A Bis-benzimidazole PMOs Ratiometric Fluorescence Sensor with Integrating of AIEE and ESIPT for Sensitive Detection of Cu$^{2+}$

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PMOs=Periodic mesoporous organosilicas; AIEE=Aggregation-induced emission enhancement; ESIPT=excited-state intramolecular proton transfer.
Supporting information

Figure S1. FT-IR spectra of BBM, BBM-Si and BBM-PMO-X after extraction, X=0, 2, 5, 10, respectively. (X is the quality fraction of BBM-Si).
Figure S2. $^{29}\text{Si}$ MAS NMR spectrum of BBM-PMO-20.

Figure S3. TGA / DSC of BBM-PMO-10.

Figure S4. Fluorescence spectra of BBM ($10^{-6}$ M) in different solvents (a) protic solvents (CH$_3$OH, CH$_3$CH$_2$OH); (b) aprotic solvents (DCM, DMF, THF).
Figure S5. The formation of zwittrion.

Figure S6. (a) Fluorescence spectra of BBM (10^{-6} \text{ M}) in different THF/H_{2}O (v/v); (b) fluorescence intensity ratio $I_{2}/I_{1}$ in THF/H_{2}O of different water fraction ($f_{w}$).
Figure S7. (a) Fluorescence emission spectra of BBM (10⁻⁶ M) in THF:H₂O=3:7 (v/v) with different pH value; (b) fluorescence intensity ratio I₂/I₁ of BBM (10⁻⁶ M) in THF:H₂O=3:7 (v/v) in the absence and presence of Cu²⁺ (10⁻⁵ M).

Figure S8. Time-resolved fluorescence for the BBM-Si and BBM-PMO dissolved in THF. The fluorescence signal was collected at 450 nm, the excitation wavelength at 380nm.
Table S1. Fluorescence lifetimes of BBM-Si and BBM-PMOs

|       | BBM-Si | BBM-PMO-2 | BBM-PMO-5 | BBM-PMO-10 |
|-------|--------|-----------|-----------|------------|
| \( \tau_1 / \text{ns} \) | 2.07(97\%) | 1.68(86\%) | 1.03(47\%) | 0.73(21\%) |
| \( \tau_2 / \text{ns} \) | 4.57(3\%) | 3.83(14\%) | 2.07(53\%) | 2.05(79\%) |
| \( \bar{\tau} / \text{ns} \) | 2.15 | 1.98 | 1.58 | 1.77 |

Figure S9. Fluorescence intensity ratio \( I_2/I_1 \) of BBM-PMO-10 (5 \times 10^{-6} \text{ g/mL}) in the presence of a single metal ion (red bar) and in the mixture of \( \text{Cu}^{2+} \) and other metal ions (black bar).
Figure S10. Fluorescence spectra of BBM in THF:H$_2$O=3:7 (v/v) with different concentration of Cu$^{2+}$ ($8 \times 10^{-7}$ to $8 \times 10^{-6}$ M); (b) linear relationship between fluorescence intensity ratio I$_2$/I$_1$ of BBM ($10^{-6}$ M) and concentration of Cu$^{2+}$ in the solvent.

Figure S11. The reproductive test of BBM-PMO-10 ($5 \times 10^{-6}$ g/mL) in THF/H$_2$O (3:7 v/v).
Figure S12. $^1$H NMR spectrum of BBM

Figure S13. HRMS spectrum of BBM
**Figure S14.** $^1$H NMR spectrum of BBM-Si.

**Figure S15.** HRMS spectrum of BBM-Si
Figure S16 (a) Fluorescence spectra of solutions containing different molar fraction of Cu$^{2+}$. (b) The Job’s plot of I$_2$/I$_1$ with molar fraction of Cu$^{2+}$. 