Supporting Information

Forming water-soluble supramolecular polymer and AIEE hydrogel: two novel approaches for highly sensitive detection and efficient adsorption of aldehydes

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Materials and General Methods:

Materials: All aldehydes, 4-aminopyridine, trimesoyl chloride, DMF, triethylamine, ethyl alcohol, solvents were either employed as purchased or dried by CaCl₂. Fresh double distilled water was used throughout the experiment. Nuclear magnetic resonance (NMR) spectra were recorded on Varian Mercury 400 instruments. Mass spectra were recorded on a Bruker Esquire 6000 MS instrument. The infrared spectra were performed on a Digilab FTS-3000 Fourier transform-infrared spectrophotometer. Melting points were measured on an X-4 digital melting-point apparatus (uncorrected). Fluorescence were recorded Shimadzu **RF-5301PC** spectra on а of scanning spectrofluorophotometer. Study electron microscopy (SEM), Determination of the SEM images was performed on a JSM-6701F FE-SEM microscope.

Preparation of water suspension of DTA: First, **DTA** (5.0 mg) was weighed out in a test bottle. Then, deionized water (1.0 mL) was added into that test bottle followed by shaking for 1-3 min at room temperature, producing a viscous and milky suspension (0.5%, 10 mg/mL=1%).

Fluorescence titration experimental details: A serious of the solution or gel with different equivalents guests $(1.0 \times 10^{-2} \text{ M})$ were prepared by dissolving **DTA** (5 mg) and proper equivalent of guest (the equivalents: for **3-FB**: 0 eq., 0.44 eq., 0.88 eq., 1.32 eq., 1.76 eq., 2.20 eq., 2.64 eq., 3.08 eq., 3.52 eq., 3.96 eq., 4.40 eq., 4.84 eq.; for 3-fluorobenzaldehyde: 0.56 eq., 0.64 eq., 0.72 eq., 0.80 eq., 0.88 eq., 0.96 eq., 1.04 eq., 1.12 eq.) in water (1 mL), respectively. Then, the fluorescence intensity of each mixture at 467 nm was record. Finally, we also calculated the LOD of **DTA** for **3-FB** by 3 σ /S method, the LOD of **DTA** for **3-FB** was 8.87×10^{-9} M.

Solution containing DTA and FA preparation: The mixture of DTA (5.0 mg) and formaldehyde (3.0 mL, 1.0×10^{-2} M) were added into H₂O (1 mL), obtaining stable solution containing DTA and FA.

Gel preparation: The mixture of DTA (5.0 mg) and 3-fluorobenzaldehyde (3.0 mL, 0.01 M) were added into H_2O (1 mL), the mixture was heated dissolve, then cooled it to room temperature, obtaining stable gel (white).

Xerogel preparation: The gel was heated to dissolve, then it was dumped on the glass plate and aired at room temperature, obtaining the xerogel.

¹**H NMR titration experiment**: Firstly, the DMSO- d_6 solution of **DTA** (1.3 $\not>$ 10⁻² M) was obtained by dissolving 3 mg **DTA** in 0.5 ml DMSO- d_6 . Then different equivalents of guest (formaldehyde or 3-fluorobenzaldehyde) (0.01 M) was added into above solution and mixed uniformity. Finally, the ¹H NMR spectrum of them was recorded.

Calculation for the LOD:

Formula 1: Equation of linear fitting: y=Ax + B.

$$\delta = \sqrt{\frac{\Sigma(Fi - F0)^2}{N - 1}} (N = 20)$$

Formula 2:

$$LOD = K \beta \frac{\delta}{s} (K = 3)$$
Formula 3:

Formula 4: S=AØ106

State, Fi: the fluorescence emission intensity of DTA with different concentration guest at λ_{em} = 467 nm; F0: the 20 times average fluorescence emission intensity of DTA at λ_{em} = 467 nm; A: slope of equation of linear fitting; B: intercept of equation of linear fitting.

Results and Discussion:



Scheme S1. The synthesis of DTA.

The compound **DTA** was synthesized according to previous method^{S1}.

To a solution of mixture of trimesoyl chloride (0.2639 g, 1.0 mmol) and triethylamine

(1-2 d) was slowly dropwise added into the solution of 4-aminopyridine (0.3105 g, 3.3

mmol) in DMF (10 mL), the mixture was stirred at room temperature for 12 h, appearing a pale solid. The solid is vacuumed suction filtration and washed with cold ethyl alcohol (10 ml), finally the product solid was followed by drying in a vacuum oven at 40 °C for 24 h. Yield: 0.0421g (96%). M.P.: 167 °C. ¹H NMR (400 MHz, DMSO-*d*₆, room temperature) δ (ppm): 11.78 (s, 3 H), 8.99 (s, 3 H), 8.68 (m, 6 H), 8.25 (m, 6 H); ¹³C NMR (DMSO-*d*₆, 150MHz): 165.68, 149.58, 135.07, 131.36, 114.75; ESI-MS m/z: [M]+ Calcd: C₂₄H₁₈N₆O₃: 439.14, found 439.19; IR (anhydrous KBr, cm⁻¹) v: 3421 (w) (N-H), 3080 (w) (C-H on pyridyl and phenyl group), 1710 (w) (C=O), 1508 (w) (C=N on pyridyl).

8.99 8.67 8.26 8.25 8.25 8.25 8.29 8.20 8.19

-11.78



Figure S1. ¹H NMR Spectrum of DTA.



Figure S2. ¹³C NMR Spectrum of DTA.



Figure S3. The MS Spectrum of DTA.



Figure S4. IR Spectrum of DTA.



Figure S5. Fluorescence spectrum of **DTA** with various aldehydes (benzaldehyde; glyoxal; glutaraldehyde; 1-caprylicaldehyde; salicylaldehyde; 4-nitrobenzaldehyde; formaldehyde; 3-nitrobenzaldehyde; 2-nitrobenzaldehyde; 4-chlorbenzaldehyde; 3-chlorben-

zaldehyde; 2-chlorbenzaldehyde; 3-fluorobenzaldehyde; 2-fluorobenzaldehyde; 4fluorobenzaldehyde; 4-methylbenzaldehyde; 3-methylformaldehyde; 2-methylformaldehyde) in pure water.



Figure S6. Photographs of fluorescence changes for DTA with FA and co-existed various other aldehydes in pure water; Change in the emission spectrum of DTA in the presence of FA and co-existing various other aldehydes in pure water. (1, free DTA; 2, benzaldehyde; 3 glyoxal; 4, glutaraldehyde; 5, 1-caprylicaldehyde; 6, salicylaldehyde; 7, 4-nitrobenzaldehyde; 8, 3-nitrobenzaldehyde; 9, 2nitrobenzaldehyde; 10, 4-bromobenzaldehyde; 11, 3-bromobenzaldehyde; 12 2bromobenzaldehyde; 13, 4-chlorbenzaldehyde; 14, 3-chlorbenzaldehyde; 15, 2chlorbenzaldehyde; 16, 3-fluorobenzaldehyde; 17, 2-fluorobenzaldehyde; 18, 4fluorobenzaldehyde; 19, 4-methylbenzaldehyde; 20, 3-methylformaldehyde; 21, 2methylformaldehyde).



Figure S7. Photographs of fluorescence changes for **DTA** with 3-fluorobenzaldehyde and coexisted various other aldehydes in pure water; Change in the emission spectrum of **DTA** in the presence of 3-fluorobenzaldehyde and co-existing various other aldehydes in pure water. (1, free **DTA**; 2, benzaldehyde; 3, glyoxal; 4, glutaraldehyde; 5, 1-caprylicaldehyde; 6, salicylaldehyde; 7, 4-nitrobenzaldehyde; 8, 3-nitrobenzaldehyde; 9, 2-nitrobenzaldehyde; 10, 4-bromobenzaldehyde; 11, 3-bromobenzaldehyde; 12 2-bromobenzaldehyde; 13, 4-chlorbenzaldehyde; 14, 3-chlorbenzaldehyde; 15, 2-chlorbenzaldehyde; 16, 3-fluorobenzaldehyde; 17, 2-fluorobenzaldehyde; 18, 4-fluorobenzaldehyde; 19, 4-methylbenzaldehyde; 20, 3-methylformaldehyde; 21, 2-methylformaldehyde).



Figure S8. The fluorescent titration of DTA for formaldehyde.



Figure S9. The photograph of the linear range: DTA for formaldehyde

(LOD=1.79×10⁻⁸ M).



Figure S10. The photograph of the linear range: DTA for 3-fluorobenzaldehyde

(LOD=8.87×10⁻⁹ M).



Figure S11. The MS spectrum of the mixture of DTA and formaldehyde.



Figure S12. FT-IR spectra of DTA and xerogel of DTA+3-fluorobenzaldehyde.



Figure S13. The photograph of the linear range: calibration for HCHO by acetylacetone spectrophotometry.

Formula	y=-0.3153x+3.2124
Abs. (Sample)	1.066
Initial concentration	1×10 ⁻⁵ M
Residual concentration	1.59×10 ⁻⁷ M
Adsorption percentage	98.41%

Table S1. Calculation of adsorption percentage for HCHO.

Computational formula of adsorption percentage:

Adsorption percentage $=\frac{Initial \ concentration - Residual \ concentration}{Initial \ concentration} \times 100\%$ $=\frac{1 \times 10^{-5} - 1.59 \times 10^{-7}}{1 \times 10^{-5}} \times 100\% = 98.41\%$

S1: (a) X. Z. Luo, X. J. Jia, J. H. Deng, J. L. Zhong, H. J. Liu, K. J. Wang and D. C. Zhong, *J. Am. Chem. Soc.* 2013, *135*, 11684-11687; (b) Y. Q. Fan, J. Liu, Y. Y. Chen, X. W. Guan, J. Wang, H. Yao, Y. M. Zhang, T. B. Wei, Q. Lin, *J. Mater. Chem. C*, 2018, *6*, 13331-13335.