In situ synthesis of multicolor phosphorescent films in polyacrylamide by regulating the conjugation of guest molecular

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Experimental section

Materials

4-ethoxycarbonyl phenylboronic acid (4-EpBA) and 9-phenanthracenylboronic acid (9-PhBA) were obtained from Macklin Co. Ltd. Polyacrylamide (PAM) was purchased from Aladdin Chemical Co., Ltd. Deionzed water was got from a milipore purification system.

Synthesis

4-EpBA (10 mg) was dispersed in 35 ml of deionized water and stirred for 5 min, then PAM (500 mg) was slowly added to the solution and stirred for 30 min to make the solution viscous. Finally, the prepared solution was added to the coater and scraped uniformly with a razor blade. The

phosphorescent flexible film was obtained with a mass ratio of PAM:4-EpBA of 50:1 by heating at a rate of 0.1 °C/min to 140℃ and holding for 1h, followed by natural cooling to room temperature. Replacing the organic guest molecule (4-EpBA) with 9-PhBA can obtain phosphorescent flexible films with a PAM:9-PhBA mass ratio of 50:1. In addition, other mass ratios of phosphorescent films were synthesized and obtained using the same method.

Characterization

The morphology of samples were investigated by field emission scanning electron microscopy (SEM, FEI Quatan FEG 250). The X-ray photoelectron spectroscopy (XPS) of the samples was measured using a Thermo Fisher ESCALAB Xi and the surface functional groups were investigated using Fourier transform infrared spectroscopy (FT-IR) on a Thermofisher Nicolet iS10 spectrophotometer. The photoluminescence (PL) spectra, phosphorescence spectra and time-resolved PL spectra were recorded on an Edinburgh Instruments FLS 1000 spectrometer. The ultraviolet-visible (UV-Vis) absorbance spectra were recorded by PE Lambda 950. The TGA curves were tested by synchronous thermal analyzer using NETZSCH STA449F5. The samples were heated at 10 $K \cdot min^{-1}$ rate under air atmosphere.

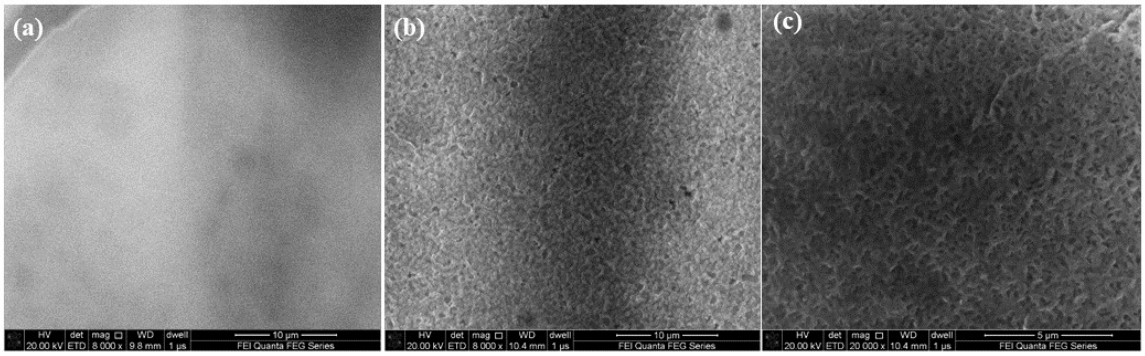

Figure S1. SEM images, (a) for PAM, (b) for 4-Ep@PAM and (c) for 9-Ph@PAM.

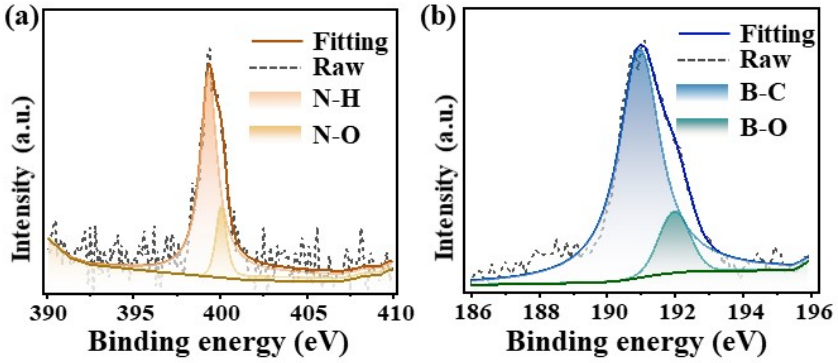

Figure S2. The high-resolution XPS spectra, (a) for N1s and (b) for B1s.

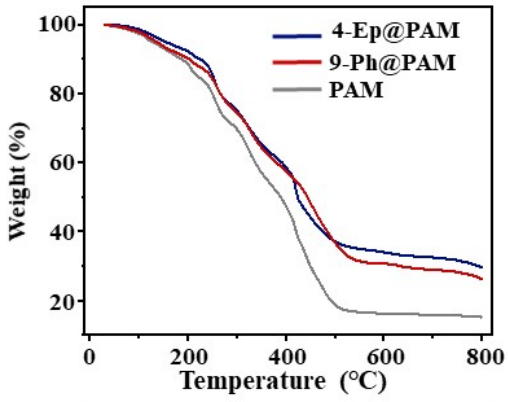

Figure S3. TG curves of PAM, 4-Ep@PAM and 9-Ph@PAM.

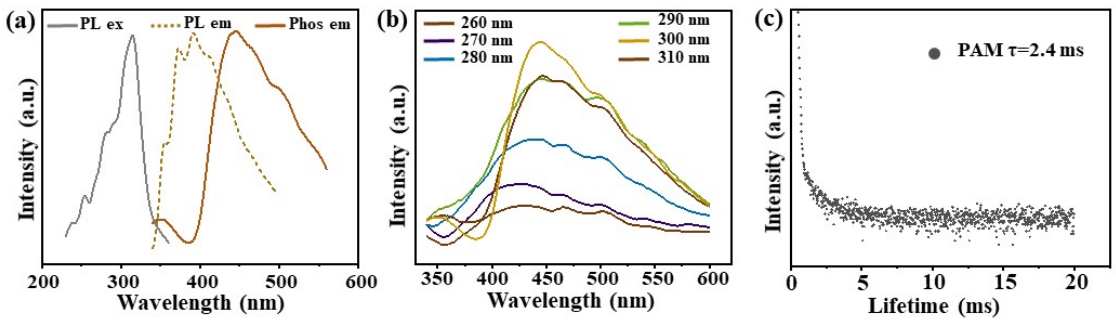

Figure S4. (a) Optimal excitation, PL and RTP mapping spectra, (b) spectral mapping of RTP emission at different excitations, (c) RTP decay curve of PAM.

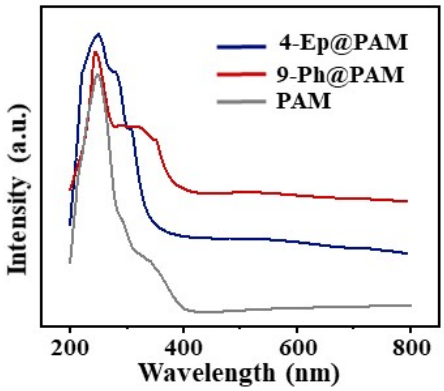

Figure S5. The UV-visible absorption spectra of PAM, 4-Ep@PAM, and 9-Ph@PAM

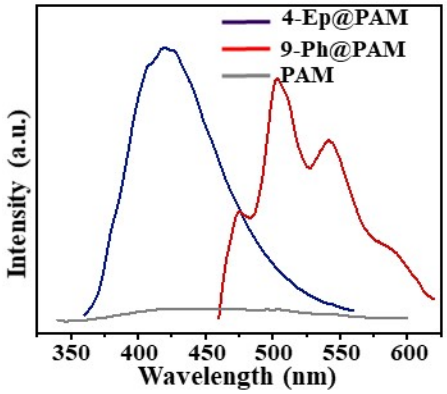

Figure S6. PAM, 4-Ep@PAM and 9-Ph@PAM RTP emission intensity comparison plots.

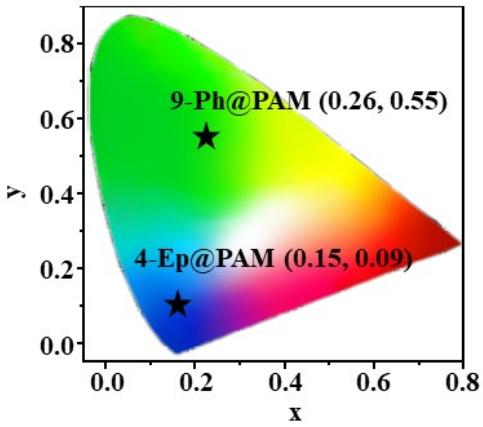

Figure S7. CIE coordinates of 4-Ep@PAM and 9-Ph@PAM

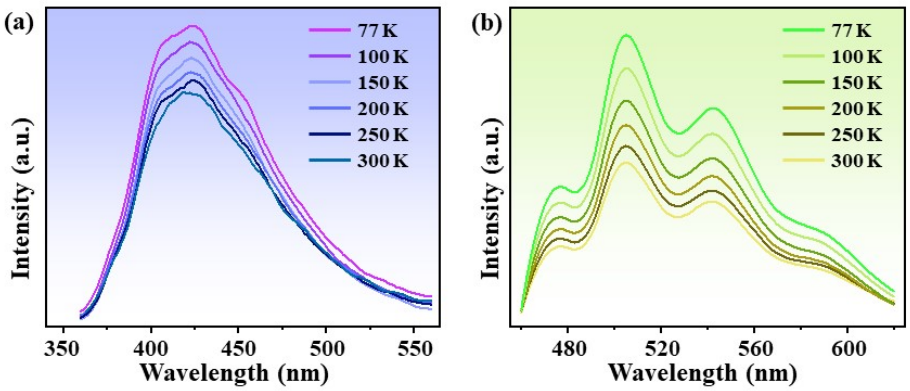

Figure S8. Variable-temperature phosphorescence spectra 4-Ep@PAM and 9-Ph@PAM.

Table S1. XPS data analyses of the C1s spectra of 4-Ep@PAM and 9-Ph@PAM

Chemical bond	4-Ep@PAM	9-Ph@PAM
C-C/C=C	74.68%	75.43%
C-N/C-O	21.59%	18.86%
C=O	3.73%	5.71%

Table S2. XPS data analyses of the O1s spectra of 4-Ep@PAM and 9-Ph@PAM

Chemical bond	4-Ep@PAM	9-Ph@PAM
C-O	85.26%	78.43%
C=O	15.74%	22.57%

Table S3. The fitting data of 4-Ep@PAM

PAM:4-Ep	τ_1 (ms)	τ_2 (ms)	B_1	B_2	τ_{avg} (ms)
10:1	242	827	657	356	622
25:1	416	882	322	216	689
50:1	462	910	489	347	723
75:1	556	796	548	342	669

Table S4. The fitting data of 9-Ph@PAM

PAM:9-Ph	τ_1 (ms)	τ_2 (ms)	B_1	B_2	τ_{avg} (ms)
10:1	268	2308	90	345	2248
25:1	379	2376	131	627	2312
50:1	384	2447	85	394	2379
75:1	414	2403	79	375	2333