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Supporting Information

A Molecular Imaging Approach to Mercury Sensing Based on Hyperpolarized ^{129}Xe Molecular Clamp Probe

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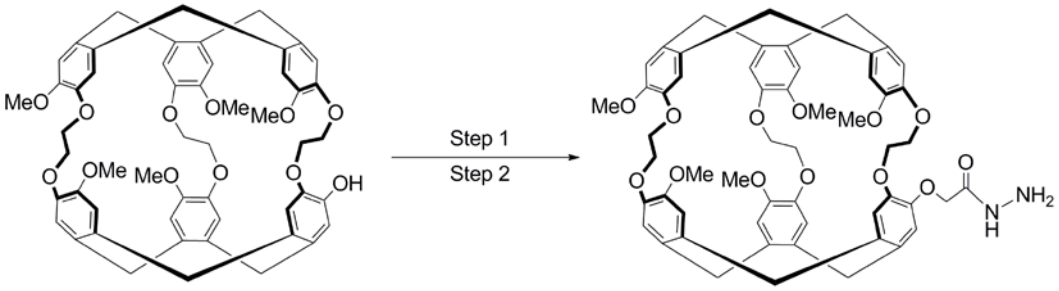
Supporting Information

Synthesis and characterization of the compounds.



Scheme S1. The synthesis route of Cryptophane-A-hydrazine.

Cryptophane-A-hydrazine was sythesized in two steps.

Step 1: Cryptophane-A-OH (50 mg, 0.057 mmol) was disolved in dried acetone (50 ml), stired with excess K_2CO_3 for 10 min. Then ethyl 2-bromoacetate (16.7 mg, 0.1 mmol) was added to the solution. The resulted mixture was refluxed over night, filtered, and evaporated to dryness.

Step 2: The resulted solid of step 1 was disovled in ethanol (50 ml), refluxed with excess Hydrazine hydrate over night under N_2. Then evaporated to dryness and recrystallized from CH_2Cl_2/hexane to furnish an white solid. ^{1}H NMR(500 MHz; $CDCl_3$) δ: 8.23 (br, 3H, NH), 6.83-6.67 (m, 12H, Ar), 4.63-4.52 (m, 8H, CH_2), 4.26-4.13 (m, 12H, CH_2), 3.80-3.76 (m, 15H, CH_3O), 3.49-3.40 (m, 6H, CH_2). Anal. calcd for $C_{53}H_{56}N_2O_{13}$: C, 69.31; H, 5.92; N, 2.94. Found: C, 69.33; H, 5.91; N, 2.92. ESI-MS: M^+ requires 994.43, found 994.42.

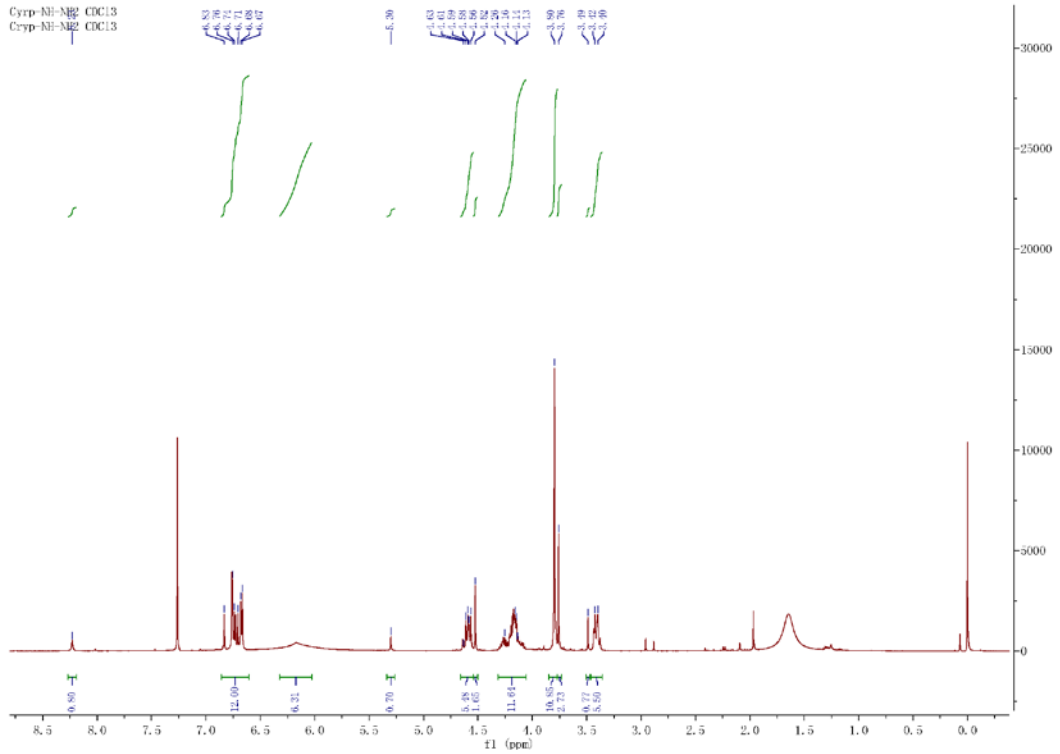


Figure S1. ^{1}H NMR spectrum of Cryptophane-A-hydrazine.

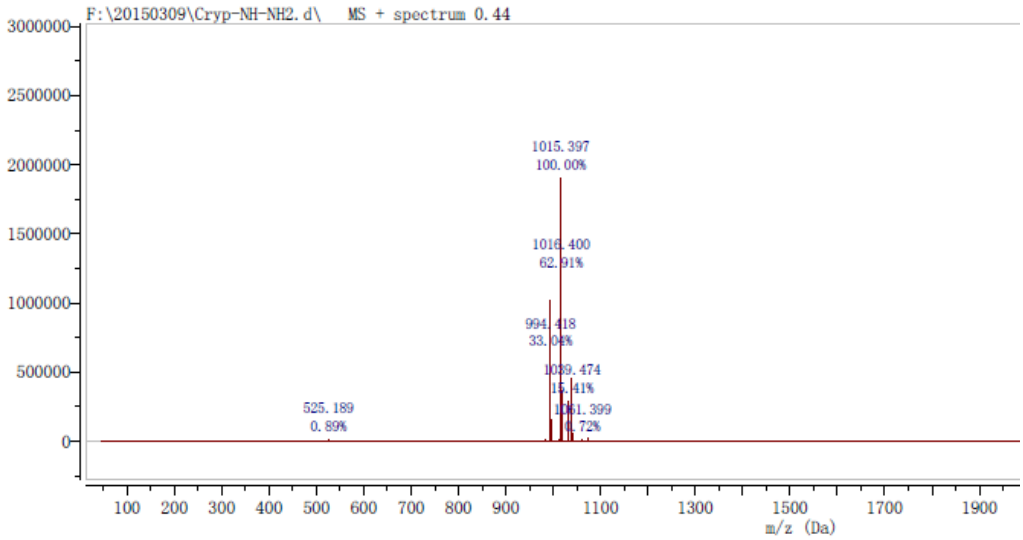
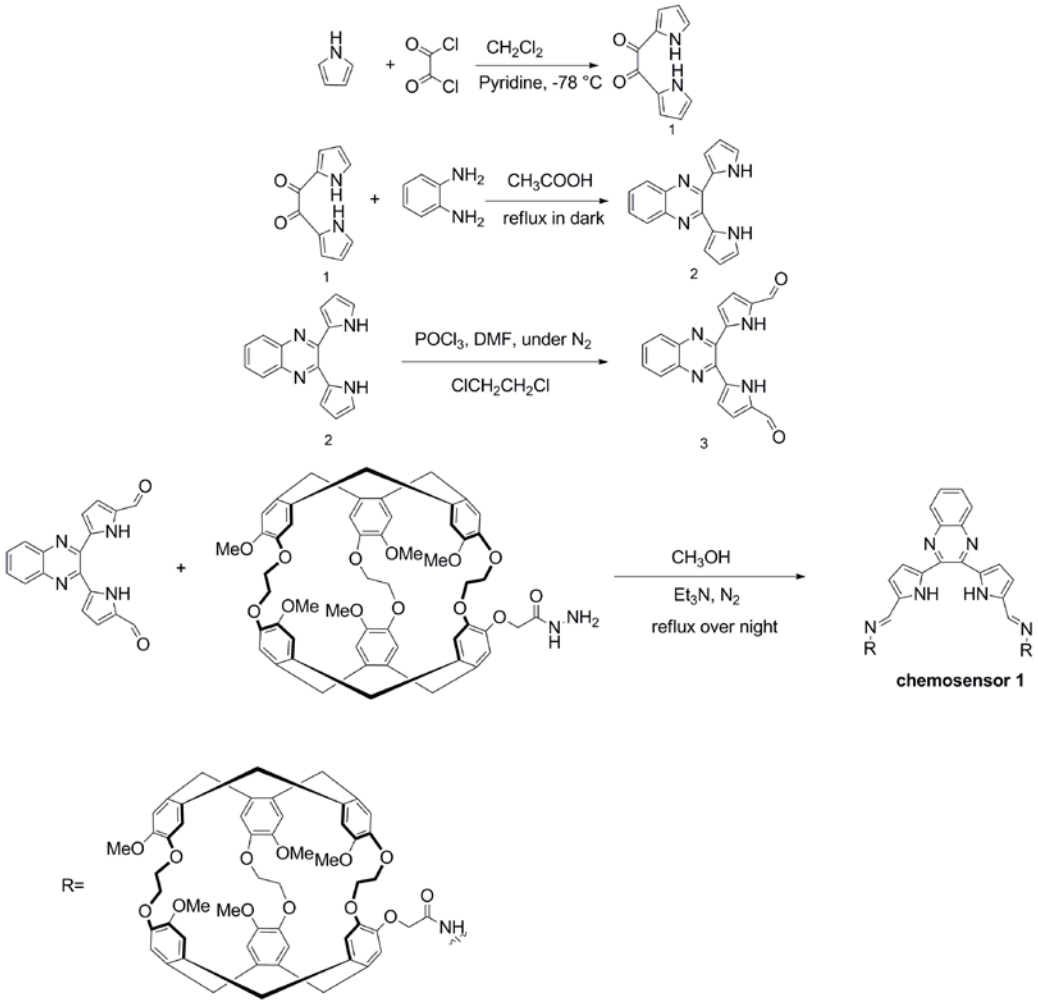


Figure S2. Mass spectrum of Cryptophane-A-hydrazine.



Scheme S2. The synthesis route of chemosensor **1.**

1, 2 - Bis(1H - pyrrole - 2 - yl)ethane - 1, 2-dione (1): This compound was prepared according to the published procedure.[1]

2, 3 - Bis(1H - pyrrol - 2 - yl)quinoxaline (2): It was prepared by the literature method.[2]

2, 3 - Bis(5 - formylpyrrol - 2 - yl)quinoxaline (3): It was synthesized under the guiding of the literature. [3]

chemosensor **1**: A solution of 2,3-bis(5-formylpyrrol-2-yl)-quinoxaline (3) (8.3 mg, 0.025 mmol) and triethyl amine (10 μL) in dry methanol (30 mL) was stirred at reflux for 30 min. After that, Cryptophane-A-hydrazine (50 mg, 0.05 mmol) in dry methanol (2 mL) was added dropwise to the solution. The resulting mixture when refluxed over night, the color of which was changed to orange from yellow. Evaporated the resulting solution to dryness, and recrystallized from CH_2Cl_2/hexane to furnish an orange solid (50 mg, 86%).^{1}H NMR(500 MHz; $CDCl_3$) δ: 10.5 (br, 2H, NH), 8.48-7.42 (m, 4H, quinoxaline), 6.68-6.60 (m, 26H, 24Ar and 2 CH=N), 5.95-5.92 (m, 4H, pyrrole), 5.38 (br, 2H, NH-N), 4.50-4.09 (m, 26H, CH_2), 3.72-3.51 (m, 30, CH_3O), 3.34-2.94 (m, 24H, CH_2). Anal. calcd for $C_{128}H_{120}N_8O_{26}$: C, 70.32; H, 5.53; N, 5.13. Found: C, 70.30; H, 5.55; N, 5.11. ESI-MS: $(M-2H^+ + K^+)^-$ requires 2221.78, found 2221.72.

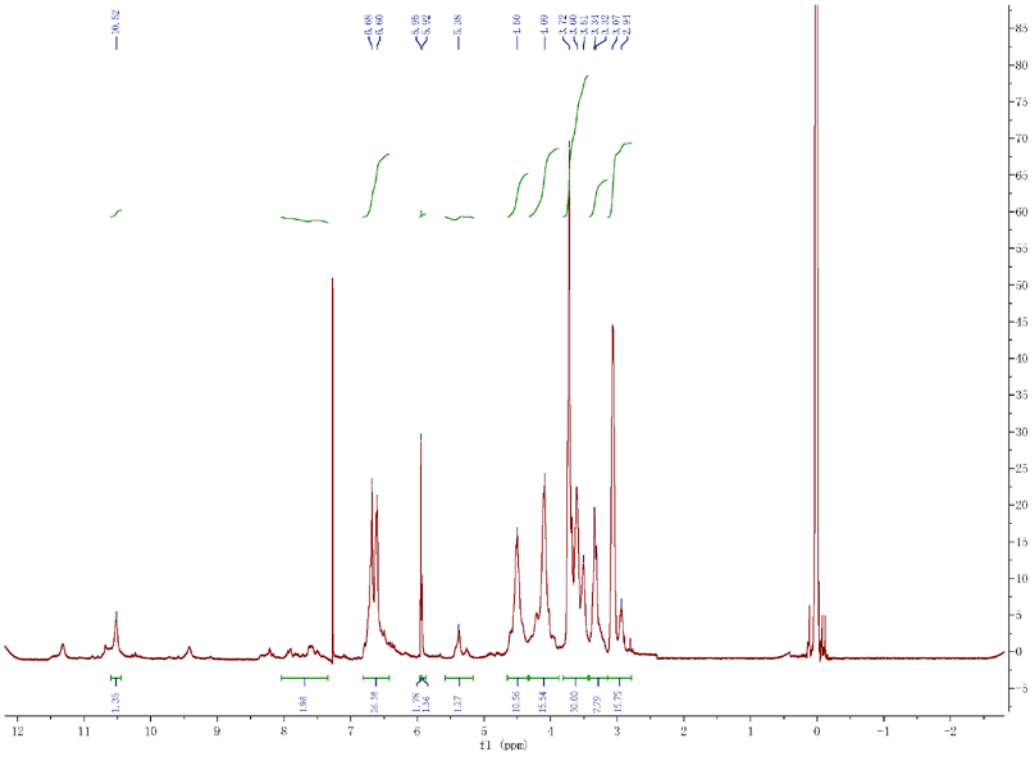


Figure S3. ^{1}H NMR spectrum of chemosensor **1.**

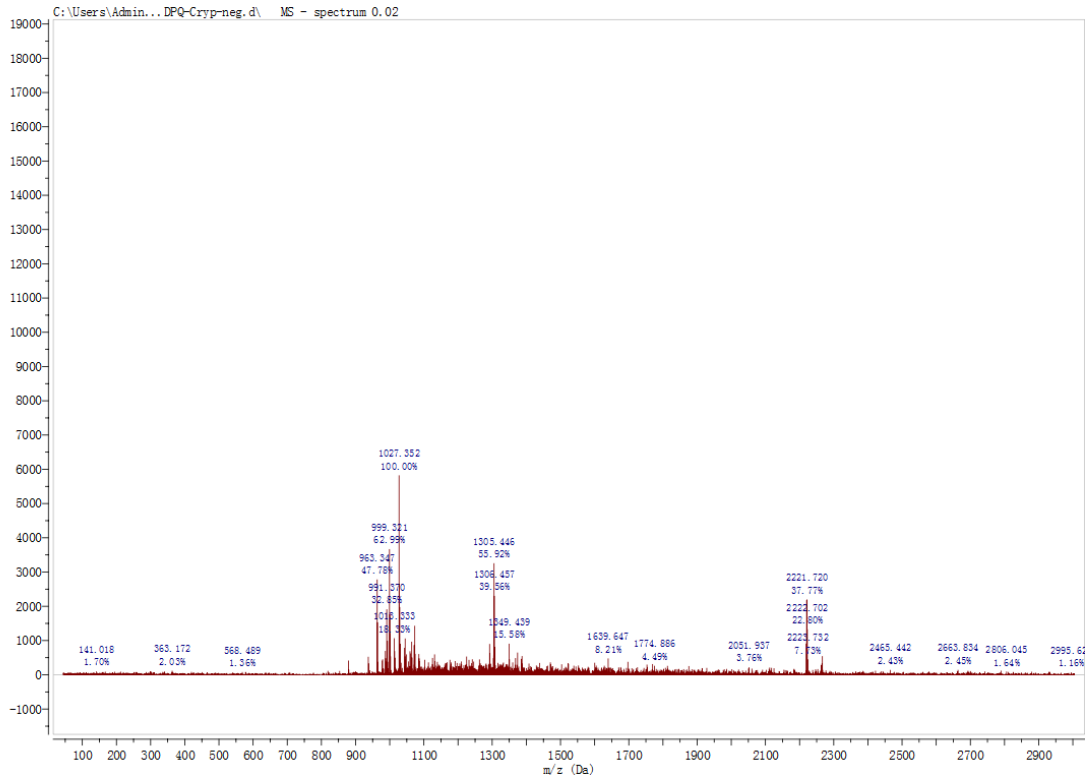


Figure S4. Mass spectrum of chemosensor **1.**

Binding experiments of the hyperpolarized ^{129}Xe NMR sensor to Hg2+ ions in mouse serum.

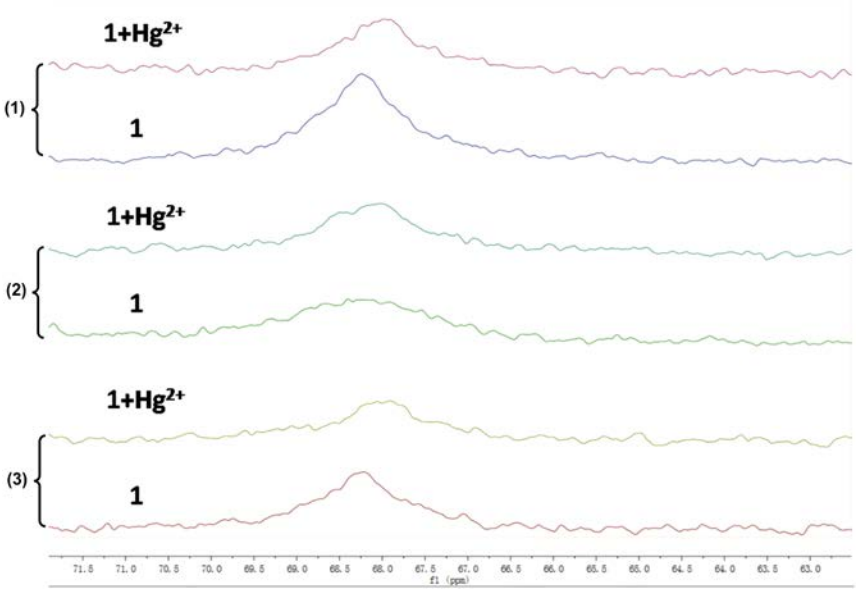


Figure S5. Binding experiments of the hyperpolarized ^{129}Xe NMR sensor to Hg^{2+} ions in mouse serum (V_{serum} : V_{DMSO} = 4 : 1). The concentration of chemosensor **1** and Hg^{2+} are both 40 μM. This experiement was performed 3 times to yield estimates of the error bars. The labels (1), (2), (3) indicate the experiment number.

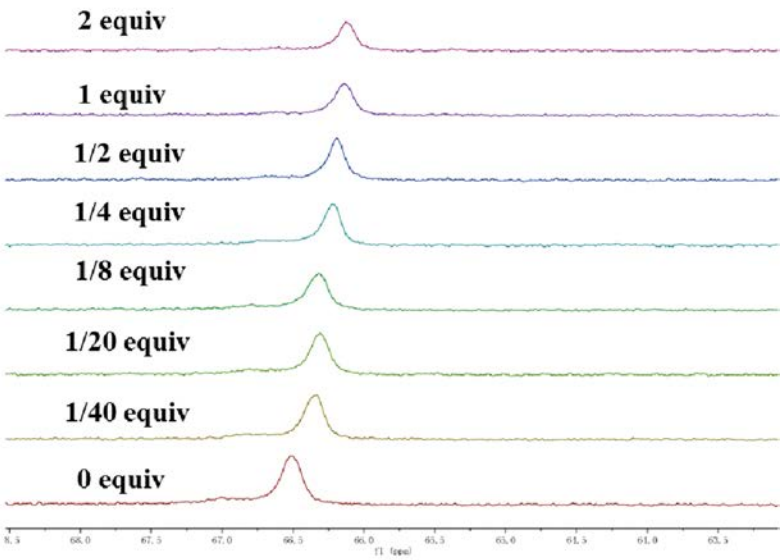


Figure S6. Sensitivity experiments of the hyperpolarized ^{129}Xe NMR approach for Hg^{2+}. The concentration of chemosensor **1** was 40 μM.

^{129}Xe NMR and MRI experiments:

Hyperpolarized ^{129}Xe fluid was polarized by spin-exchange optical pumping method using a homebuilt polarizer using a 86%-enriched ^{129}Xe gas mixture from Spectra Gases Inc. consisting of 2% Xe, 10% N_2 and 88% He. The average value of the ^{129}Xe nuclear-spin polarization generated by this setup was estimated to be about 10%. The temperature in the pumping cell was 298 K and the pressure was 47 psi. The hyperpolarized gas mixture was bubbled into a 10 mm tailor-made NMR tube at the rate of 0.08 standard liters per minute.

References

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