## **Supporting Information**

# Encapsulation-Induced Emission Enhancement (EIEE) of Eu(III)-Complexes by Aromatic Micelles in Water

Tomokuni Kai, Mai Kishimoto, Munetaka Akita, and Michito Yoshizawa\*

Laboratory for Chemistry and Life Science, Institute of Innovative Research, Tokyo Institute of Technology, 4259 Nagatsuta, Midori-ku, Yokohama 226-8503, Japan

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#### Materials and methods

NMR: Bruker AVANCE-400 (400 MHz), MALDI-TOF MS: Shimadzu AXIMA-CFR Plus, ESI-TOF MS: Bruker microTOF II, Particle Size Analysis (DLS): Wyatt Technology DynaPro NanoStar, AFM: Asylum Reseach Cypher S, UV-vis: JASCO V-670DS, Emission: HITACHI F7000, Absolute PL quantum yield: Hamamatsu Quantaurus-QY C11347-01, Emission lifetime: Hamamatsu Quantaurus-Tau C11367.

Solvents and reagents: TCI Co., Ltd., Wako Pure Chemical Industries Ltd., Kanto Chemical Co., Inc., Sigma-Aldrich Co., and Cambridge Isotope Laboratories, Inc. Compounds: Eu(III)-complex **1a** and amphiphilic compound **3** were synthesized according to previously published procedures.<sup>[S1,2]</sup>

#### References

- [S1] P. K. Shahi, A. K. Singh, S. K. Singh, S. B. Rai, B. Ullrich, ACS Appl. Mater. Interfaces, 2015, 7, 18231–18239.
- [S2] Y. Okazawa, K. Kondo, M. Akita, M. Yoshizawa, Chem. Sci., 2015, 6, 5059– 5062.

#### Abbreviation





4,4,4-Trifluoro-1-(2-thienyl)-1,3-butanedione (0.677 g, 3.05 mmol), 1,10-phenanthroline (0.177 g, 0.983 mmol), NaOH (0.147 g, 3.68 mmol), and ethanol (15 mL) were added to a 50mL glass flask. EuCl<sub>3</sub>•6H<sub>2</sub>O (0.396 mg, 1.08 mmol) dissolved in ethanol (5 mL) was added dropwise to this flask. The resultant mixture was stirred at 70 °C overnight. The crude product was washed with ethanol and hexane to afford **1a** (0.754 g, 0.757 mmol, 77% yield) as a white solid.

<sup>1</sup>H NMR (400 MHz, acetone-*d*<sub>6</sub>, r.t.): δ 3.05 (s, 3H), 5.86 (s, 3H), 6.31 (s, 3H), 7.12 (s, 3H), 8.59 (s, 2H), 9.30 (s, 2H), 10.2 (s, 2H), 11.5 (s, 2H).



**Figure S1.** <sup>1</sup>H NMR spectrum (400 MHz, acetone- $d_6$ , r.t.) of **1a**.



Pentamethylbenzene dimer **6** (208 mg, 0.517 mmol), NaOH (166 mg, 4.15 mmol), and THF (60 mL) were added to a 100 mL glass flask. 1,3-Propanesultone (217 mg, 1.78 mmol) was added dropwise to this flask. The resultant mixture was stirred at r.t. overnight. The suspended solution was filtrated and then  $CH_2Cl_2$  and hexane were added to the filtrate. The resultant solution was concentrated under reduced pressure. The crude product was washed with water and 1-propanol to afford **3** (0.147 g, 0.213 mmol, 41% yield) as a white solid.

<sup>1</sup>H NMR (400 MHz, CD<sub>3</sub>OD, r.t.):  $\delta$  1.95 (s, 12H), 2.06 (m, 4H), 2.21 (s, 12H), 2.25 (s, 6H), 2.68 (t, J = 6.8 Hz, 4H), 4.05 (t, J = 6.0 Hz, 4H), 6.41 (s, 1H), 6.80 (s, 1H). ESI-TOF MS: Calcd. for C<sub>34</sub>H<sub>44</sub>O<sub>8</sub>S<sub>2</sub> 322.12, Found 322.12 [M – 2•Na<sup>+</sup>]<sup>2–</sup>.



Figure S2. <sup>1</sup>H NMR spectrum (400 MHz,  $CD_3OD$ , r.t.) of 3.



A mixture of amphiphilic compound **3** (1.4 mg, 2.0  $\mu$ mol) and Eu(III) complex **1a** (2.0 mg 2.0  $\mu$ mol) were ground for 1 min by using an agate mortar and pestle. After the addition of H<sub>2</sub>O (2.0 mL), the suspended solution was sonicated (40 KHz) for 10 min. The solution was centrifuged (14,800 rpm, 10 min) and then filtrated by a membrane filter (pore size: 200 nm) to give a colorless aqueous solution of **2** containing **1a**. The formation of host-guest Eu(III)-composite **2**•**1a** was confirmed by DLS, AFM, and UV-visible analyses. In a manner similar to **2**•**1a**, host-guest Eu(III)-composites **4**•**1a** and **5**•**1a** were prepared using amphiphilic compounds **4**' and **5**', respectively. A mixture of SDS (5.8 mg, 20  $\mu$ mol) and **1a** (2.0 mg 2.0  $\mu$ mol) was used for the control experiment under the same conditions (grinding for 1 min and sonication in H<sub>2</sub>O (2.0 mL) for 10 min).



**Figure S3A.** a) UV-visible and b) emission spectra (r.t.,  $\lambda_{ex} = 375$  nm, 50  $\mu$ M) of **1a** in CH<sub>3</sub>CN.



**Figure S3B.** Solvent-dependent emission spectra (r.t.,  $\lambda_{ex} = 375$  nm) of **1a** in 0:100, 5:95 and 10:90 H<sub>2</sub>O/CH<sub>3</sub>CN.



Figure S4A. a) UV-visible and b) emission spectra (D<sub>2</sub>O, r.t.,  $\lambda_{ex} = 375$  nm, 1.0 mM based on 3) of 2•1a.



**Figure S4B.** a) UV-visible and b) emission spectra (H<sub>2</sub>O, r.t.,  $\lambda_{ex} = 375$  nm, 1.0 mM based on the amphiphile) of **4**•1a.



**Figure S4C.** a) UV-visible and b) emission spectra (H<sub>2</sub>O, r.t.,  $\lambda_{ex} = 375$  nm, 1.0 mM based on the amphiphile) of **5-1a**.



Figure S5. a) UV-visible and b) emission spectra (H<sub>2</sub>O, r.t.,  $\lambda_{ex} = 375$  nm, 10.0 mM based on SDS) of (SDS)<sub>n</sub>•1a.

Preparation of 2·1b TK152



A mixture of amphiphilic compound **3** (1.4 mg, 2.0  $\mu$ mol) and Eu(III) complex **1b** (2.0 mg 2.0  $\mu$ mol) were ground for 1 min by using an agate mortar and pestle. After the addition of H<sub>2</sub>O (2.0 mL), the suspended solution was sonicated (40 KHz) for 10 min. The solution was centrifuged (14,800 rpm, 10 min) and then filtrated by a membrane filter (pore size: 200 nm) to give a colorless aqueous solution of **2** containing

**1b**. The formation of host-guest Eu(III)-composite **2**•**1b** was confirmed by DLS and UV-visible analyses. Similarly, host-guest Eu(III)-composite **4**•**1b** was prepared using amphiphilic compounds **4**'.



**Figure S6.** a) UV-visible and b) emission spectra (r.t.,  $\lambda_{ex} = 365 \text{ nm}$ , 50  $\mu$ M) of **1b** in CH<sub>3</sub>CN.



Figure S7A. a) UV-visible and b) emission spectra (r.t.,  $\lambda_{ex} = 365$  nm, 1.0 mM based on 3) of 2-1b in D<sub>2</sub>O.



**Figure S7B.** a) UV-visible and b) emission spectra (r.t.,  $\lambda_{ex} = 365$  nm, 1.0 mM based on the amphiphile) of **4-1b** in H<sub>2</sub>O.



**Figure S7C.** a) UV-visible and b) emission spectra (r.t.,  $\lambda_{ex} = 365$  nm, 1.0 mM based on the amphiphile) of **5-1b** in H<sub>2</sub>O.



**Figure S8.** a) UV-visible and b) emission spectra (H<sub>2</sub>O, r.t.,  $\lambda_{ex} = 365$  nm, 10.0 mM based on SDS) of (SDS)<sub>n</sub>•1b in H<sub>2</sub>O.



Figure S9. DLS charts (H<sub>2</sub>O, r.t., 1.0 mM based on the amphiphilic compound) of 2•1a, 4•1a, 5•1a, 2•1b, and 4•1b.



**Figure S10.** Emission decay profiles (r.t.,  $\lambda_{ex} = 370 \text{ nm}$ ,  $\lambda_{det} = 614 \text{ nm}$ ) of **1a**, **2**•**1a**, **1b**, and **2**•**1b**. Black lines represent experimental data and red lines represent the fit to the data.



Figure S11. Optimized structures of a) 2•1a comprising (3)<sub>8</sub>•1a and b) 2•1b comprising (3)<sub>9</sub>•1b.



**Figure S12.** Time-dependent emission spectra (H<sub>2</sub>O, r.t.,  $\lambda_{ex} = 365$  nm) of a) **2-1a** and b) **2-1b**.



**Figure S13.** Normalized solid-state UV-visible (r.t., orange line) and excitation spectra (r.t., blue line,  $\lambda_{det} = 614$  nm) of a) **1a** and b) **1b**. Solid-state emission spectra (r.t.) of c) **1a** ( $\lambda_{ex} = 375$  nm) and d) **1b** ( $\lambda_{ex} = 365$  nm).



**Figure S14.** Normalized excitation spectra (r.t.,  $H_2O$ ,  $\lambda_{det} = 614$  nm) of a) **2-1a** and b) **2-1b**.