Supporting information

A New "Turn-On" Fluorescence Probe for Al^{3+} Detection and Application Exploring in Living Cell and Real Samples

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1. Synthetic details

1.1. The synthesis of 3-(Diphenyl amino) benzaldehyde (M1)

Anhydrous DMF (5 mL, 65 mmol) was added slowly to $POCl_3$ (6 ml, 65 mmol). The solution was stirred under the ice bath condition until the reaction mixture became white solid. Then the triphenylamine (2.5 g, 10 mmol) were added. The reaction mixture was refluxed for 13 h at the temperature of 90 °C. then cooled and added excessive cooled water. Finally, the mixture was adjusted to pH=7 with NaOH and extracted with dichloromethane and dried over anhydrous magnesium sulfate. Afterwards, the dichloromethane was removed by rotary evaporators and the residue was purified by using column-layer chromatographic to obtain compound1. Yield: 65 %. ^{1}H NMR (400 MHz, $CDCl_3$), δ ppm: 9.81 (s, 1 H), 7.70-7.65 (m, 2 H), 7.37-7.30 (m, 4 H), 7.15 (m, 6 H), 7.02 (m, 2 H).

1.2 The synthesis of 9-ethyl-carbazole (M2)

Carbazole (6.6g, 39 mmol) and potassium hydroxide (14 g, 250 mmol) were dissolved in 80 mL of dimethylformamide (DMF) and stirred for 25 minutes, then bromoethane (6.54 g, 60 mmol) was added. The reaction mixture was stirred 8 h at 25 °C. Finally, pouring plenty of water into the solution and stirring for 1 h, the white crude product was obtained by filtering and washing using ultrapure water. The residue was further recrystallized from ethanol, and the purified white crystals were obtained Yield 85%.

1.3 The synthesis of 9-ethyl-3,6-dinitro-carbazole (M3).

Acetic anhydride (30 mL, 0.27 mol) and acetic acid (15 mL, 0.5 mol) was added to a flask and stirred for 5 min. $Cu(NO_3)_2{\cdot}3H_2O$ (4.82 g，20 mmol) was added to the reaction mixture and stirred for another 5 min at 25 °C, and then 9-ethyl-carbazole (3.5 g, 18 mmol) added. Stirring for 50 min at 25 °C, then the plenty of ultrapure water (500 ml) was poured into it. The yellow crude product was obtained by filtrating and washing. The residue was purified by column-layer chromatographic. Yield: 83%. ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 9.18 (s, 2 H), 8.59 (d, *J*=8.8 Hz, 2 H), 7.61 (d, *J*=12 Hz, 2 H), 4.41 (t, *J*=10 Hz, 2 H), 1.2 (d, *J*=8 Hz, 3 H).

1.4 The synthesis of 3,6-diamino-9-ethyl-carbazole (M4)

Pd/C (10 mg) and 9-ethyl-3,6-dinitro-carbazole (4.3 g, 15 mmol) were added to the 200 mL ethanol solution at 25 °C. The reaction mixture was refluxed and heated for 10 min, then added to 10 mL hydrazinium hydroxide and sequentially heated for 4 h at 60 °C, and then the Pd/C was filtered off. The solution was removed by rotary evaporators and the residue was further recrystallized from methylbenzene to get the purified brown product. Yield: 35%. ^{1}H NMR (400 MHz, DMSO) δ ppm: 7.15 (d, *J*=8 Hz, 2 H), 7.08 (d, *J*=4 Hz, 2 H), 6.72 (m, 2 H), 4.58 (s, 4 H), 4.18 (m, 4 H), 1.18 (t, *J*=12.5 Hz, 3 H).

2. Compound characterization

Figure. S1 shows the hydrogen spectrum of intermediate M1. Figure. S2 shows the hydrogen spectrum of intermediate M4. Figure. S3 shows the hydrogen spectrum of ITEC. Figure. S4 shows the mass spectrum of ITEC. Figure. S5 shows the infrared image of ITEC.

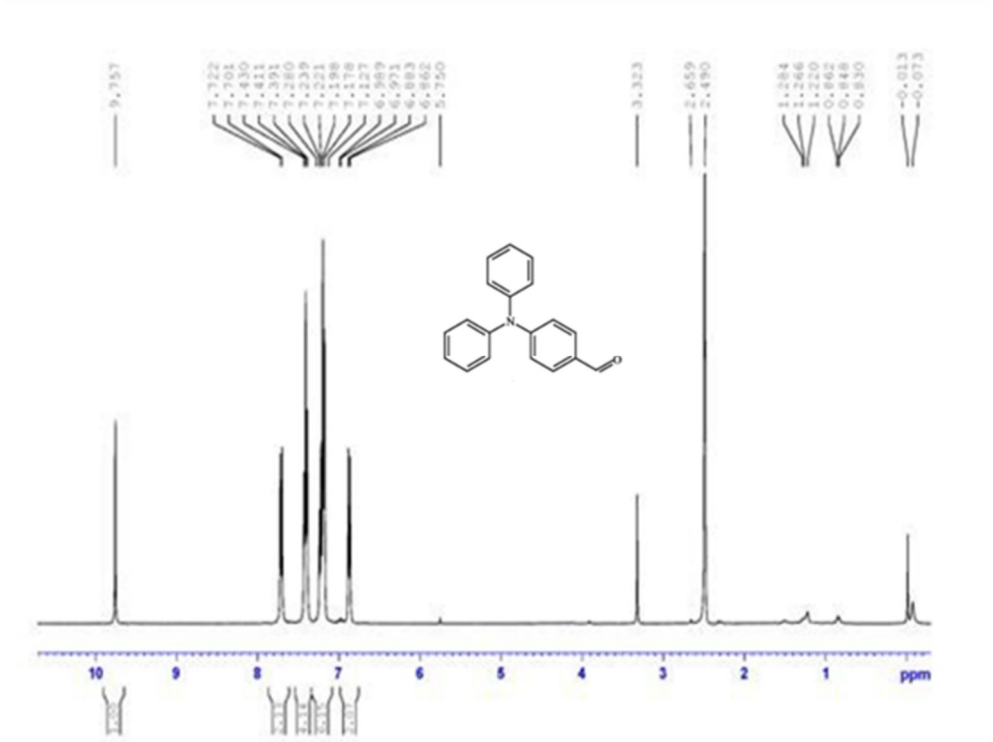


Figure. S1. The ^{1}H NMR spectrum of intermediate M1 in DMSO.

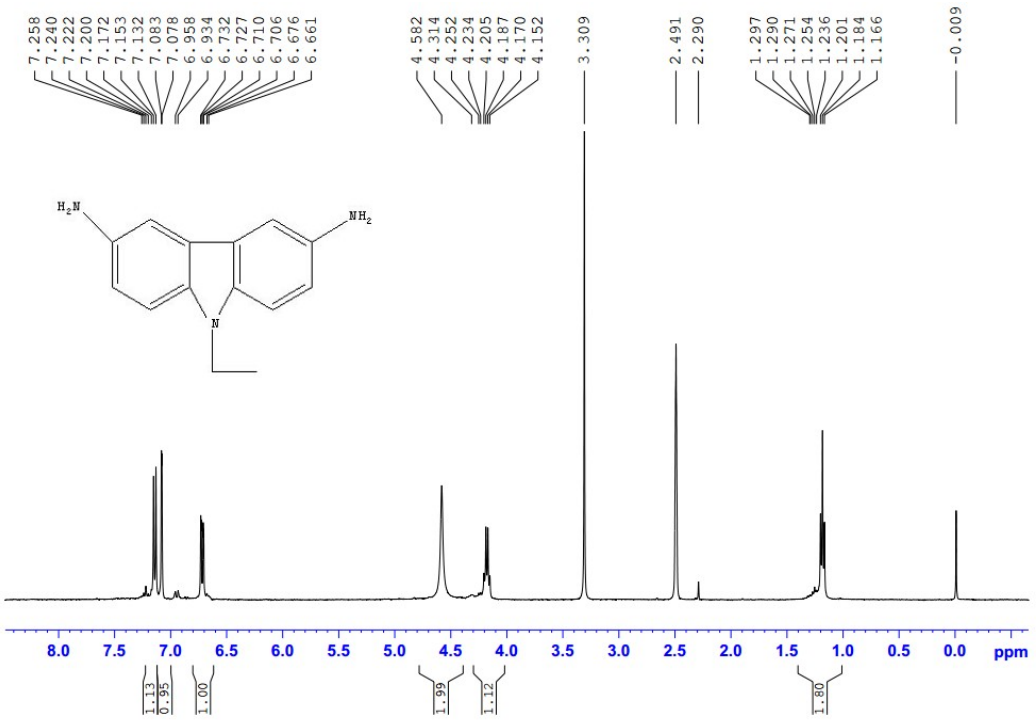


Figure. S2. The ^{1}H NMR spectrum of intermediate M4 in DMSO.

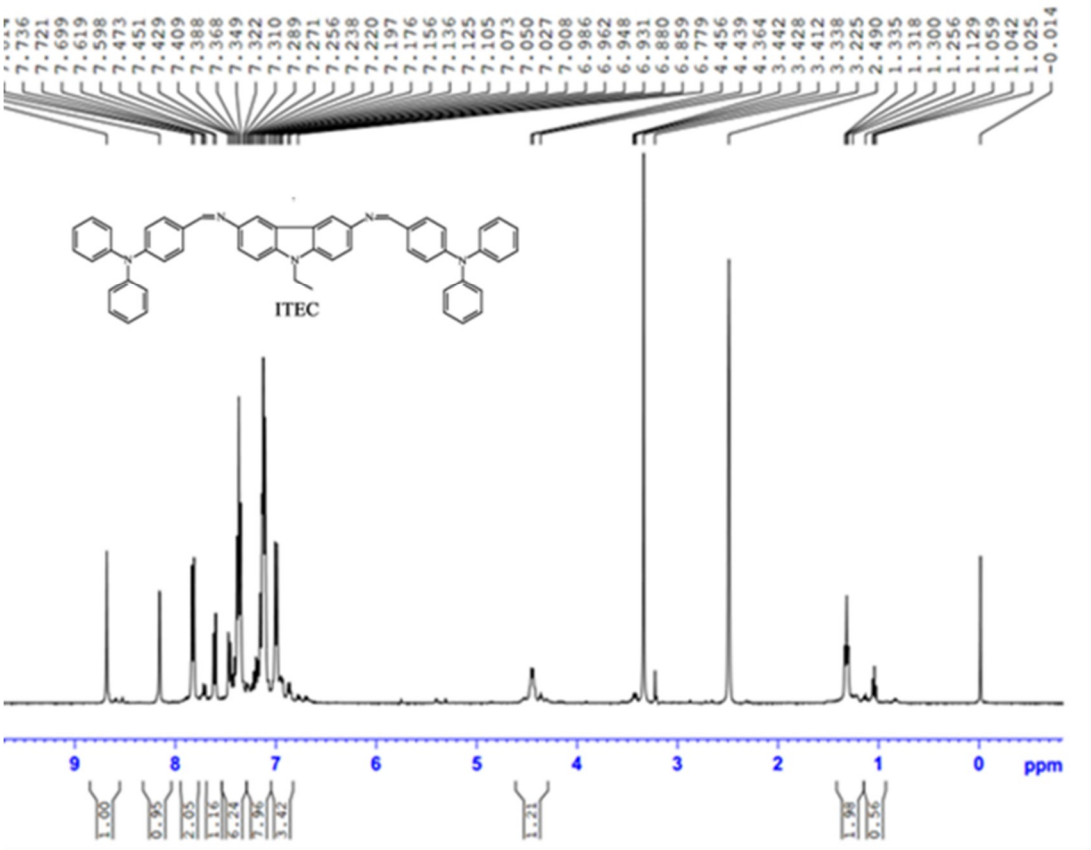


Figure. S3. The ^{1}H NMR spectrum of ITEC in DMSO.

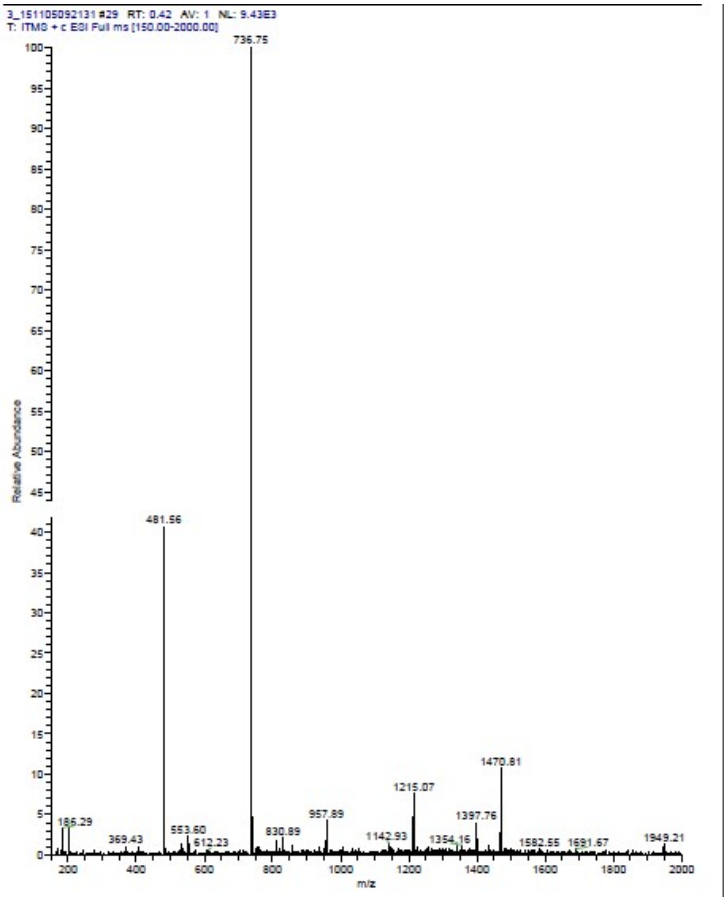


Figure. S4. Mass spectrum of ITEC.

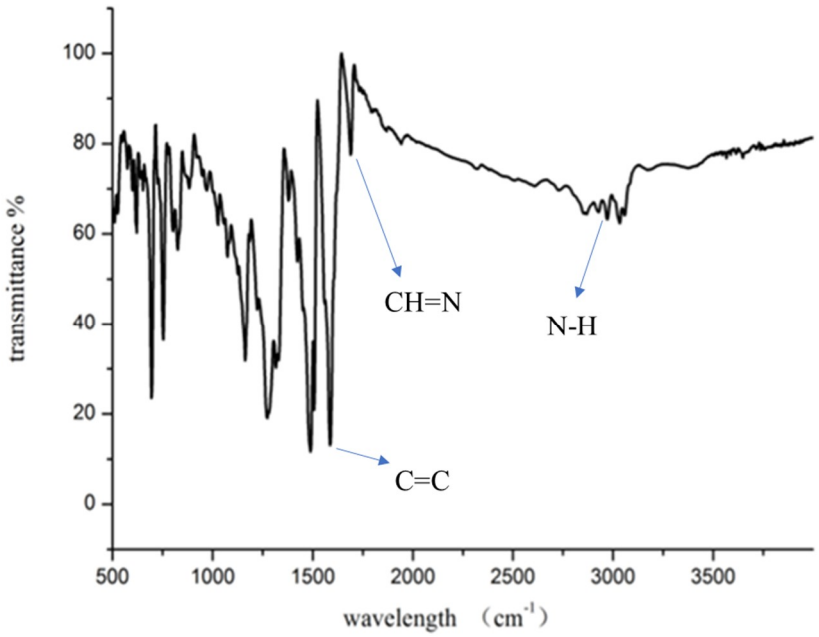


Figure. S5. The FTIR spectrum of ITEC.

3. The interaction mechanism of ITEC-Fe^{3+}

From **Figure. S6**, the fluorescent spectrum vertex reached the mole fraction of 0.3, which indicated a 2: 1 stoichiometry between ITEC and Fe^{3+}. To further investigate interaction mechanism, the ^1H NMR spectra of ITEC and ITEC-Fe^{3+} were performed and showed in **Figure. S6**. The integral intensities of peaks from a to b at 7.71 ppm improve continually with the increase of Fe^{3+} concentrations, which indicates that the proton signal of HC=N will change with the addition of Fe^{3+}. Based on the above studying, a possible sensing mechanism of ITEC toward Fe^{3+} has been proposed as shown in **Figure. S8**.

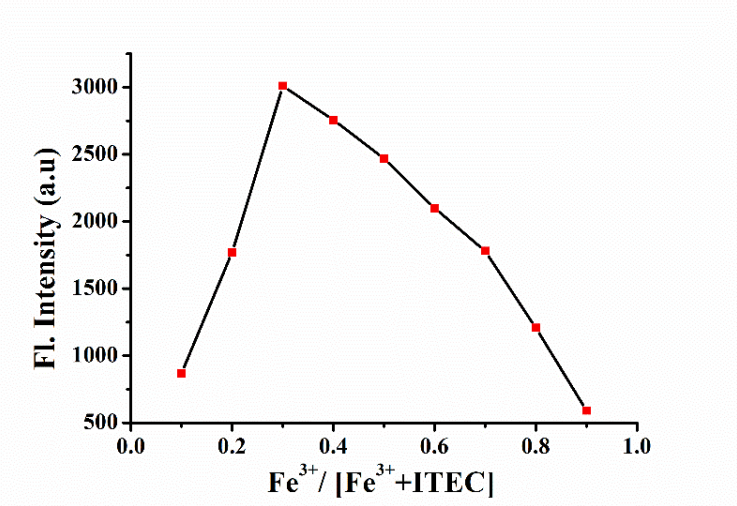


Figure. S6. The Job's plot for determining the stoichiometry between ITEC and Fe^{3+}.

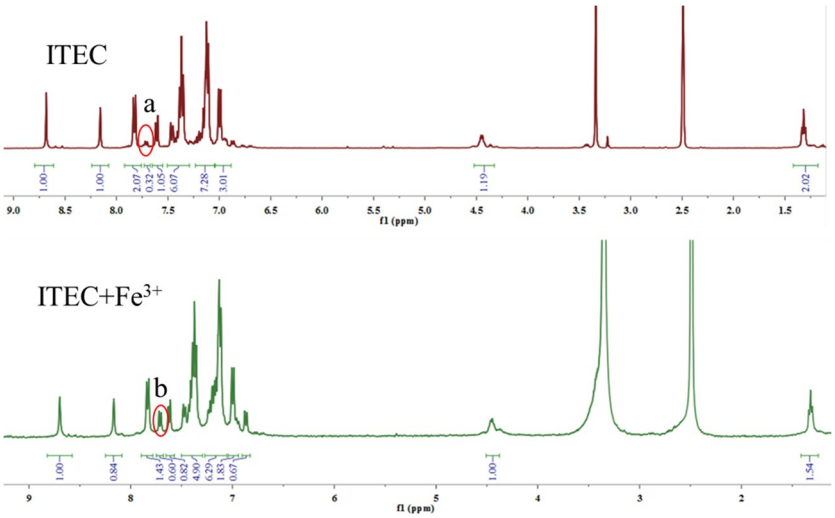


Figure . S7. ^1H NMR (400 MHz) spectra of ITEC and ITECwith Fe^{3+} (1.0 equiv.)

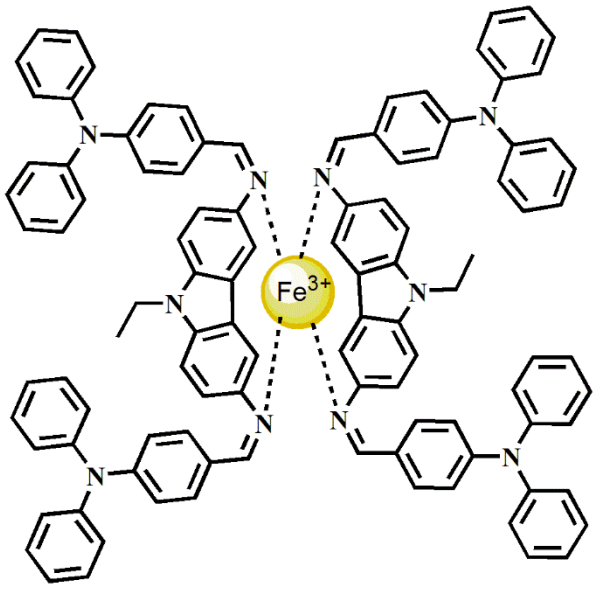


Figure . S8. The proposed binding mechanism of ITEC with Fe^{3+}.