mercury VX-300 spectrometer. Mass spectra were recorded on a Varian 7.0T FTICR mass spectrometer (MALDI). Elemental analysis was performed by using a Vario EL Cube elemental analyzer (Elementar Ltd. Corp., Germany). UV/Vis spectra were recorded in a quartz cell (light path 10 mm) on a Shimadzu UV-3600 spectrophotometer equipped with a PTC-384WI temperature controller. Fluorescense spectra were recorded on Cary Eclipse Fluorescence Spectrophotometer. Fluorescense lifetime was detected on Fluorescent Spectrometer Mode: FLS920.

Synthesis of L

2-bromo-N-(1,10-phenanthrolin-5-yl)acetamide hydrobromide (0.418 mmol, 200 mg) was separated in DMF 2 ml then mixed with N,N-diisopropylethylamine (0.527 mmol, 68 mg) to form a red clear solution. This solution was added to a solution of mono-imidazole-6-*β*-CD (0.348 mmol, 413 mg) in DMF (5 mL). The mixture was stirred at room temperature for 48 h, and then was poured into excess ethanol (300 mL) to give an orange suspension. The

precipitate was collected with filtration (0.22 μm water phase membrane) then dissolved in the minimum amount of cold water, and then poured into acetone (400 mL). The product (orange powder) was collected by filtration with a yield of 270 mg (52 %). ESI-MS, *m/z* (caculated) = 1420.48 (**L**-Br), *m/z* (found) = 1420.47 (**L**-Br); Elemental analysis calculated for $C_{59}H_{90}BrN_5O_{39}$ (**L**·$4H_2O$) (%): C 45.04, H 5.77, N 4.45. Found (%): C 45.19, H 6.03, N 4.49; ^{1}H NMR (D_2O, 400 MHz) δ 9.07-9.01 (d, 3H), 8.51-8.41 (m, 2H), 7.96 (s, 1H), 7.85-7.77 (m, 2H), 7.70-7.68 (d, 2H), 5.53 (s, 2H), 5.07-4.94 (m, 7H), 4.56-4.50 (m, 1H), 4.22-4.18 (m, 1H), 4.05-3.28 (m, 40H). ^{13}C NMR (100 MHz, D_2O) δ 166.49, 149.82, 149.24, 143.62, 142.10, 138.24, 137.29, 132.04, 129.55, 127.53, 124.42, 123.86, 123.53, 121.92, 101.82, 82.57, 81.58, 81.09, 73.05, 72.89, 72.49, 72.35, 72.02, 71.78, 71.51, 69.55, 60.73, 60.22, 59.94, 51.28, 50.22

Synthesis of RuL_3

L (330 mg, 0.22 mmol) and $Ru(DMSO)_4Cl_2$ (30 mg, 0.062 mmol) was dissolved in 10 ml water and 2 ml EtOH. This mixture was stirred and heated to 100^{o}C under Ar atmosphere and aluminium foil was used to prevent light. After 48h, the colour of mixture turn to be drak red from yellow. The mixture was cooled to room tempterture then purged to excess EtOH (about 300 ml) then pink suspension was found. The precipitate was collected with filtration (0.22 μm organic phase memberane). The crude product was dissolved in the minimum amount of cold water, and then poured into EtOH (400 mL). This operation was repeated for 2 times. The product (orange-red powder) was collected by filtration with a yield of 140 mg (48 %). ESI-MS, *m/z* (caculated) = 1454.44 (**RuL_3**-2H-2Cl-3Br), *m/z* (found) = 1454.44 (**RuL_3**-2H-2Cl-3Br); *m/z* (caculated) = 2181.16 (**RuL_3**-3H-2Cl-3Br), *m/z* (found) = 2181.14 (**RuL_3**-3H-2Cl-3Br); Elemental analysis calculated for $C_{177}H_{326}Br_3Cl_2N_{15}O_{145}Ru$ (**RuL_3**·$40H_2O$) (%): C 39.40, H 6.09, N 3.89. Found (%): C 39.41, H 6.29, N 3.94; ^{1}H NMR (D_2O, 400 MHz) δ 9.07 (s, 3H), 8.61-8.54 (m, 6H), 8.31 (s, 3H), 8.15-8.08 (m, 6H), 7.68-7.59 (m, 9H), 5.56 (s, 6H), 5.05-4.99 (m, 21H), 4.58-4.55 (m, 3H), 4.23 (m, 3H), 3.99-3.33 (m, 120H)

The determination about the formation of assemblies.

The method to investigate the best concentration ratio to form assemblies was followed the previous reports[S4]. The store solutions of **RuL** and HA (MW = 100 kDa) were prepared. ([$\mathbf{RuL_3}$] = 20 mM and [HA] = 0.2 mM). Such solution was diluted to the needed concentration with redistilled water. In a general method, a series of samples with sequential concentrations were prepared, filled to standard quartz cell and stabilized for about 10 minutes before the transmittance spectra (200-800 nm) were recorded. The transmittance (%) of these samples at λ = 650 nm were used to calculate the CAC. If no mentioned, the temperature of experiments was 25 ^{o}C. 1cm x 1cm quartz cell was used. The CAC of hyaluronan was determined at [HA] = 0.5 μM and [$\mathbf{RuL_3}$] = 1-40 μM. In the next stage, the concentration of $\mathbf{RuL_3}$ was fixed at 40 μM and [HA] was changed from 0.1-1.5 μM. The lowest of T_{650}% was found at [$\mathbf{RuL_3}$] = 40 μM and [HA] = 0.5 μM.

TEM Measurement.

High-resolution TEM images were acquired using a Tecnai 20 high-resolution transmission electron microscope operating at an accelerating voltage of 200 keV. Samples ([$\mathbf{RuL_3}$] = 40 μM and [HA] = 0.5 μM) were prepared by dropping the solution on carbon membrane. The samples were then air-dried and the samples were examined.

DLS Measurement.

DLS measurements and zeta potential measurements were examined on a laser light scattering spectrometer (Nanobrook 173plus, Brookhaven Co. USA) equipped with a digital correlator at 636 nm at a scattering angle of 90^{o}. Sample ([$\mathbf{RuL_3}$] = 40 μM and [HA] = 0.5 μM) was prepared in redistilled water then added to glass cell for DLS. The temperature was 25^{o}C in the diameter detection and 37^{o}C in the assembly stability experiment.

Fluorescence Spectroscopy

The condition of experiment about excitation and emission fluorescence spectra which were shown in Figure 1 in main article are those: standard 3 ml (10mm x 10mm) quartz cell, Ex slit

= 5 nm, Em slit = 10 nm. In Figure S10 of ESI, micro 1 ml (3mm x 10mm) quartz cell was used. Ex wavelength = 532 nm, Ex slit = 10 nm, Em slit = 10 nm. The temperatures in all of fluorescence investigation are 25 ^{o}C (298 K) if no mention.

Fluorescence lifetime

The fluorescence lifetime was detected on Fluorescent Spectrometer Mode: FLS920 (Edinburgh Instruments) with microseconds lamp. (Ex = 450 nm and Em = 600 nm). The solution ([$\mathbf{RuL_3}$] = 2 μM in water) was filled to micro 1 mL (3 mm x 10 mm) quartz cell. The 10 mm face was irradiated with excited light beam.

HAase response of assemblies

In each experiment of assembly, the concentration of store solution HAase was 4000 U ml $^{-1}$. Such concentration was calculated from "400 U / mg solid" according to the introduction of commercial HAase powder.

(1) Time dependence of HAase induce degradation of $\mathbf{H_{0.5}R_{40}}$

The samples contain [$\mathbf{RuL_3}$] = 40 μM, [HA] = 0.5 μM. The concentration of HAase was 10 U ml^{-1}. Such sample was filled to standard quartz cell (1cm x 1cm) and the temperature was maintained at 37^{o}C by the temperature controller on uv-vis spectroscopy. The transmittances from 200-800 nm were collected per 1800 s and the total experiment time was 5 hours. As a control experiment, the stability of $\mathbf{H_{0.5}R_{40}}$ assembly was also detected follow this operation.

(2) HAase concentration dependence of HAase induce degradation of $\mathbf{H_{0.5}R_{40}}$

HAase concentration dependence of HAase induce degradation was detected following above method. The concentrations of HAase were fixed at 1 U ml^{-1} and 10 U ml^{-1}. The transmittances from 200-800 nm were collected per 1800 s and the total experiment time was 5 hours. As a control, the sample in the absence of HAase was also detected with same condition and operation.

HAase induced color changes with laser

To investigate the colorimetric changes in the disassembly of $\mathbf{H_{0.5}Ru_{40}}$ induced by HAase, handle pen-like laser equipments were used in HAase response experiment. Red laser (λ = 650 nm, 50 mW), Green laser (λ = 532 nm, 200 mW) and Blue-Violet laser (λ = 405 nm, 50 mW). The temperature was maintained at 37°C with water bath during experiment. Green laser (λ = 532 nm, 200 mW) irradiated from one side of bottle and the phenomena were captured with camera. The angle between the laser and the camera was near 90 degree. The bottle, camera and laser were on same plane in our experiment.

(1) Time dependence of HAase induce degradation of $\mathbf{H_{0.5}R_{40}}$

The samples (3 ml) contain [$\mathbf{RuL_3}$] = 40 μM, [HA] = 0.5 μM, [HAase] = 10 U ml^{-1} was prepared, sealed in glass bottle then stored in 37°C water bath. After 0h, 2h and 7h later, the sample had been cooled to room temperature and the images were captured.

(2) HAase concentration dependence of HAase induce degradation of $\mathbf{H_{0.5}R_{40}}$

The samples (3 ml) contain [$\mathbf{RuL_3}$] = 40 μM, [HA] = 0.5 μM, [HAase] = 0.1, 1 and 10 U ml^{-1} were prepared, sealed in glass bottle then stored in 37°C water bath. After the samples had cooled to room temperature, the images were recorded at 7h.

Figures

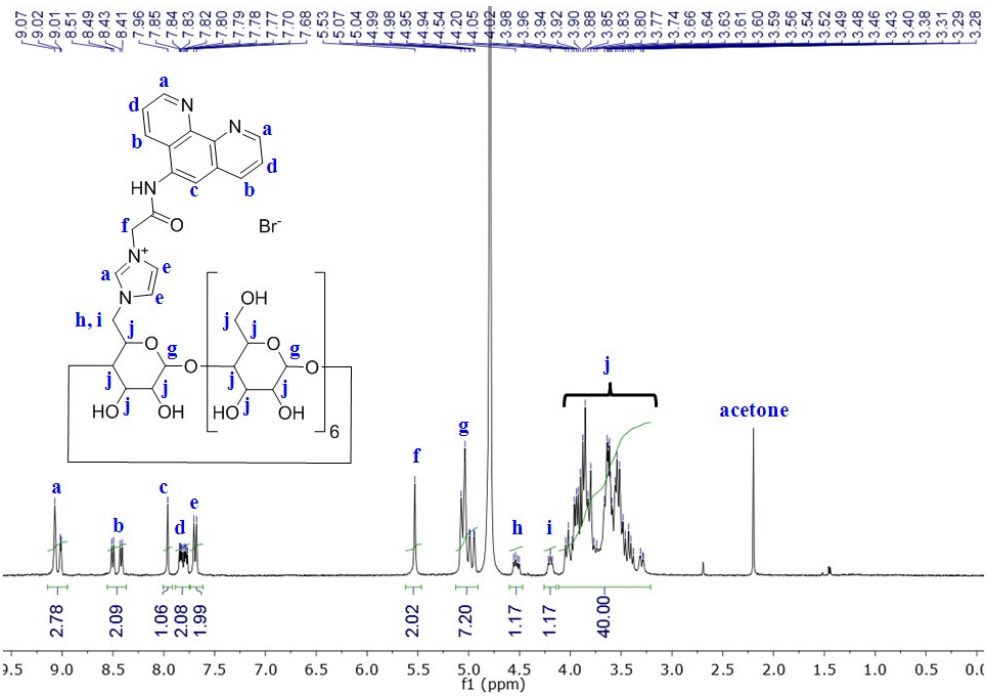


Figure S1 ^{1}H NMR (400 MHz) spectrum of **L** in D_2O.

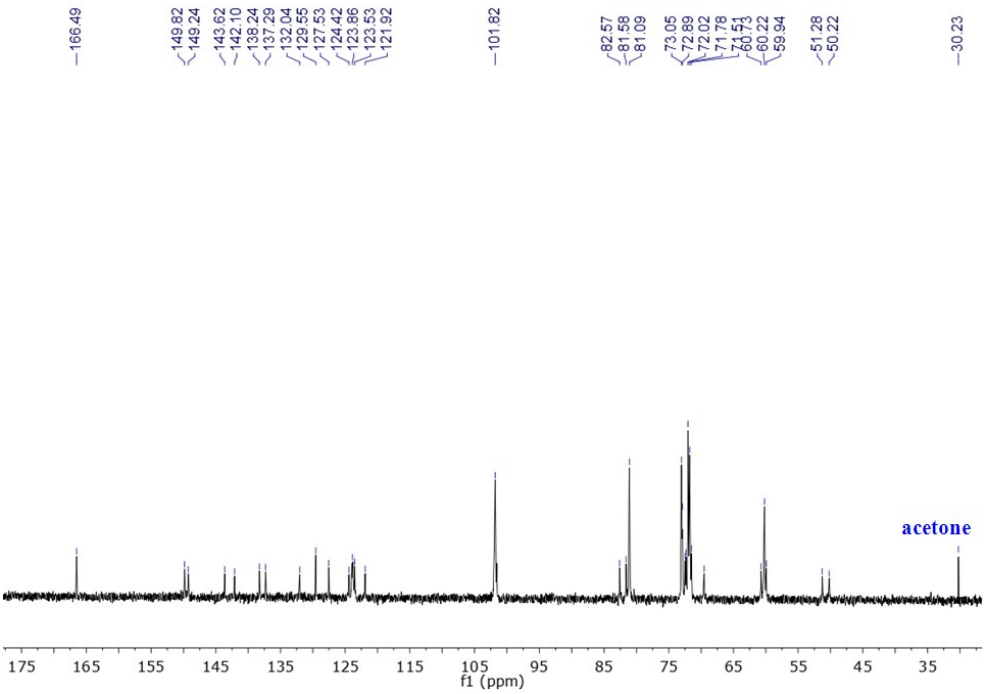


Figure S2 ^{13}C NMR (100 MHz) spectrum of **L** in D_2O.

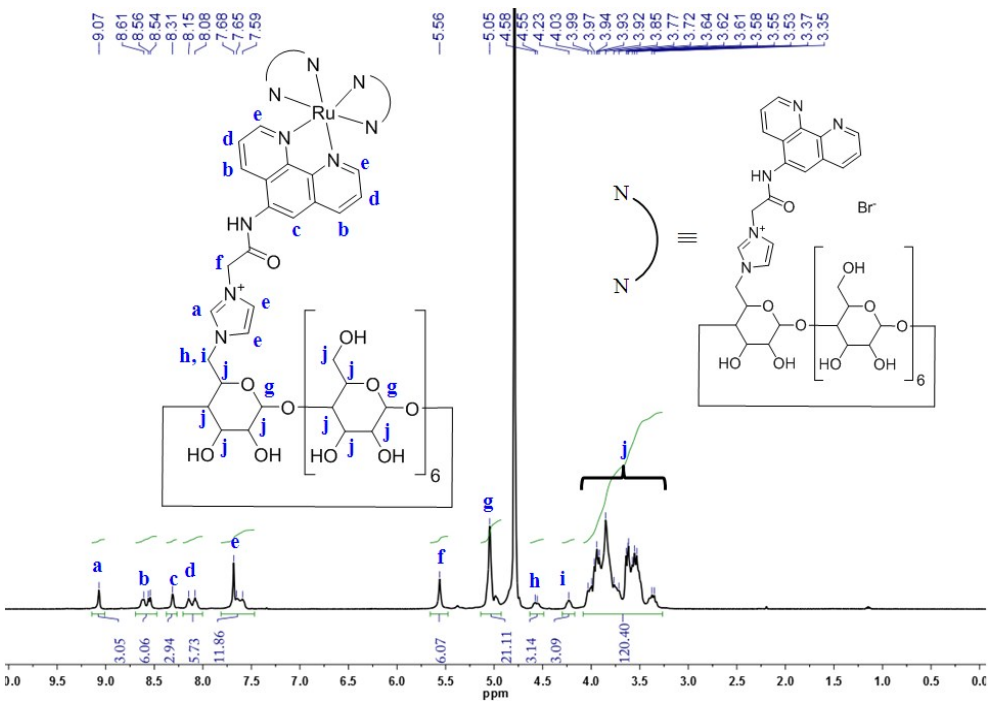
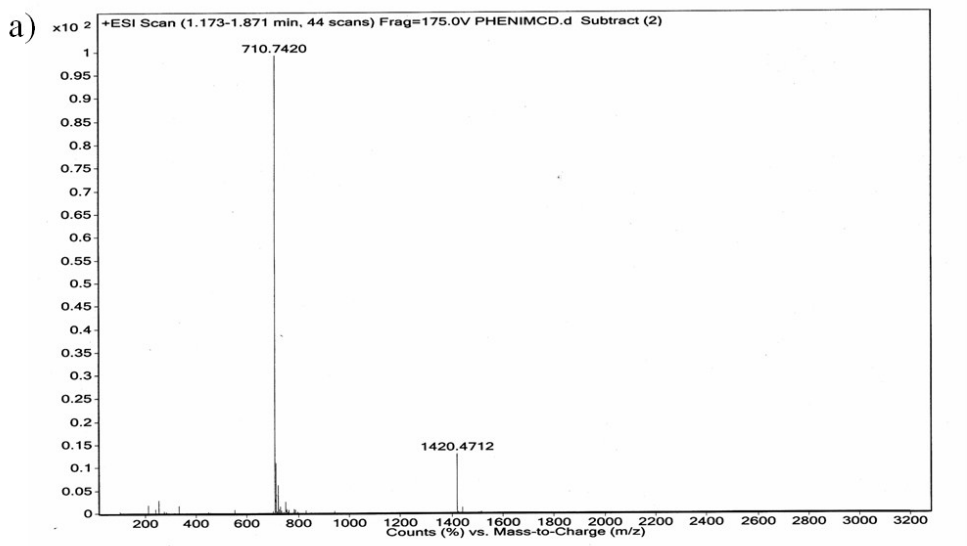


Figure S3 ^{1}H-NMR (400 MHz) spectrum of **RuL$_3$** in D_2O.



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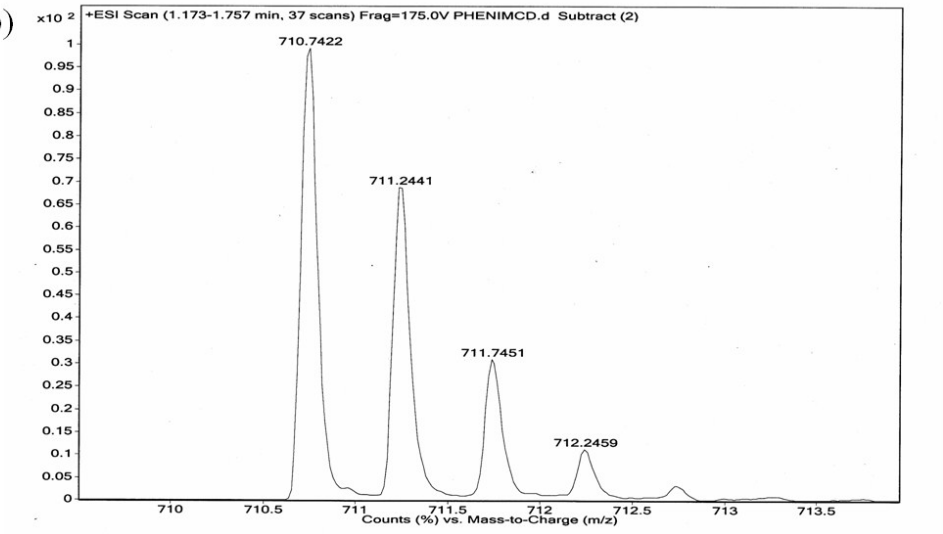


c)

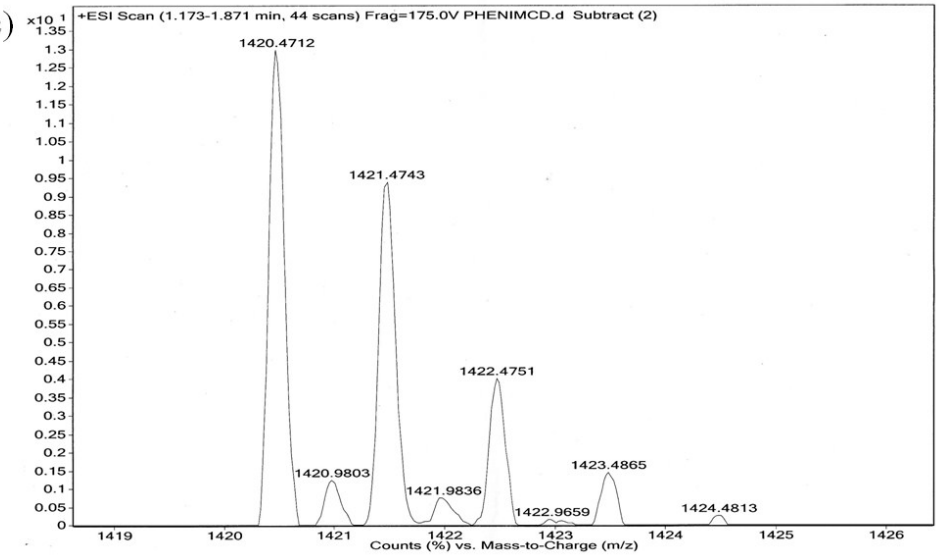
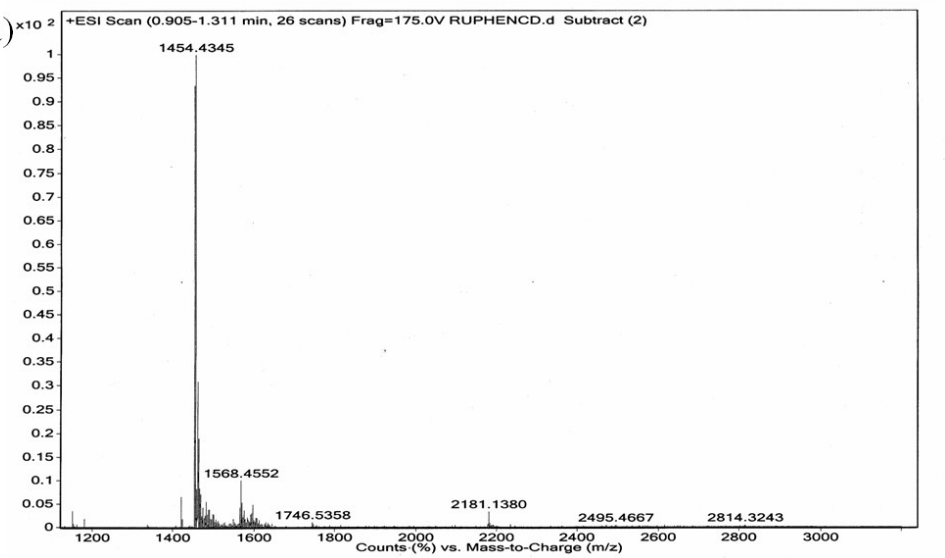
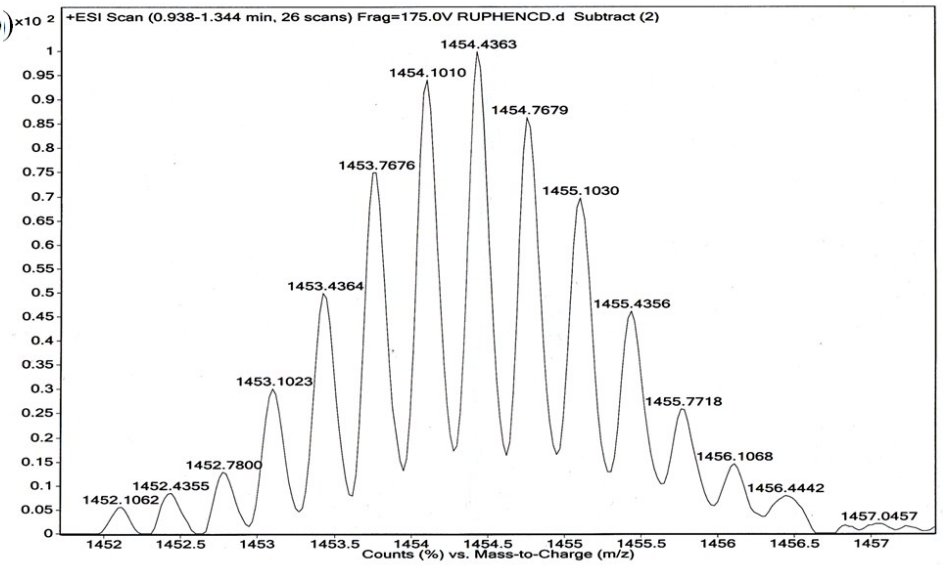


Figure S4 (a) ESI-MS spectrum of **L**; (b) *m/z* (caculated) = 710.74 (**L**-Br+H), *m/z* (found) = 710.74 (**L**-Br+H); (c) *m/z* (caculated) = 1420.48 (**L**-Br), *m/z* (found) = 1420.47 (**L**-Br).

a)


+ESI Scan (0.905-1.311 min, 26 scans) Frag=175.0V RUPHENCD.d Subtract (2)
x10 2
1454.4345
1568.4552
1746.5358
2181.1380
2495.4667
2814.3243
Counts (%) vs. Mass-to-Charge (m/z)

b)


+ESI Scan (0.938-1.344 min, 26 scans) Frag=175.0V RUPHENCD.d Subtract (2)
x10 2
1454.4363
1454.1010
1454.7679
1453.7676
1455.1030
1453.4364
1455.4356
1453.1023
1455.7718
1452.7800
1456.1068
1452.4355
1456.4442
1452.1062
1457.0457
Counts (%) vs. Mass-to-Charge (m/z)

c)

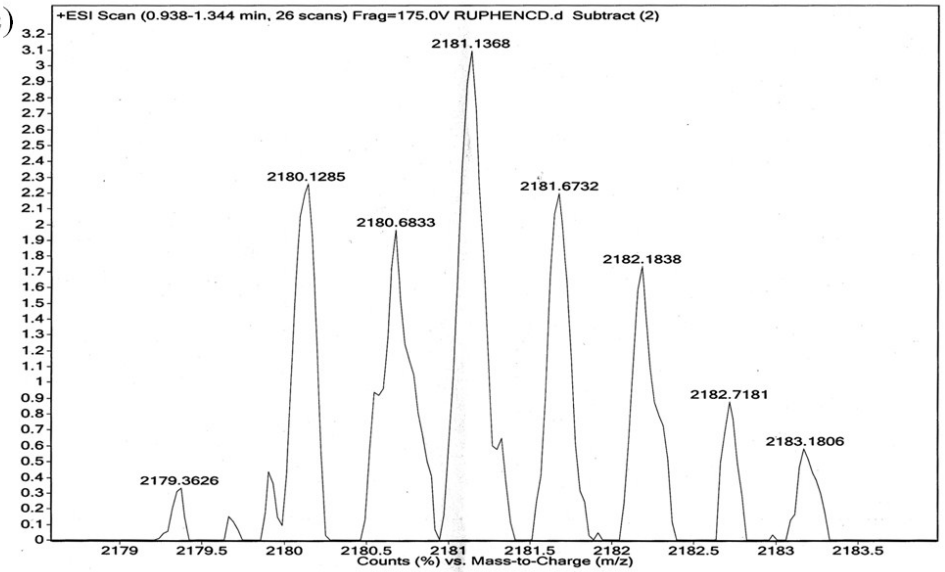

+ESI Scan (0.938-1.344 min, 26 scans) Frag=175.0V RUPHENCD.d Subtract (2)
2181.1368
2180.1285
2181.6732
2180.6833
2182.1838
2182.7181
2183.1806
2179.3626
Counts (%) vs. Mass-to-Charge (m/z)

Figure S5 (a) ESI-MS spectrum of **RuL$_3$**; (b) *m/z* (caculated) = 1454.44 (**RuL$_3$**-2H-2Cl-3Br), *m/z* (found) = 1454.44 (**RuL$_3$**-2H-2Cl-3Br); (c) *m/z* (caculated) = 2181.16 (**RuL$_3$**-3H-2Cl-3Br), *m/z* (found) = 2181.14 (**RuL$_3$**-3H-2Cl-3Br).

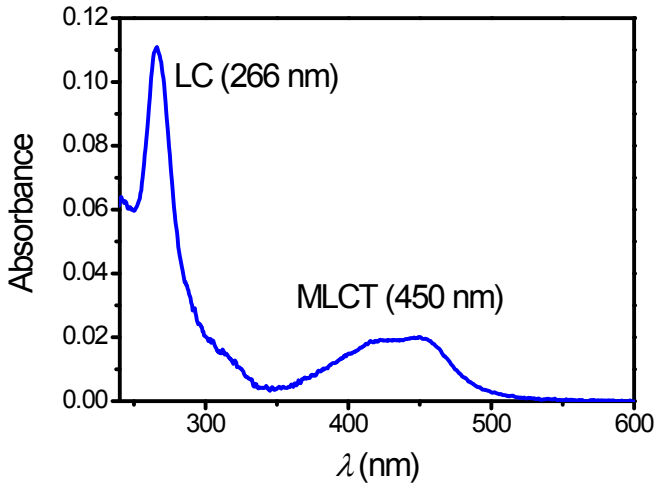


Figure S6 UV-Vis spectrum of **RuL$_3$** (2 μM in water, 10 mm standard cell, 10mm x 10 mm)

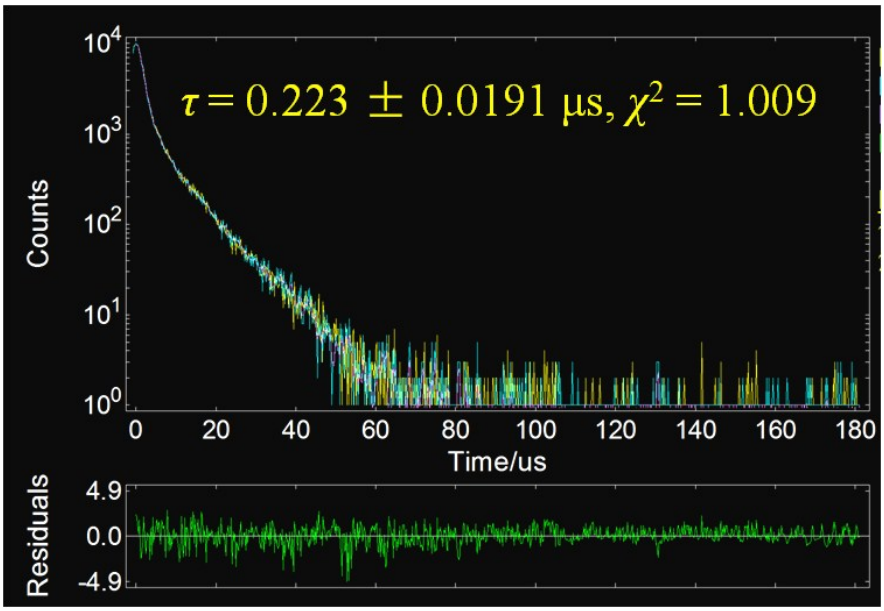


Figure S7 Fluorescence life time spectrum of **RuL$_3$** in water in 1 ml micro cell. Condition: [**RuL$_3$**] = 2 μM, Temp. = 25 ^{o}C (Ex = 450 nm, Em = 600 nm)

EDINBURGH INSTRUMENTS

F900 28/05/2015

Fit Results

Fit : $A+B1\exp(-t/w_4)$

Instrument Response	: **IR1**
Range (ch)	: 0 to 999
Peak Count	: 9881 in channel 94
Total Count	: 214375
Background	: 0.122
Decay Scan	: **Decay3**
File location	: File has not been saved.
Range (ch)	: 0 to 999
Peak Count	: 9868 in channel 94
Total Count	: 214375
Time Calibration	: 200.000 µs/ch
Total Experiment Time	: 468.00 s
Fit Range (ch)	: 94 to 999

Parameter	Value	Std. Dev.	Rel %
w_4	2.231E-007 s	1.9074E-008 s	
Shift	1.351E-004 s	2.104E-005 s	
B1	0.839	0.0634	100.00
A	-0.200		
f^2	1.009		

Figure S8 Fluorescence life time experiment report of **RuL_3** in water in 1 ml micro cell. Condition: [**RuL_3**] = 2 µM, Temp. = 25 °C. (Ex = 450 nm, Em = 600 nm).

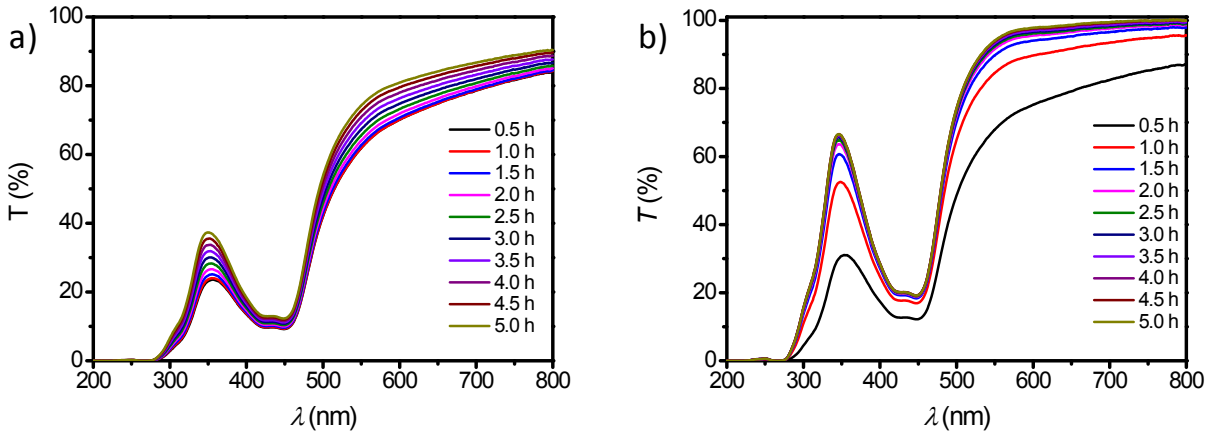


Figure S9 Time dependence transmittance of $\mathbf{H_{0.5}R_{40}}$ solution in the present of HAase. (a) [HAase] = 1 U ml^{-1}; (b) [HAase] = 10 U ml^{-1}. Temp. = 37 °C. 1cm x 1cm quartz cell was used.

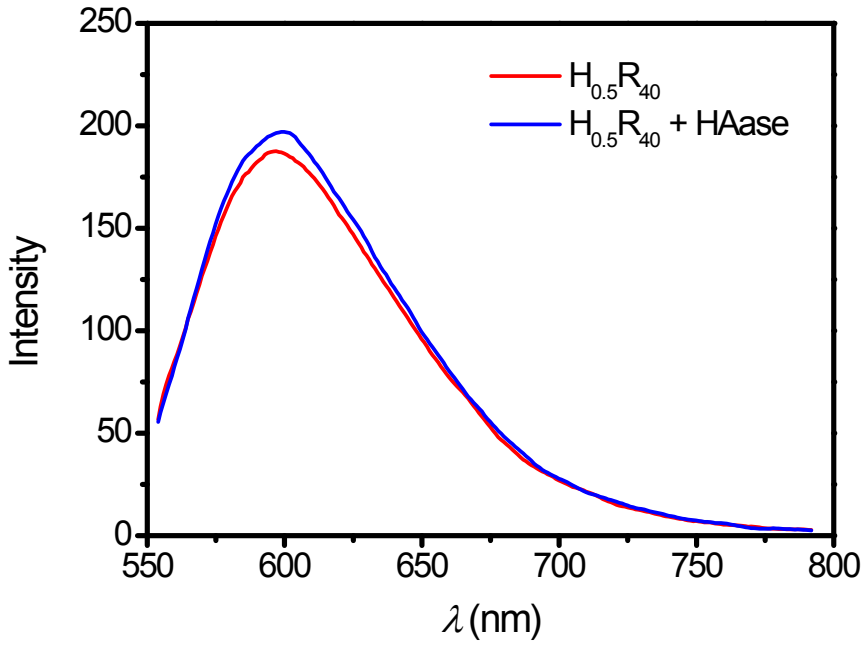


Figure S10 Fluorescence spectra of $\mathbf{H_{0.5}R_{40}}$ and $\mathbf{H_{0.5}R_{40}}$ with HAase (7 h) in water. 1 ml micro cell (3 mm x 10 mm) was used. (Ex = 532 nm, Ex slit = 10 nm, Em slit = 10 nm).Temp. = 25 °C

Reference

S1. J. Bos, F. Fusetti, A. J. M. Driessen and G. Roelfes, *Angew. Chem. Int. Ed.*, 2012, **51**, 7472-7475.

S2. R. Breslow, P. Bovy and C. Lipsey Hersh, *J. Am. Chem. Soc.*, 1980, **102**, 2115-2117.

S3. C. E. McCusker and J. K. McCusker, *Inorg. Chem.*, 2011, **50**, 1656-1669.

S4. D.-S. Guo, K. Wang, Y.-X. Wang and Y. Liu, *J. Am. Chem. Soc.*, 2012, **134**, 10244-10250.