Supplementary Material (ESI) for Analyst

Electronic supporting information

Fluorescence Detection of Trace PCB101 Based on PITC Immobilized on Porous AAO Membrane

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Part S1. Quantum analysis of control experiments

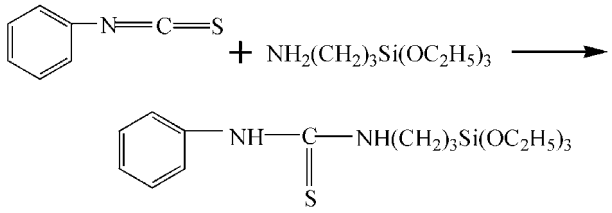
According to the experiments, fluorescent membrane obtained by this method shows similar fluorescence intensity to that obtained by titrating a drop of (A very common one-off plastic burette was used in all titrating experiments. v=0.030 ml) 10^{-5} mol/L PITC/n-hexane solution onto the AAO template after n-hexane completely evaporated. If the PITC molecules titrated onto the AAO surface are supposed to be homogenously distributed and have the same fluorescence quantum efficiency with those on the PITC@AAO membrane, the number of fluorescent molecules irritated by the light source can be approximately calculated. The area of porous AAO membrane is 2.54 cm^2 (diameter=1.8 cm). As PITC is homogenously distributed, the number of fluorescent molecules irradiated by the light source can be calculated by $(10^{-5} mol/L \times 0.028 ml / 2.54 cm^2) \times S$ (S is the area irradiated by the light source). In order to compare the sensitivity of PITC in the membrane and the solution effectively, the concentration of PCB101 solution used for titration must meet demand as

$$\frac{C_1 \times 2.54 cm^2}{0.028 ml \times 10^{-5} mol/L \times S} = \frac{C_2}{C \times 1 cm \times S}$$

where C, C_1 and C_2 are the concentrations of PITC solution used, PCB101 titrated to the membrane, and PCB101 in 1.5 ml PITC solution respectively. The light pathway length through the cuvette is 1 cm. Here, PITC concentration of $C=1.1\times10^{-5}$ mol/L was applied, and $C_1$and C_2 were 0.1 ppm and 1 ppm respectively.

Part S2. Emission mechanism of PITC

To illuminate the enhancement mechanism, it is necessary to study the emission mechanism of PITC. The following experiment was carried out: PITC and 3-aminopropyltriethoxysilane was mixed in 1:1 stoichiometry in ethanol. The reaction occurred according to the following equation.



As the reaction going on, –NCS (the phenyl electron-donating group) on PITC, disappeared and the emission of PITC was quenched as a result of reduced electron potential. This could attest that PITC emission band around 350 nm might be the result of π^*-π or π^*-n transition of the π-conjugate system. Moreover, the emission of PITC would be red-shifted in solvent of increased polarity , the character of π^*-π transition, thus PITC emission is determined to be π^*-π transition in nature(Fig. S3).

Fig. S1-S5

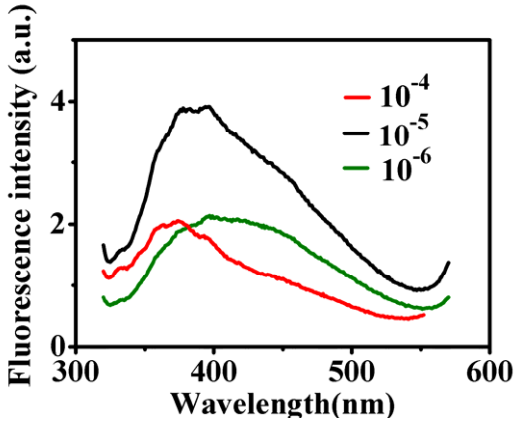


Fig. S1 Fluorescence spectra of PITC@AAO membrane with different PITC concentrations. (λ_{ex}=300 nm)

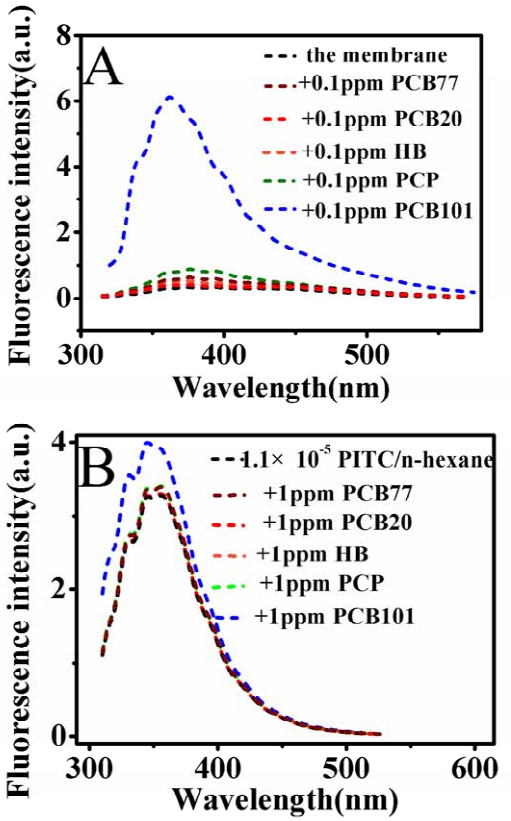


Fig. S2 Fluorescence spectra of (A) PITC@AAO membrane and (B) 1.1×10^{-5} mol/L PITC/n-hexane solution titrated with 0.1 ppm and 1 ppm 3,3',4,4'-tetrachlorobiphenyl (PCB77), 2,3,3'-trichlorobiphenyl (PCB20), hexachlorobenzene (HB), pentachlorophenol (PCP) and PCB101 respectively. (λ_{ex}=300 nm)

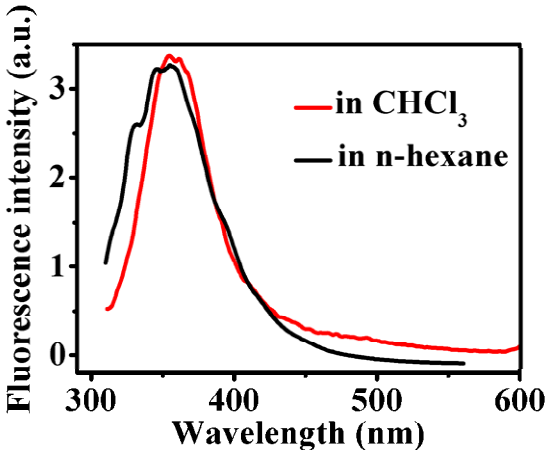


Fig. S3 Fluorescence spectra of 10^{-5} mol/L PITC in n-hexane and chloroform respectively. (λ_{ex}=300 nm)

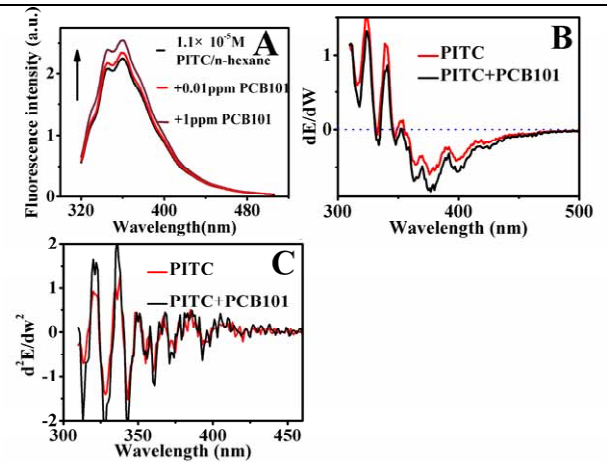


Fig. S4 (A) Fluorescence spectra of 1.1×10^{-5} mol/L PITC/n-hexane solution, titrated with PCB101 (λ_{ex}=300 nm). (B) The first and (C) second derivatives of PITC fluorescence spectra before and after being titrated with 1 ppm PCB101. (λ_{ex}=300 nm)

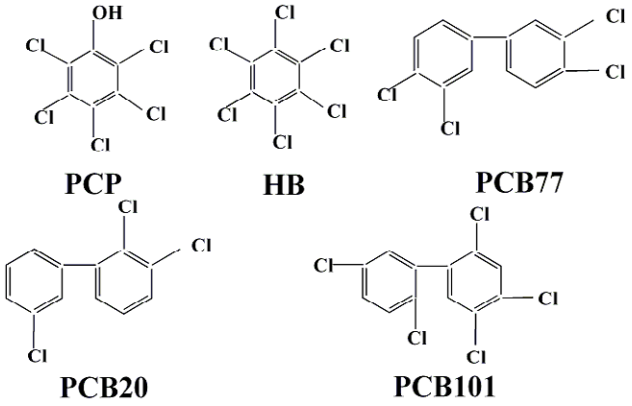


Fig. S5 Structures of PCB101 and organochlorine analogs used.