Electronic Supplementary Material (ESI) for RSC Advances.

Novel functionalized conjugated polypyrene with polyacrylate: synthesis, electrochemistry, luminescence, and chemical sensing properties

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The fluorescence quantum yield (Φ) of soluble Py-PAA, PPy-AA and PPy-PAA were measured and calculated according to the well-known method given as:

$$\Phi = \Phi_{ref}(n^2 A_{ref} I / n_{ref}^2 A I_{ref}) \quad (1)$$

where ref denotes the reference, n is the refractive index of the solvent, A is the absorbance at the excitation wavelength, and I is the intensity of the emission spectrum. Here, we use anthracene in acetonitrile (Φ_{ref} = 0.27) as the reference [1]. It is worth mentioning that absorbance of the sample and the reference should be similar and small (<0.10) [2].

The fluorescence quantum efficiency of Py-PAA, PPy-AA and PPy-PAA-2 in THF were measured to be 0.39, 0.55 and 0.66 respectively according to Eq.(1).

The molecular weight measurements of PPy-AA and PPy-PAA-2 were determined by gel permeation chromatography (GPC) with tetrahydrofuran as the solvent. From GPC results, PPy-AA showed its number-average molar mass (M_n) of about 4211 and weight-average molar mass (M_w) of 7582 (M_w/M_n=1.80) in tetrahydrofuran. The PPy-PAA-2 showed M_n=11366 and M_w=16902 (M_w/M_n=1.48).

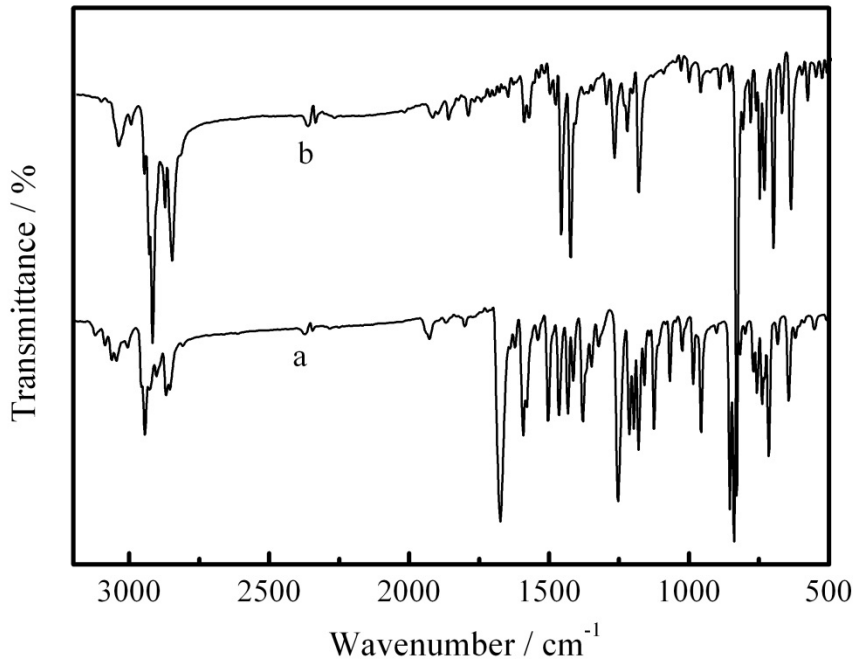

Fig. S1. IR spectra of 6-bromo-1-(pyren-1-yl)hexan-1-one (a) and 1-(6-Bromohexyl) pyrene (b).

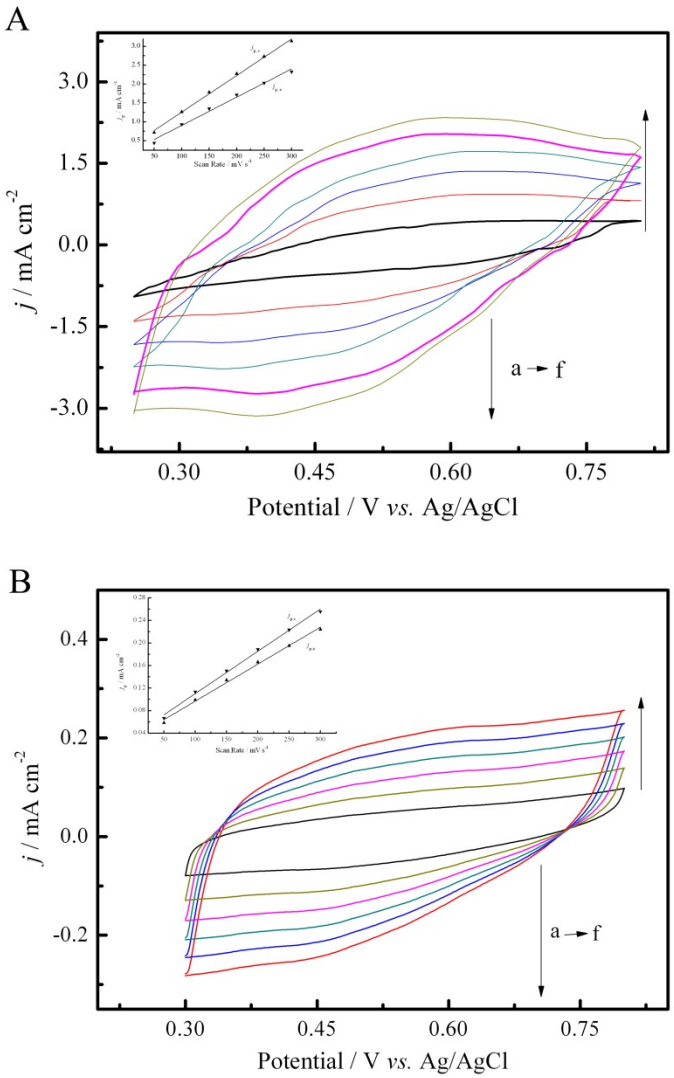

Fig. S2. CVs of PPy-AA (A) and PPy-PAA-1 (B) films prepared from DCM containing Bu_4NPF_6 (0.1 M) in concentrated sulfuric acid at potential scan rates of (a) 50, (b) 100, (c) 150, (d) 200, (e) 250, and (f) 300 mV s^{-1}. Inset: plots of redox peak current densities vs. potential scan rates. j_p is the peak current density: $j_{p,a}$ and $j_{p,c}$ denote the anodic and cathodic peak current densities, respectively.

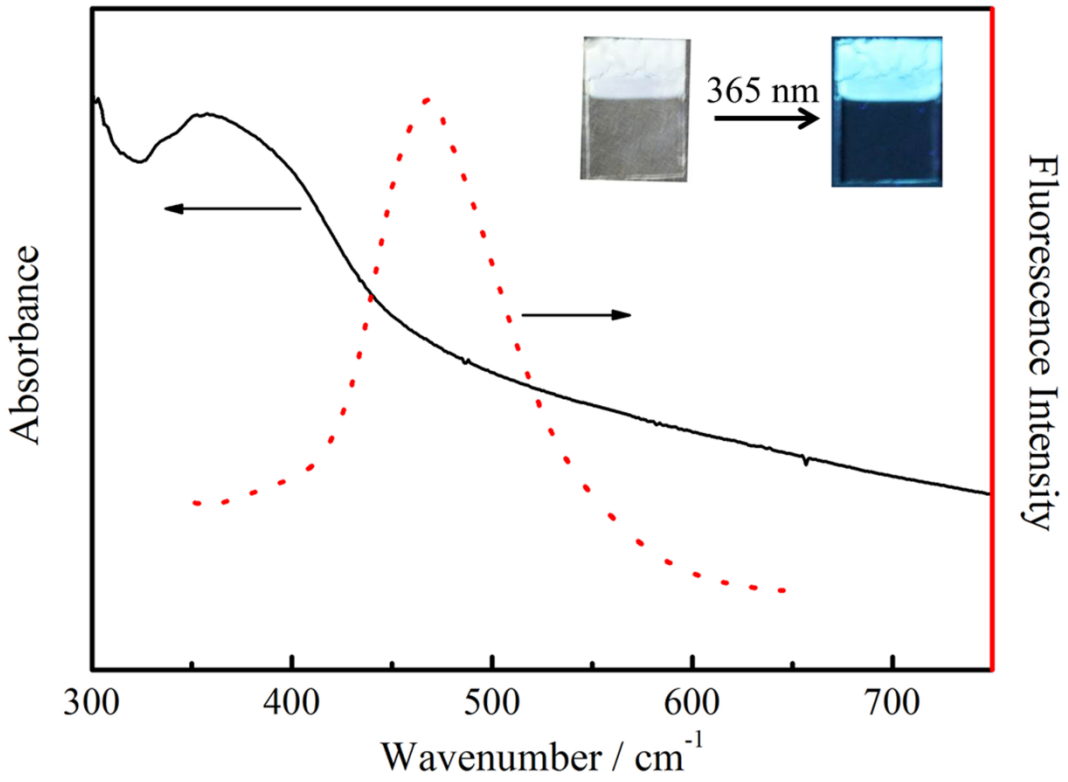

Fig. S3. Solid-state UV–vis spectra and emission spectra of PPy-PAA-1 deposited on the ITO electrode. Inset: Photograph of PPy-PAA-1 under 365 nm UV irradiation.

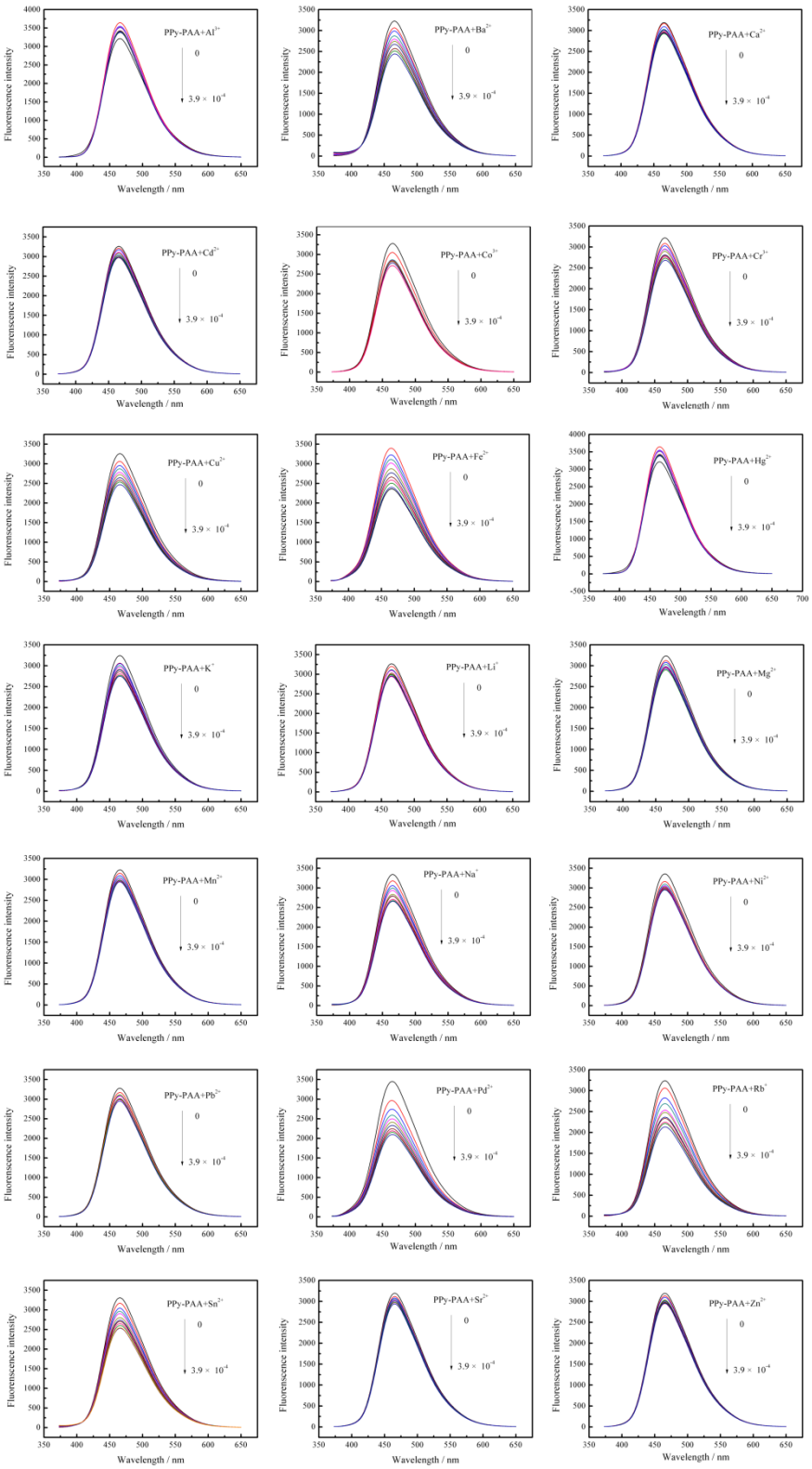

Fig. S4 Fluorescence emission spectra of PPy-PAA-2 (1×10^{-6} M) in THF in the presence of different amounts of metal ions. Excitation wavelength: 363 nm.

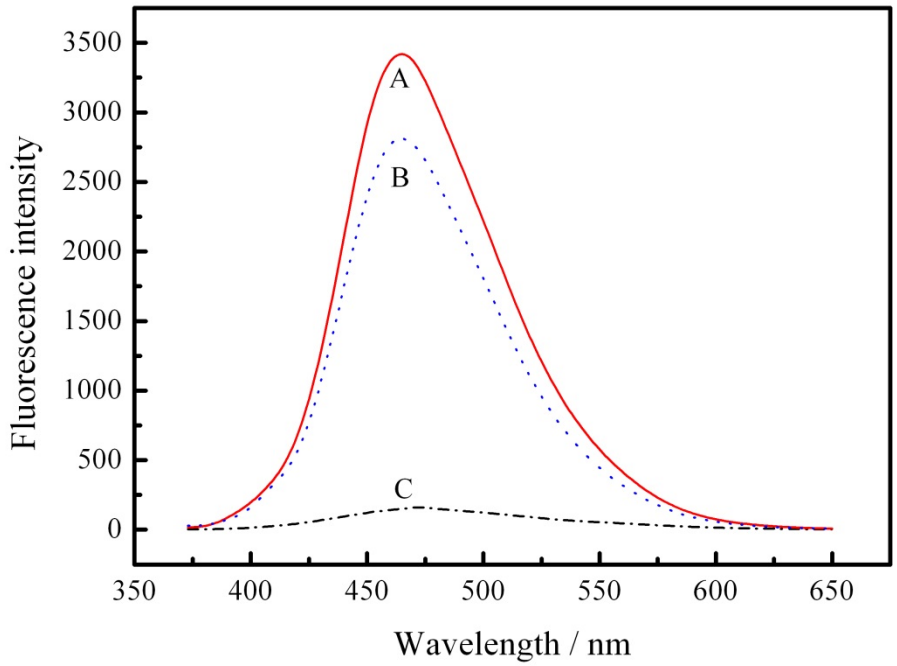

Fig. S5 Fluorescence Emission spectra of PPy-PAA-2 (1×10^{-6} M) in THF in the presence of different metal ions (5.67×10^{-7} mol/L), A: PPy-PAA-2, B: PPy-PAA-2 + cation without Fe^{3+}, C: PPy-PAA-2 + all cation. Excitation wavelength (nm): 363.

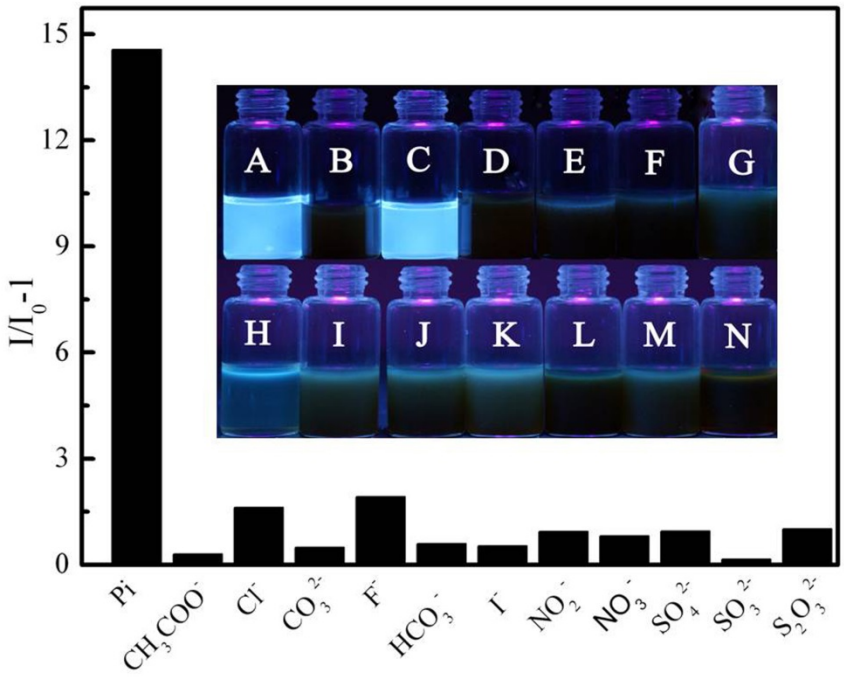

Fig. S6 Fluorescence emission response profiles of PPy-PAA-2 + Fe^{3+} in THF after added Fe^{3+} (5.67×10^{-7} mol L^{-1}), and turned on by different anions (3.5×10^{-5} mol L^{-1}). Insert: fluorescence images in the presence of different metal anions. A) PPy-PAA, B) PPy-PAA-2 + Fe^{3+}, C) Pi, D) NO_2^-, E) SO_3^{2-}, F) $S_2O_3^{2-}$, G) I^-, H) Cl^-, I) SO_4^{2-}, J) CO_3^{2-}, K) F^-, L) HCO_3^-, M) NO_3^-, N) Br^-. The polymer concentration was 1.0×10^{-6} mol L^{-1}. Excitation wavelength (nm): 363.

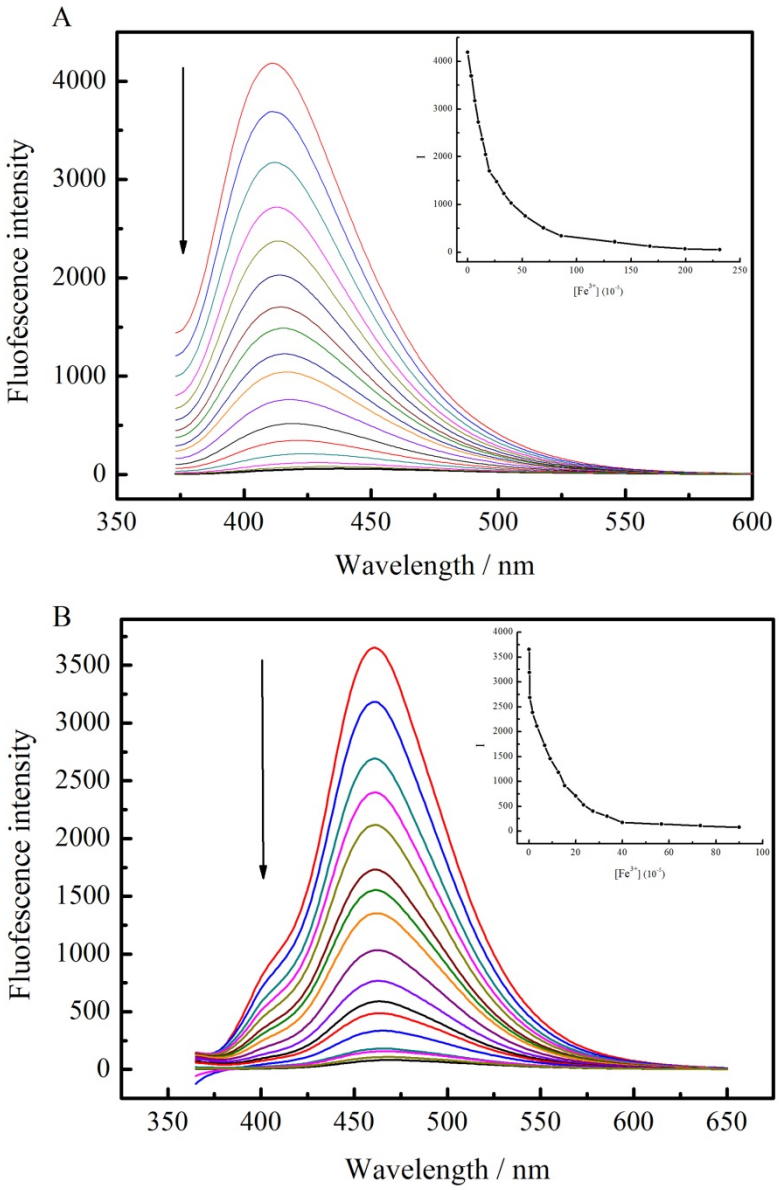

Fig. S7 Fluorescence emission spectra of PPy (1×10^{-6} M, figure A) and PPy-AA (5×10^{-6} M, figure B) in THF in the presence of different amounts of Fe^{3+}. Inset: fluorescence response of PPy and PPy-AA to Fe^{3+}. Excitation wavelength (nm):317 for PPy and 355 for PPy-AA.

The quenching efficiency of PPy, PPy-AA and PPy-PAA-2 were nearly fit to the Stern–Volmer equation, $I_0/I = K_{SV}[A] + 1$, which related the fluorescence intensity, I,

at different concentrations of analyte quencher, [A], where I_0 was the intensity at [A] = 0, and K_{SV} was the Stern–Volmer constant. According to the fluorescence titration of PPy, PPy-AA and PPy-PAA in THF solutions with Fe^{3+}, K_{SV} were determined to be 8.6×10^3 M^{-1} for PPy, 8.0×10^4 M^{-1} for PPy-AA and 4.7×10^5 M^{-1} for PPy-PAA-2, respectively.

Reference:

1. C. Zimmermann, M. Mohr, H. Zipse, R. Eichberger, W. Schnabel, J. Photochem. Photobiol. A. Chem., 1999, 125, 47.

[2] F. C. Tasi, C. C. Chang, C. L. Liu, W. C. Chen, S. A. Jenekhe, Macromolecules, 2005, 38, 1958.