Electronic Supplementary Material (ESI) for Analyst.

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Electronic Supplementary Information

Super-assembled Silica Nanoprobes for Intracellular Zn Ion Sensing and Reperfusion Injury Treatment through in-situ MOF Crystallization

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Figure S1. The synthesis process of probe PZn through a mild Schiff base reaction.

Figure S2. ^{1}H NMR spectrum of probe PZn.

Figure S3. TEM image, SEM image and size distribution of P@MSN@ZIF8.

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Figure S7. In vitro cytotoxicity assay of 2MI-P@MSN on SH-SY5Y cells.

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Table S1. Surface properties of MSN-NH_2 and 2MI-P@MSN samples.

Table S2. Comparison with the recent work on Zn^{2+} probe.

References

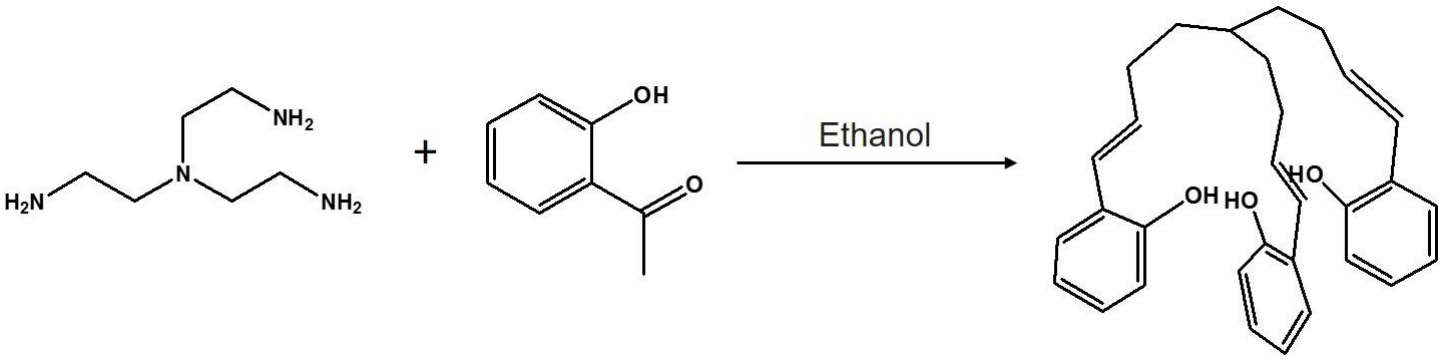

Figure S1. The synthesis process of PZn probe through a mild Schiff base reaction.

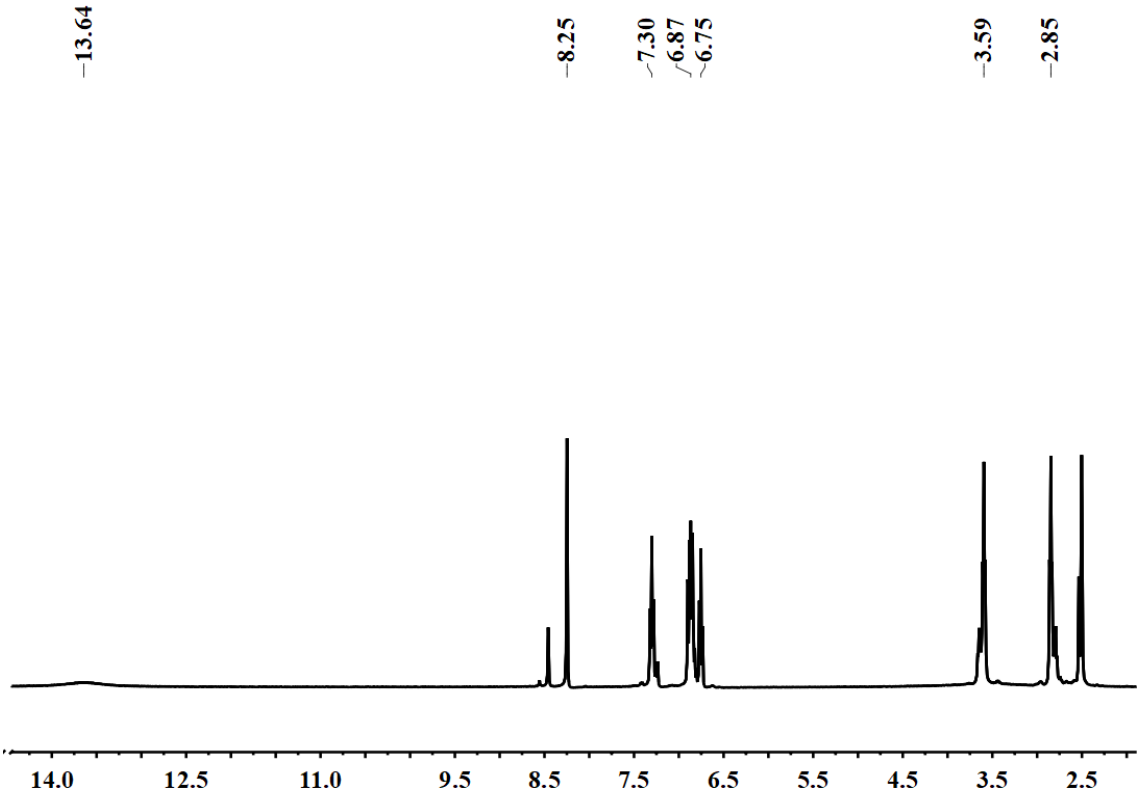

Figure S2. ^{1}H NMR spectrum of PZn probe.

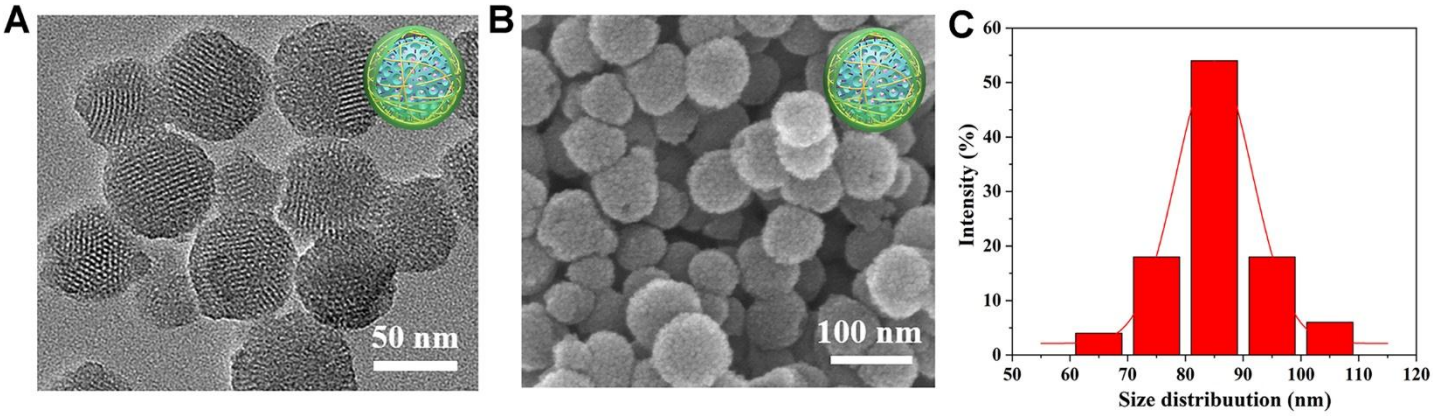

Figure S3. (**A**) TEM image of P@MSN@ZIF8 incubated with zinc ion for 3 hours. (**B**) SEM image of P@MSN@ZIF8. (**C**) Size distribution of P@MSN@ZIF8.

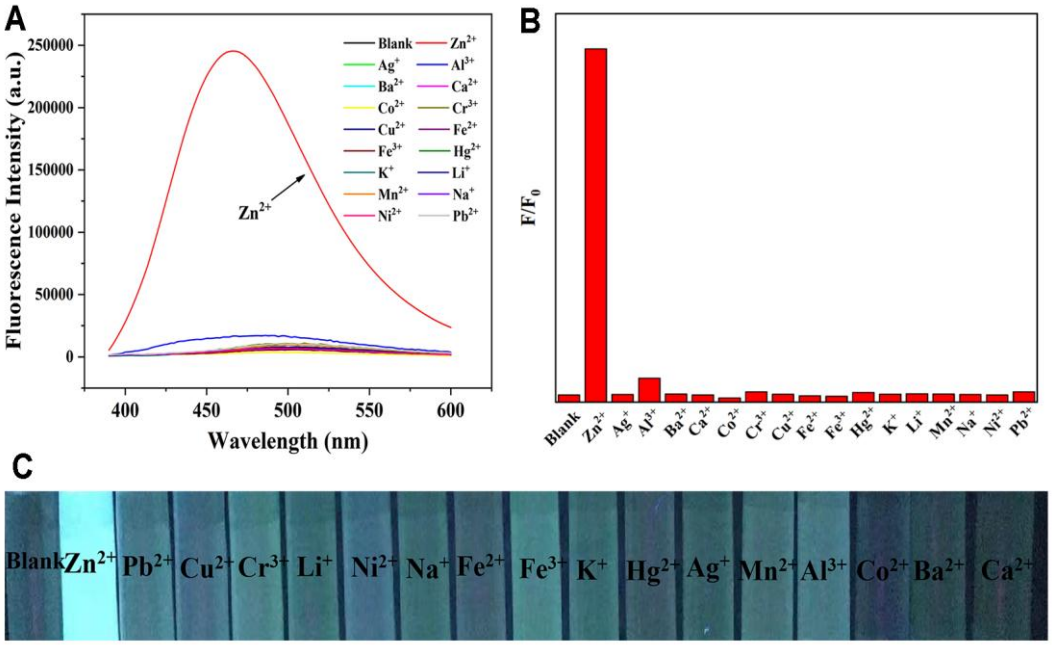

Figure S4. (**A**) Fluorescence spectra of PZn treated with various metal ions (Zn^{2+}, Ag^{+}, Al^{3+}, Ba^{2+}, Ca^{2+}, Co^{2+}, Cr^{3+}, Cu^{2+}, Fe^{3+}, Fe^{2+}, Hg^{2+}, K^{+}, Li^{+}, Mn^{2+}, Na^{+}, Ni^{2+}, Pb^{2+}) and blank group. (**B**) Fluorescence ratio of PZn at 466 nm treated with multiple metal ions. F_0 was the fluorescence intensity in Zn^{2+} solution and F was the fluorescence emission intensity of the PZn in various metal ions solution, respectively. (**C**) The visual fluorescence color of PZn under ultraviolet light after the addition of various metal ions.

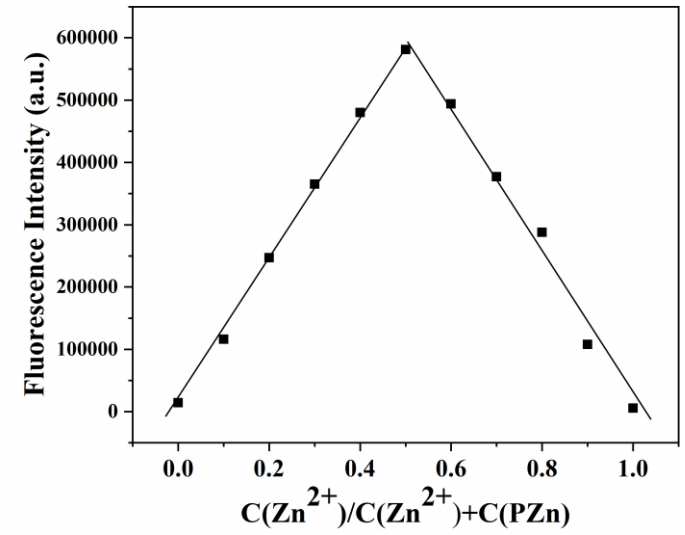

Figure S5. Fluorescence intensity of PZn at different stoichiometric ratios of Zn^{2+} and PZn. The total concentration was 1×10^{-4} M.

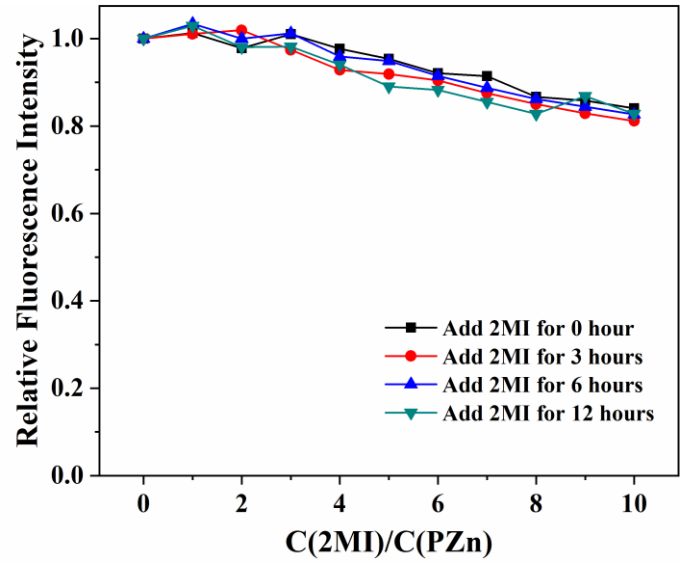

Figure S6. The relative fluorescence intensity of the PZn after adding 2MI at different concentration ratios and various times.

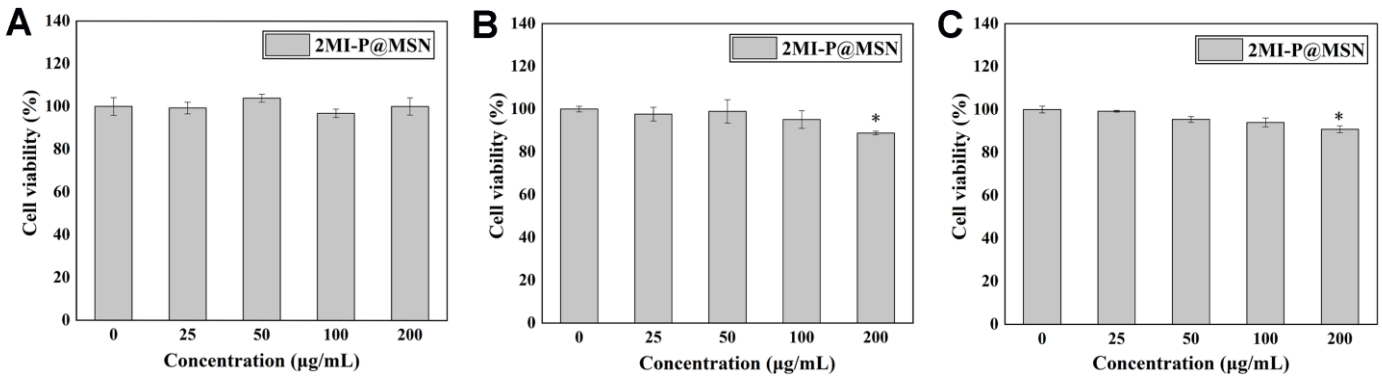

Figure S7. In vitro cytotoxicity assay of 2MI-P@MSN on SH-SY5Y cells. (**A-C**) The cell viability of SH-SY5Y cells incubated with various concentrations of 2MI-P@MSN for 3, 6, 12 hours, respectively. *P < 0.05 and **P < 0.01.

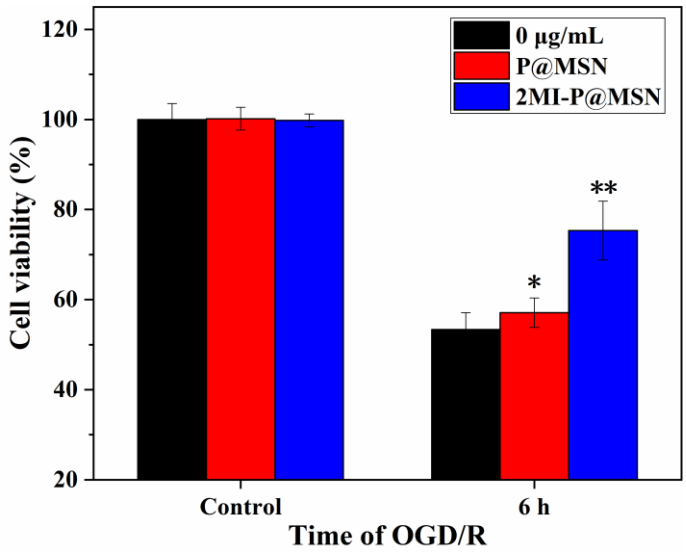

Figure S8. The cell viability of SH-SY5Y cells incubated with P@MSN and 2MI-P@MSN and treated with OGD/R for 6 hours. The control was the cell viability of SH-SY5Y cells incubated with 0 and 25 μg/mL of P@MSN and 2MI-P@MSN. The 6 h was the cell viability of SH-SY5Y cells treated with OGD 3 hours and reperfusion for 6 hours. *$P < 0.05$ and **$P < 0.01$.

	MSN-NH_2	**2MI-P@MSN**
S_{BET} (m^2/g)	897.398	267.023
V_t (cm^3/g)	0.947	0.632
D_{BJH} (nm)	2.11	1.96

Table S1. Surface properties of MSN-NH_2 and 2MI-P@MSN samples. The S_{BET} was the Brunauer–Emmett–Teller (BET) surface area, V_t was the pore volume, D_{BJH} was the Barrett-Joyner-Halenda (BJH) pore size distribution.

No.	Emission Wavelength	Detection Limit (LOD)	Stoichiometric Ratio	Solvent	Function	Reference
1	410 nm	5.2×10^{-7} M	1:3	DMF/H2O (6:4, v/v)	Zn^{2+} detection	[S1]
2	450 nm	3.5×10^{-7} M	1:1	Ethanol	Zn^{2+} detection	[S2]
3	365 nm、555 nm	5.0×10^{-8} M	1:1	Ethanol	Zn^{2+} detection	[S3]
4	405 nm	4.2×10^{-7} M	1:1	HEPES buffer with 0.01% Triton X-100	Zn^{2+} detection	[S4]
5	560 nm	1.7×10^{-8} M	1:1	CH_3CN/H_2O (1:1, v/v)	Zn^{2+} detection	[S5]
6	535 nm	3.8×10^{-8} M	1:1	MeOH/H_2O (4:1, v/v)	Zn^{2+} detection	[S6]
7	466 nm	1.6×10^{-7} M	1:1	H_2O	Zn^{2+} detection, cell protection	This work

Table S2. Comparison with the recent work on Zn^{2+} probe.

The performance of the Zn^{2+} ion probe proposed in this work was compared with other reported methods in literatures. According to Table S2, relatively low LOD was achieved by 2MI-P@MSN in this work. Moreover, 2MI-P@MSN showed high selectivity and sensitivity towards detection of Zn^{2+} ion in aqueous solutions and living cells. In addition to intracellular zinc ion imaging, 2MI-P@MSN also protected cells from reperfusion injury. In summary, the proposed method in this work realized the integration of detection effects and protection effects into a multi-functional material framework and obtained satisfactory results.

References

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