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Supporting Information

Microwave-Assisted the Establishment of Efficient Amorphous Polymeric Phosphorescent Materials with Ultralong Blue Afterglow

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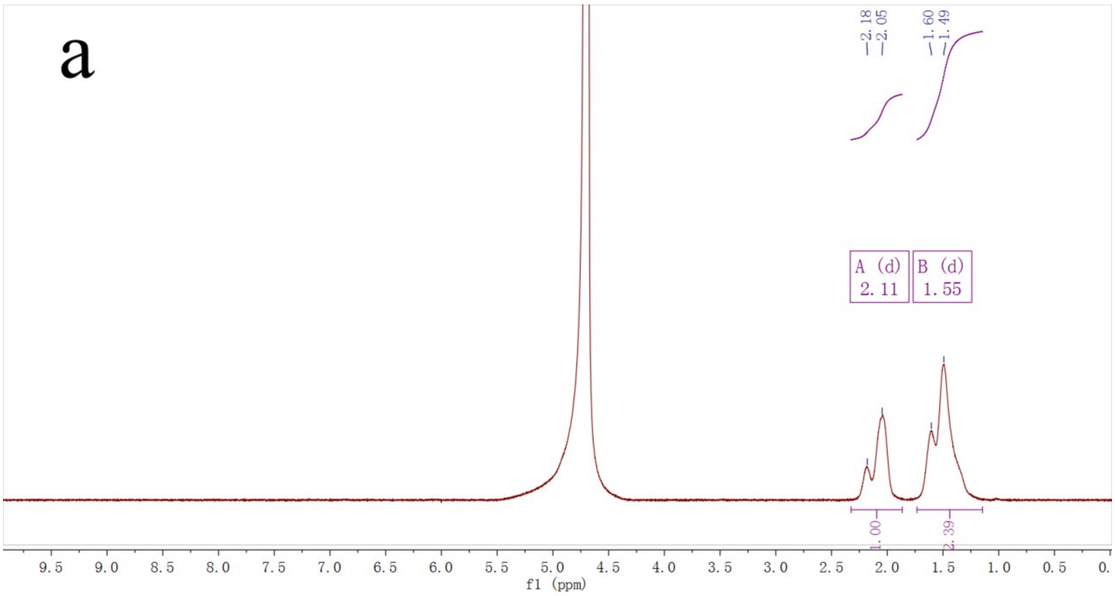
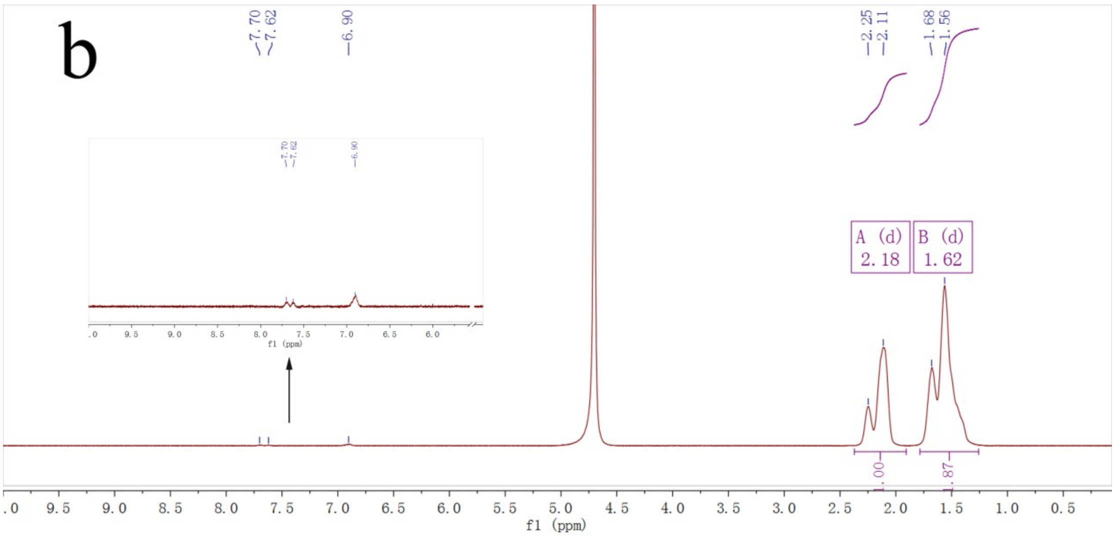
Section S1. Structure Characterization

1. NMR





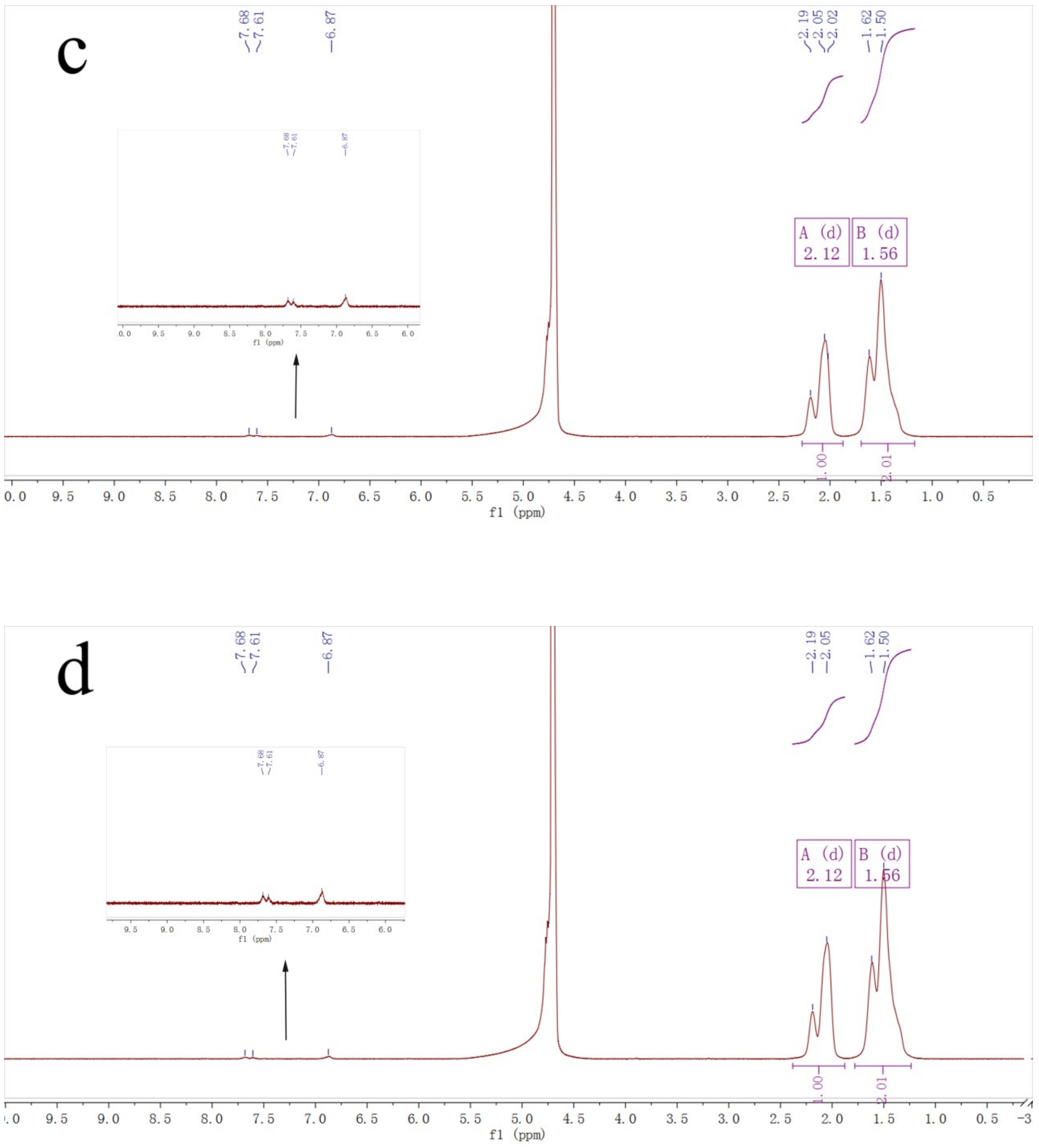


Figure S1. ^{1}H NMR of PAM and copolymers obtained. (a, b, c, d) respectively present the ^{1}H NMR of PAM and copolymers of molar ratio (1:25, 1:50, 1:75) in D_2O.

2. FT-IR

Fourier Transform Infrared Spectroscopy (FT-IR) was carried out to furtherly enhances the proof of copolymerization. Acrylamide and PAM showed in (**Figure S2c**), the characteristic sharp peaks of acrylamide appearing at 3338 cm^{-1} , 1668 cm^{-1}, 1616 cm^{-1} respectively represent the N-H stretching vibration absorption peak associated by hydrogen bonding, the stretching vibration peak of C=O coming from carbonyl and N-H deformation vibration belonging to acrylamide. And the strong characteristic peaks of vinyl carbazole at 3017 cm^{-1}, 1479 cm^{-1} (**Figure S2b**) originating from the C-H stretch vibration peak of benzene ring and C=C absorption peak of skeletal vibration of benzene ring in carbazole groups. The copolymers of all molar ratios exhibiting the same characteristic peaks as acrylamide and vinyl carbazole showing close to 3380 cm^{-1}, 3190 cm^{-1}, while since the great disparate amount between vinyl carbazole and acrylamide participating in the polymerization, except the binary polymer at the molar ratio of 1:12.5, the rest molar ratios copolymers displayed obviously wider peaks at 1616 cm^{-1} which was contributed to the overlap effect between the deformation vibration of N-H skeletal vibration of benzene ring at 1594 cm^{-1} coming from carbazole groups and the N-H deformation vibration peak at 1616 cm^{-1} coming from amide groups of AM which indicated the copolymerization happened between acrylamide and vinyl carbazole.

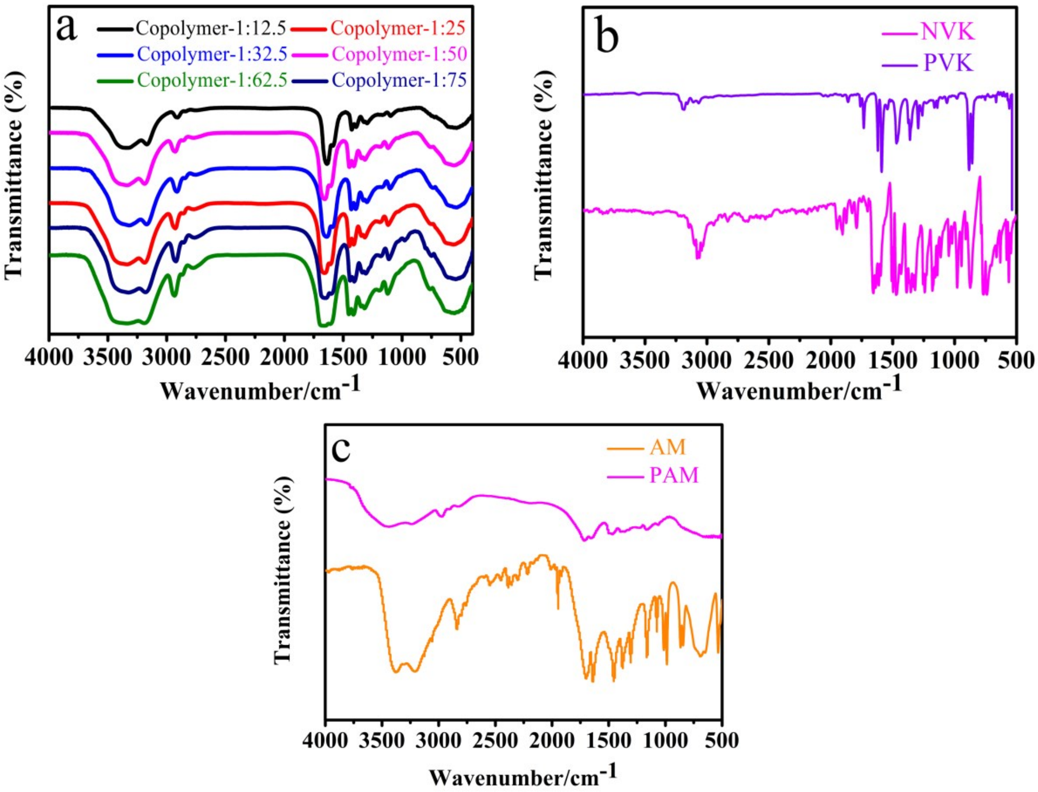


Figure S2. FT-IR spectra of monomers and copolymers showed molar ratio from 1:12.5 to 1:75. (a) FT-IR of copolymers at the molar ratios from 1:12.5 to 1:75; (b) Vinyl carbazole and poly(vinyl carbazole); (c) Acrylamide and poly(acrylamide).

Section S2. Specific Dosage of Copolymerization

Copolymers of different molar ratios fit in different participation dosage of monomers, initiator and deionized water. Specific amount were displayed in **Table S1**.

Table S1. The amount of each component in copolymerization

	Monomer		Initiator	Solvent
	Vinyl carbazole	Acrylamide	$(NH_4)_2S_2O_8$ aqueous solution [1]	Deionized water
	(mg, mmol)		(mL)	(mL)
Copolymer-1:12.5	50, 0.26	229.88, 3.23	0.70	5.0
Copolymer-1:25	50, 0.26	459.77, 6.46	1.27	7.5
Copolymer-1:37.5	50, 0.26	689.65, 9.70	1.85	10.0
Copolymer-1:50	50, 0.26	919.53, 12.94	2.40	15.0
Copolymer-1:62.5	50, 0.26	1149.42,16.17	3.00	18.2
Copolymer-1:75	50, 0.26	1379.30, 19.40	3.57	20.0

[1]. $(NH_4)_2S_2O_8$ concentration is 0.018 M.

Section S3. Viscosity-average Molecular Weight of PAMs Detected

The average molecular weight of the viscosity (M_η) was determined by the viscosity method with UbbeloHde Viscometer. Since the aqueous solution viscosity of polymer reflects the internal friction force during the flow, the viscosity of polymer solution can be obtained by comparing the relationship between the friction force of a pure solution and a thin solution of a polymer.

Polyacrylamide of certain concentration dissolved in water was prepared as a fixed initial concentration solution after full swelling and dissolution. Place the prepared UbbeloHde Viscometer at Smart thermostat instrument to keep the temperature sustaining at 30 °C with error range does not exceed 0.02 °C, respectively document the time pure solvents and polymer solutions leave capillaries behind for. Ensure that within the error range, measure three times and take the average finally obtained the t and t_0 respectively present the record the flow of time of polymer aqueous solution and pure solvent. **Table S2-Table S8** displayed the flow time of PAMs from P10-P100, PAMs obtained from other methods at different diluted concentration. According to the relative viscosity $\eta_r = \frac{t}{t_0}$ and specific viscosity $\eta_{SP} = \eta_r - 1$, we could obtain curves of $\frac{\eta_{SP}}{C} - C$ and $\frac{\ln \eta_r}{C} - C$ showed in **Figure S3** then extrapolate the two curves the intercept corresponding to the intersection point obtained is the intrinsic viscosity [η]. When the two straight lines do not intersect on the ordinate when extrapolating, curve of $\frac{\eta_{SP}}{C} - C$ wasadopted to get the intrinsic viscosity $[\eta]$. Check the empirical parameters from POLYMER HANDIBOOK, average relative molecular weight $\bar{M}$ was obtained from $[\eta] = K[M]^{\alpha}$. Respectively record the time for solution to flow through the capillary as t_0, PAMs obtained at different firepower (P10, P30, P50, P80 and P100).

Table S2. Flow time of PAM obtained at MWP-P10 at different diluted concentration.

PAM-P10 initial concentration (g/cm^3) : 0.01 (210 mg/21 mL) Constant temperature: 30 °C

$c/g{\bullet}cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln \eta_r/c$
0.01	227.65	227.91	227.76	227.77	2.5713	1.5713	157.1347	94.4430
0.008077	219.06	219.16	219.22	219.15	2.4740	1.4740	182.4995	112.1529
0.006774	212.08	212.16	212.21	212.15	2.3950	1.3950	205.9301	128.9286
0.005122	207.47	207.17	207.35	207.33	2.3406	1.3406	261.7354	166.0316
0.003750	201.31	201.61	201.46	201.46	2.2743	1.2743	339.8209	219.1159

Table S3. Flow time of PAM obtained at MWP-P30 at different diluted concentration.

PAM-P30 initial concentration (g/cm^3) : 0.01 (115.4 mg/11.54 mL) Constant temperature: 30 °C

$c/g{\bullet}cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln \eta_r/c$
0.01	251.17	251.44	251.36	251.32	2.8372	1.8372	183.7247	104.2834
0.006977	249.31	249.26	249.29	249.29	2.8142	1.8142	260.0327	148.3007
0.0005375	230.27	230.43	230.25	230.35	2.6005	1.6005	298.7367	178.3851

0.0003659	224.39	224.41	224.36	224.39	2.5332	1.5332	419.0263	254.0322
0.0002542	214.24	214.32	214.39	214.32	2.4195	1.4195	558.3884	374.5686

Table S4. Flow time of PAM obtained at MWP-P50 at different diluted concentration.

PAM-P50 initial concentration (g/cm^3) : 0.01 (123.2 mg/12.32 mL)   Constant temperature: 30 °C

$c/g\bullet cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln \eta_r/c$
0.01	229.51	229.62	229.47	229.53	2.5913	1.5913	159.1255	95.2142
0.007113	223.37	223.42	223.55	223.45	2.5225	2.5225	214.0455	130.0781
0.005520	218.76	218.84	218.55	218.72	2.4691	2.4691	266.1629	163.7533
0.003812	214.56	214.69	214.74	214.66	2.4234	2.4234	373.4072	232.2121
0.002604	209.26	209.33	209.44	209.34	2.3633	2.3633	523.6408	330.3449

Table S5. Flow time of PAM obtained at MWP-P80 at different diluted concentration.

PAM-P80 initial concentration (g/cm^3) : 0.01 (119.3 mg/11.93 mL)   Constant temperature: 30 °C

$c/g\bullet cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln \eta_r/c$
0.01	299.22	299.03	299.33	299.19	3.3777	2. 3777	237.7662	121.7184
0.007047	274.42	274.67	274.59	274.56	3.1000	2.1000	297.9525	160.5389
0.005440	263.55	263.32	263.49	263.45	2.9742	1.9742	362.8993	200.3608
0.003736	246.15	246.42	246.33	246.3	2.7805	1.7805	476.5512	273.7052
0.002542	249.54	249.38	249.65	249.52	2.8169	1.8169	714.7389	407.4005

Table S6. Flow time of PAM obtained at MWP-P100 at different diluted concentration.

PAM-P100 initial concentration (g/cm^3) : 0.01 (95 mg/9.5 mL)					Constant temperature: 30 °C			
$c/g\bullet cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln \eta_r/c$
0.01	282.56	282.43	282.49	282.49	3.1891	2.1891	218.9132	115.9749
0.006552	260.52	260.06	260.19	260.26	2.9381	1.9381	295.8149	164.5006
0.004872	244.51	254.34	254.55	251.13	2.8351	1.8351	376.6788	213.9002
0.003220	226.21	226.43	226.29	226.31	2.5549	1.5549	482.8267	291.2736
0.002135	211.66	211.52	211.52	211.66	2.3894	1.3894	650.8433	408.0225

Table S7. Flow time of PAM obtained in oil bathing method at different diluted concentration.

PAM-HT initial concentration (g/cm^3) : 0.01(210 mg/21 mL)					Constant temperature: 30 ℃			
$c/g\bullet cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln \eta_r/c$
0.01	168.46	168.56	168.63	168.55	1.9028	0.9028	45.1400	32.1663
0.008077	156.87	156.64	156.59	156.70	1.7690	0.7690	95.2123	70.6243
0.006774	146.97	146.93	146.73	146.88	1.6581	0.6581	97.1517	74.6491
0.005833	139.24	139.19	139.07	139.17	1.5711	0.5711	97.9002	77.4453
0.004117	131.25	131.55	131.44	131.41	1.4836	0.4836	117.4349	95.7930

Table S8. Flow time of PAM obtained in hydrothermal heating method at different diluted concentration.

PAM-CT initial concentration (g/cm^3) : 0.01(165 mg/16.5 mL) Constant temperature: 30 °C

$c/g{\bullet}cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln\eta_r/c$
0.01	222.49	222.54	222.37	222.47	2.5115	1.5115	151.1477	92.0871
0.007674	210.58	210.59	210.73	210.63	2.3779	1.3779	179.5430	112.8701
0.006226	198.54	198.63	198.43	198.53	2.2413	1.2413	199.3584	129.6173
0.004520	193.56	193.29	193.46	193.44	2.1838	1.1838	261.8601	172.7764
0.003204	189.26	189.54	189.63	189.48	2.1390	1.1390	355.5203	237.3244

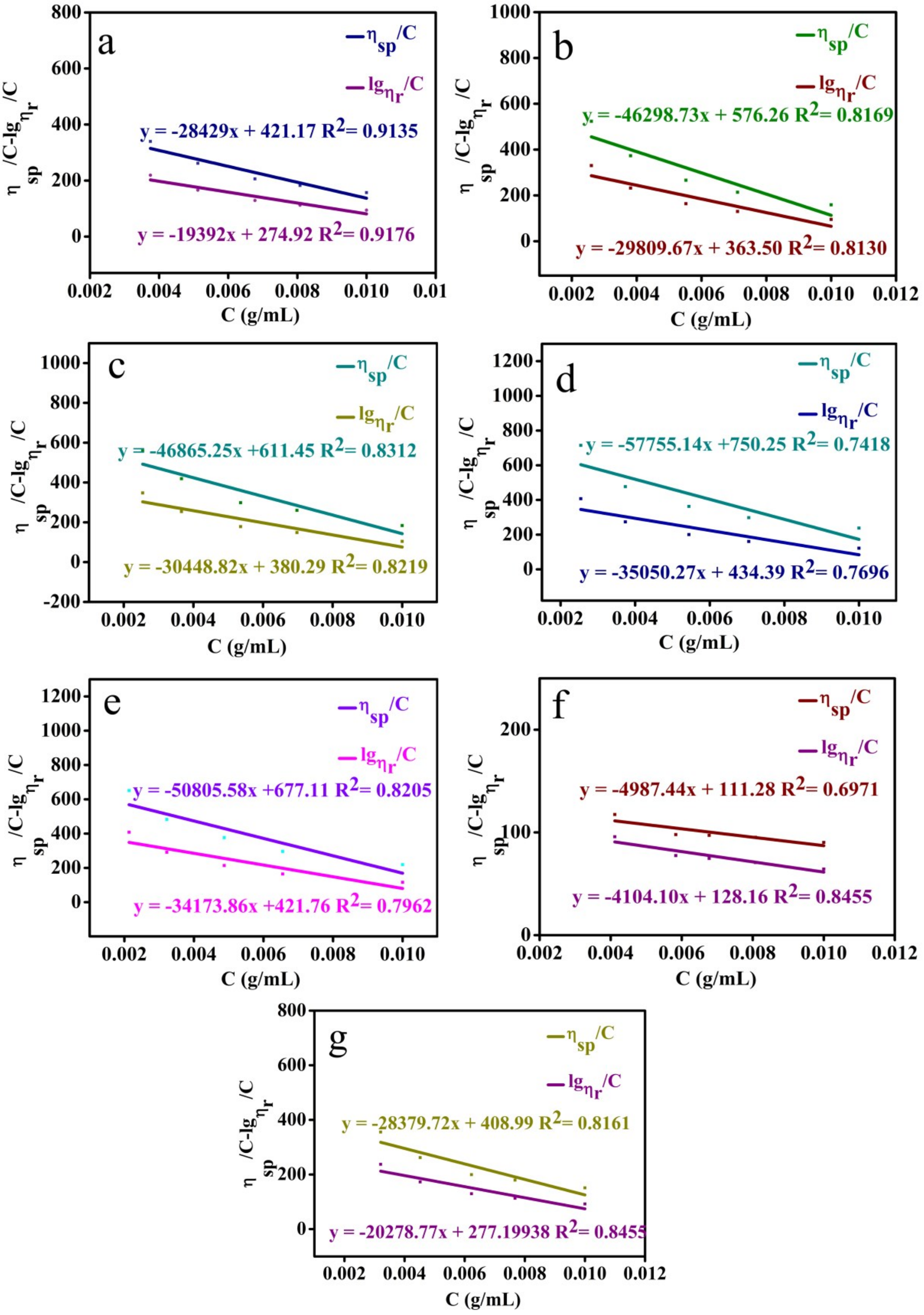


Figure S3. $\frac{\eta_{SP}}{C}-C$ and $\frac{\ln\eta_r}{C}-C$ curves of PAMs obtained in different MWP firepower and other methods. (a-e) present the fitting curves of PAMs obtained in MWP firepower from P10 to P100; (f, g) present the fitting curves of PAMs in oil bathing and hydrothermal heating method.

Section S4. Phosphorescence lifetime and decay parameters

Section S4.1 Phosphorescence lifetime and decay parameters of PAMs.

The time resolved photoluminescence decay curves and delay spectra of PAMs in different MWP power, different precipitation rate, different synthesis method and PAMs treated by different temperature from 80 °C to 130 °C were carried out by tested by the FLS 920 Fluorescence Spectrometer Equipped with microsecond flash-lamp (μF900) and nanosecond hydrogen flashlamp (nF920). The lifetime data (τ and corresponding percentage) of PAMs were fitted by the software of FLS 920 Fluorescence Spectrometer. The average lifetime of PAMs were calculated by $\tau_0 = \sum \tau_i \times B_i\%$.

Table S9. Phosphorescence lifetime and decay parameters of PAM.

Polymers		λ	τ (ms)			χ^2
			τ_1 (ms)	τ_2 (ms)	τ_3 (ms)	
Different MWP parameters	P10	414	109.22 (4.08%)	728.03 (16.84%)	3352.37 (79.08%)	1.382
		440	194.01 (6.28%)	562.66 (21.58%)	2432.17 (72.14%)	1.486
		462	95.30 (3.21%)	662.68 (19.09%)	3594.72 (77.70%)	1.219
	P30	414	16.49 (1.64%)	493.96 (11.41%)	3286.38 (86.96%)	1.408
		442	60.24 (1.51%)	752.70 (12.91%)	3568.00 (86.58%)	1.451
		462	47.33 (1.38%)	478.30 (11.41%)	3343.53 (87.21%)	1.312
	P50	414	125.03 (3.29%)	860.91 (13.03%)	3433.32 (83.69%)	1.319
		442	301.17 (2.56%)	527.33 (11.17%)	3453.73 (86.27%)	1.258
		462	16.63 (0.73%)	457.15 (11.28%)	3177.53 (87.99%)	1.294
	P80	414	53.44 (0.97%)	450.80 (6.88%)	3408.87 (92.14%)	1.370
		442	46.10 (0.42%)	590.21 (7.85%)	3270.81 (91.74%)	1.325
		462	54.13 (1.52%)	640.37 (11.16%)	3686.70 (87.32%)	1.224
	P100	414	15.57 (0.97%)	430.94 (10.14%)	3412.76 (88.89%)	1.305
		440	292.25 (7.25%)	2894.83 (92.75%)		1.278
		462	23.72 (1.19%)	422.59 (11.24%)	3082.93 (87.57%)	1.275
Different precipitation rate	Fast	414	53.44 (0.97%)	450.80 (6.88%)	3408.87 (92.14%)	1.370
		442	46.10 (0.42%)	590.21 (7.85%)	3270.81 (91.74%)	1.325
		462	54.13 (1.52%)	640.37 (11.16%)	3686.70 (87.32%)	1.224
	Slow	414	42.22 (17.23%)	313.16 (62.02%)	1334.17 (20.75%)	1.668

		442	78.70 (9.64%)	547.29 (90.36%)		1.336
		462	214.20 (31.66%)	656.91 (68.34%)		1.384
Different synthesis method	Oil bathing	485	1.90 (7.8%)	112.21 (50.01%)	2396.02 (49.21%)	1.169
	Hydrothermal	483	44.95 (10.29%)	422.56 (43.25%)	2707.71 (46.46%)	1.380
Different temperature treatment	90	417	44.91 (7.44%)	385.03 (23.31%)	3004.24 (69.24%)	1.588
		451	30.68 (12.91%)	270.10 (25.41%)	1658.67 (61.68%)	1.600
		476	11.84 (3.05%)	141.17 (24.29%)	591.89 (72.66%)	1.336
	100	420	149.69 (15.17%)	588.21 (84.83%)		1.492
		444	26.44 (3.38%)	303.74 (18.18%)	542.65 (78.44%)	1.336
		470	106.36 (8.09%)	493.60 (64.13%)	1509.82 (27.78%)	1.742
	110	453	59.30 (2.40%)	319.73 (39.59%)	723.97 (58.01%)	1.653
		480	80.03 (3.22%)	422.45 (62.33%)	893.44 (34.46%)	1.529
	120	458	11.84 (3.05%)	141.17 (24.29%)	591.89 (72.66%)	1.336
		485	44.60 (8.51%)	297.78 (36.83%)	664.12 (54.67%)	1.209
	130	483	16.78 (7.78%)	82.64 (59.69%)	237.59 (32.53%)	1.336

Section S4.2 Phosphorescence lifetime and decay parameters of Copolymers.

Limited by the life attenuation range of 0~10 s of FLS920 Fluorescence Spectrometer, time resolved photoluminescence decay curves and delay spectra of copolymers in different molar ratios were tested by the FLS 980 Fluorescence Spectrometer Equipped with microsecond flash-lamp (μF900) and nanosecond hydrogen flashlamp (nF980). The obtained time resolved photoluminescence decay curves were multi-exponential fitted (second or third order), the average lifetime of copolymers were obtained originating from the

$$I(t) = I_0 + A_1 exp\left(-{}^{t}/_{\tau_1}\right) + A_2 exp\left(-{}^{t}/_{\tau_2}\right) \; or \; I(t) = I_0 + A_1 exp\left(-{}^{t}/\right.$$
$$+ A_2 exp\left(-{}^{t}/_{\tau_2}\right) + A_3 exp\left(-{}^{t}/_{\tau_3}\right)$$

then lifetime data was calculated through the $\tau = \frac{A_1 t_1^2 + A_2 t_2^2}{A_1 t_1 + A_2 t_2}$ or

$$\tau = \frac{A_1 t_1^2 + A_2 t_2^2 + A_3 t_3^2}{A_1 t_1 + A_2 t_2 + A_3 t_3}.$$

Table S10. Phosphorescence lifetime and decay parameters of copolymers.

Copolymers	λ	A			τ (ms)			Adj. R-Square
		A_1	A_2	A_3	τ_1 (ms)	τ_2 (ms)	τ_3 (ms)	
1:12.5	414	107610.45	166099.26		1090.46	4183.99		0.99998
	440	173542.92	123094.39		4170.09	1084.54		0.9397

	462	$3.35*10^{9}$			3379.66			0.9974
1:25	414	190547.61	382035.45		1338.28	4470.66		0.9971
	440	411461.84	833987.72	74346.78	1422.88	4248.11	129.15	0.9959
	462	151749.62	712020.94	513959.77	56.04	$2.57*10^{9}$	$4.96*10^{9}$	0.9973
1:37.5	414	230550.47	79578.22	134940.29	1562.11	539.34	4598.18	0.9594
	440	986883.97	374746.84	496054.99	2255.61	516.77	4972.54	0.9882
	462	1562520.0	640569.92	1100380.0	2269.63	490.79	4773.68	0.9937
1:50	414	201178.66	297099.33	366159.17	37.99	1387.53	4145.29	0.9743
	442	762827.06	1105450.0	165109.0	1487.69	3919.72	219.93	0.9947
	462	68819.40	4165.15	55111.30	9571.63	2250.78	44507.5	0.9968
1:62.5	414	933030.43	1890640.0	1800050.0	316.21	1872.13	4595.25	0.9952
	442	933030.43	1890640.0	1800050.0	316.21	1872.13	4595.25	0.9947
	462	1841030.0	3320300.0	290105.89	952.66	3632.67	7550.64	0.9960
1:75	414	$3.90*10^{9}$	8631250.0	$4.75*10^{17}$	99009.8	34613.9	3222.70	0.9929
	440	532971.06	1039050.0	1910060.0	104.43	1191.33	3630.84	0.9923
	462	173453.07	68480800.0		583281.0	130588.00		0.92233

Section S5. Relationship of Molecular Weight and Luminescence

To deeply explore the relationship between molecular weight and luminescence performance, initiator that may bring about significant influence on molecular weight was considered as the variables to investigate the effect on luminescence. As the intuitive performance we observed, different amount of initiator indeed bring about the different luminescence emission, therefore the molecular weight of PAMs synthesized in the altered amount of initiator were calculated by the viscosity method with UbbeloHde Viscometer. We controlled the temperature and test conditions as **Section S3** expressed. **Table S11** was the viscosity-average molecular weight value through the calculated formula in **Section S3**. **Table S12-Table S21** displayed the flow time of PAMs synthesized in the changing amount of initiator from 0.2% to 2.0% and curves in **Figure S4** presented the $\frac{\eta_{SP}}{C} - C$ and $\frac{\ln \eta_r}{C} - C$ under the changed conditions of amount of initiator from 0.2% to 2.0%.

Table S11. The influence of the amount of Initiator $(NH_4)_2S_2O_8$ on the M_η of PAMs

Amount of Initiator ($(NH_4)_2S_2O_8$) (%)	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
$M_\eta/10^6$	1.2410	0.8644	1.1653	1.8832	2.5766	2.0138	0.6189	0.5032	0.4294	0.3969

Table S12. Flow time of PAM obtained at the initiator of 0.2% at different diluted concentration.

PAM-0.2% initial concentration (g/cm^3) : 0.01 (123.2 mg/12.32 mL) Constant temperature: 30 °C

$c/g \bullet cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln \eta_r/c$
0.01	234.52	234.35	234.62	234.50	3.5220	2.5220	252.2029	125.9037
0.007113	202.17	202.91	202.84	202.64	3.0436	2.0436	287.29229	156.4742
0.005520	184.15	184.01	184.90	184.35	2.7689	1.7689	320.4695	184.51134
0.003812	151.66	151.42	151.61	151.56	2.2764	1.2764	334.8502	215.7988
0.002604	128.23	128.90	128.12	128.42	1.9288	0.9288	356.7273	252.3001

Table S13. Flow time of PAM obtained at the initiator of 0.4% at different diluted concentration.

PAM-0.4% initial concentration (g/cm^3) : 0.01 (141.4 mg/14.14 mL) Constant temperature: 30 °C

$c/g \bullet cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln \eta_r/c$
0.01	229.69	229.77	229.32	229.59	3.4484	2.4484	244.8383	123.7905
0.007388	195.72	195.26	185.71	192.23	2.8872	1.8872	255.4531	143.5213
0.005857	170.41	170.22	170.54	170.39	2.5592	1.5592	266.1848	160.4244
0.004142	144.76	144.19	144.82	144.59	2.1717	1.1717	282.8920	187.2383
0.002877	122.22	122.41	122.53	122.39	1.8382	0.8382	291.2916	211.5665

Table S14. Flow time of PAM obtained at the initiator of 0.6% at different diluted concentration.

PAM-0.6% initial concentration (g/cm^3) : 0.01 (142.1 mg/14.21 mL) Constant temperature: 30 °C

$c/g \bullet cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln \eta_r/c$
0.01	221.25	221.41	221.33	221.33	3.3243	2.3243	232.4272	120.1251
0.007397	197.07	197.34	197.90	197.44	2.9654	1.9654	265.6962	146.9496
0.005869	177.68	177.57	177.92	177.72	2.6693	1.6693	284.4070	167.2762
0.004154	151.81	151.41	151.02	151.41	2.2742	1.2742	306.7480	197.7991
0.002888	132.71	132.70	132.43	132.61	1.9918	0.9918	343.4620	238.6160

Table S15. Flow time of PAM obtained at the initiator of 0.8% at

different diluted concentration.

PAM-0.8% initial concentration (g/cm^3) : 0.01 (147.1 mg/14.71 mL)					Constant temperature: 30 °C			
$c/g{\bullet}cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln\eta_r/c$
0.01	253.71	253.76	253.47	253.45	3.8066	2.8066	280.6649	133.6749
0.007463	223.14	223.45	223.71	223.43	3.3559	2.3559	315.6632	162.2235
0.005953	201.89	201.71	201.33	201.64	3.0286	2.0286	340.7640	186.1391
0.004238	177.52	177.16	177.93	177.54	2.6665	1.6665	393.2344	231.4251
0.002959	159.09	159.42	159.49	159.33	2.3931	1.3931	470.7787	294.8787

Table S16. Flow time of PAM obtained at the initiator of 1.0% at different diluted concentration.

PAM-1.0% initial concentration (g/cm^3) : 0.01 (143.8 mg/14.38 mL)					Constant temperature: 30 °C			
$c/g{\bullet}cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln\eta_r/c$
0.01	297.64	297.62	297.17	297.48	4.4680	3.4680	346.7958	149.6932
0.007420	259.15	259.47	259.36	259.33	3.8950	2.8950	390.1557	183.2454
0.005898	235.84	235.14	235.66	235.55	3.5378	2.5378	430.2611	214.2159
0.004183	199.56	199.22	199.07	199.28	2.9931	1.9931	476.5243	262.1112
0.002912	176.22	176.18	176.54	176.31	2.6481	1.6481	565.9616	334.4168

Table S17. Flow time of PAM obtained at the initiator of 1.2% at different diluted concentration.

PAM-1.2% initial concentration (g/cm^3) : 0.01 (142.2 mg/14.22 mL)					Constant temperature: 30 °C			
$c/g{\bullet}cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln\eta_r/c$
0.01	261.21	261.33	261.84	261.46	3.9270	2.9270	292.7005	136.7877
0.007399	232.47	232.55	232.71	232.58	3.4932	2.4932	336.9841	169.0624
0.005871	211.22	211.54	211.6	211.45	3.1759	2.1759	370.6118	196.8258
0.004155	184.41	174.53	174.86	177.93	2.6725	1.6725	402.4759	236.5571
0.002889	162.19	162.34	162.76	162.43	2.4396	1.4396	498.2994	308.6956

Table S18. Flow time of PAM obtained at the initiator of 1.4% at

different diluted concentration.

PAM-1.4% initial concentration (g/cm^3) : 0.01 (148.3 mg/14.83 mL)					Constant temperature: 30 °C			
$c/g\bullet cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln\eta_r/c$
0.01	187.81	187.23	187.19	187.41	2.8148	1.8148	181.4809	103.4894
0.007479	160.41	160.34	160.84	160.53	2.4111	1.4111	188.6838	117.6798
0.005973	144.29	144.54	144.02	144.28	2.1671	1.1671	195.4031	129.4868
0.004258	128.33	128.13	128.67	128.38	1.9282	0.9282	217.9885	154.2019
0.002976	112.45	112.74	112.42	112.54	1.6902	0.6902	231.9287	176.3622

Table S19. Flow time of PAM obtained at the initiator of 1.6% at different diluted concentration.

PAM-1.6% initial concentration (g/cm^3) : 0.01 (149.4 mg/14.94 mL)					Constant temperature: 30 °C			
$c/g\bullet cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln\eta_r/c$
0.01	169.71	169.67	169.02	169.47	2.5453	1.5453	154.5309	93.4252
0.007492	147.42	147.87	147.34	147.54	2.2160	1.2160	162.3002	106.2022
0.005990	136.16	136.07	136.19	136.14	2.0448	1.0448	174.4061	119.4048
0.004276	119.59	119.95	119.87	119.80	1.7994	0.7994	186.9522	137.3856
0.002992	106.72	106.01	106.75	106.49	1.5995	0.5995	200.3882	156.9995

Table S20. Flow time of PAM obtained at the initiator of 1.8% at different diluted concentration.

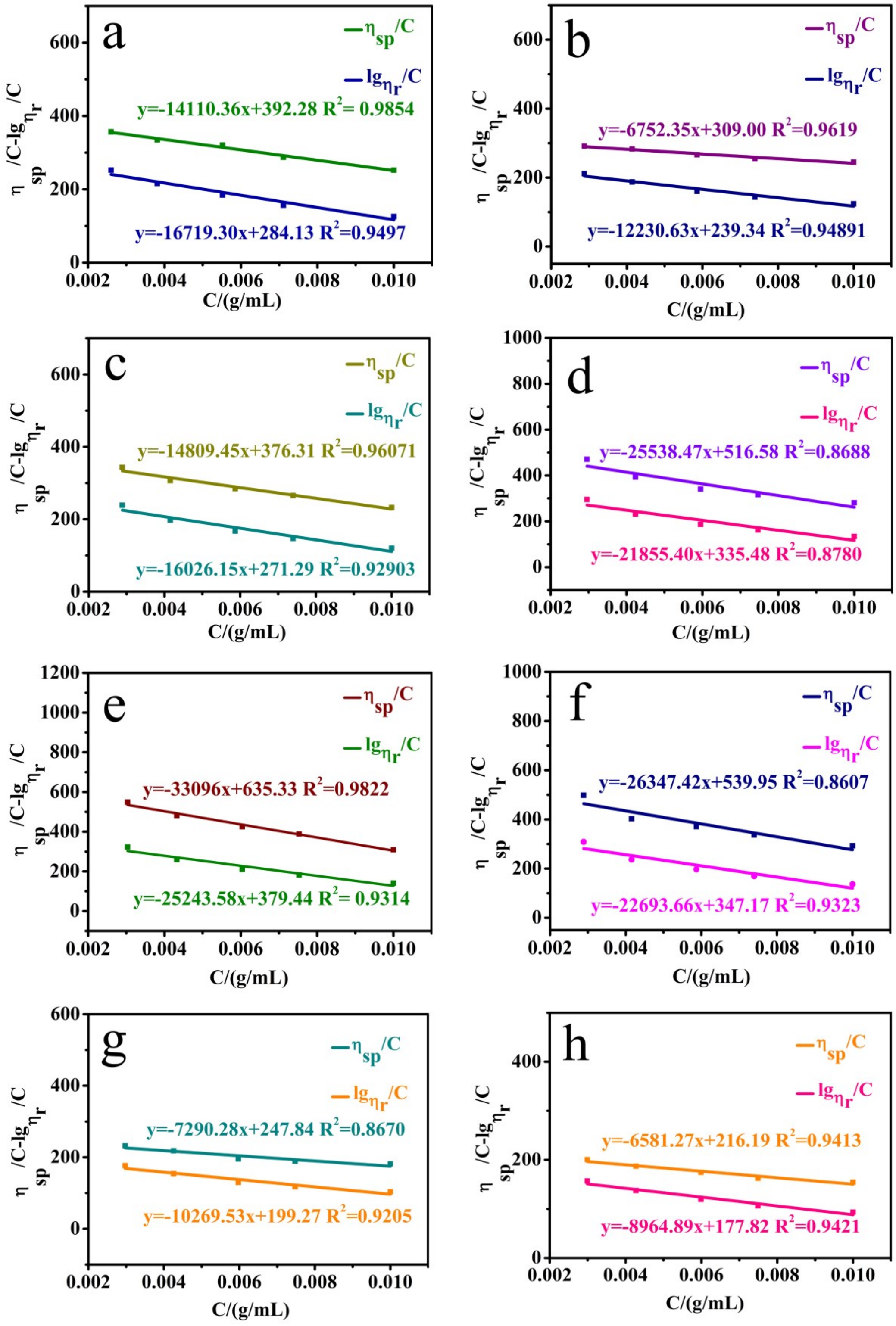
PAM-1.8% initial concentration (g/cm^3) : 0.01 (140.8 mg/14.08 mL)					Constant temperature: 30 °C			
$c/g\bullet cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln\eta_r/c$
0.01	143.16	143.02	143.22	143.13	2.1498	1.1498	114.9795	76.5372
0.007379	126.56	126.55	126.05	126.39	1.8983	0.8983	121.7255	86.8549
0.005847	118.14	118.64	118.45	118.41	1.7785	0.7785	133.1347	98.4662
0.004131	108.35	108.27	108.67	108.43	1.6286	0.6286	152.1418	118.0457
0.002869	101.05	101.52	101.43	101.33	1.5220	0.5220	181.9511	146.4073

Table S21. Flow time of PAM obtained at the initiator of 2.0% at

different diluted concentration.

PAM-2.0% initial concentration (g/cm^3) : 0.01 (140.8 mg/14.08 mL) Constant temperature: 30 °C

$c/g\bullet cm^{-3}$	t_1	t_2	t_3	$\bar{t}$	η_r	η_{sp}	η_{sp}/c	$\ln\eta_r/c$
0.01	156.31	156.23	156.62	156.39	2.3489	1.3489	134.8854	85.3927
0.007303	137.86	137.87	137.62	137.78	2.0694	1.0694	146.4359	99.5845
0.005752	123.37	123.94	123.86	123.72	1.8583	0.8583	149.2140	107.7283
0.004037	109.43	109.37	109.65	109.48	1.6444	0.6444	159.6216	123.2033
0.002789	99.37	99.23	99.46	99.35	1.4922	0.4922	176.4647	143.4971

a
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lgηr/C
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y=-16719.30x+284.13 R²=0.9497
b
ηsp/C
lgηr/C
y=-6752.35x+309.00 R²=0.9619
y=-12230.63x+239.34 R²=0.94891
c
ηsp/C
lgηr/C
y=-14809.45x+376.31 R²=0.96071
y=-16026.15x+271.29 R²=0.92903
d
ηsp/C
lgηr/C
y=-25538.47x+516.58 R²=0.8688
y=-21855.40x+335.48 R²=0.8780
e
ηsp/C
lgηr/C
y=-33096x+635.33 R²=0.9822
y=-25243.58x+379.44 R²= 0.9314
f
ηsp/C
lgηr/C
y=-26347.42x+539.95 R²=0.8607
y=-22693.66x+347.17 R²=0.9323
g
ηsp/C
lgηr/C
y=-7290.28x+247.84 R²=0.8670
y=-10269.53x+199.27 R²=0.9205
h
ηsp/C
lgηr/C
y=-6581.27x+216.19 R²=0.9413
y=-8964.89x+177.82 R²=0.9421
ηsp/C-lgηr/C
C/(g/mL)
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0.004
0.006
0.008
0.010
0
200
400
600
800
1000
1200

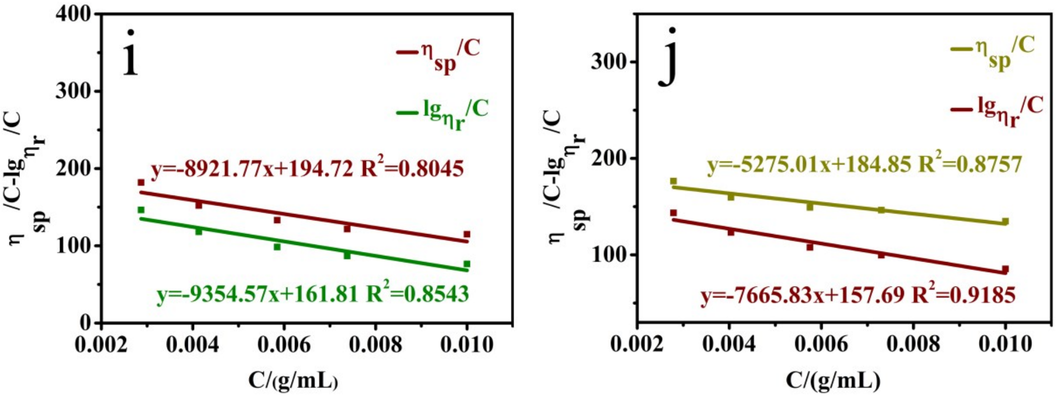

Figure S4. $\frac{\eta_{SP}}{C} - C$ and $\frac{\ln \eta_r}{C} - C$ curves of PAMs obtained in different amount of initiator. (a-j) respectively present the curves of PAMs that obtained in different initiator from 0.2% to 2.0%.

Section S6. Transient Decay Curves of PAM in Slow Precipitation Rate

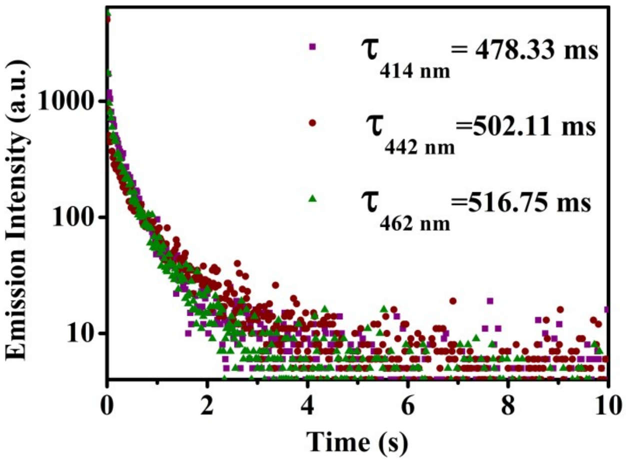

Figure S5. Transient luminescence decays of PAMs obtained in slow precipitation rate.

Section S7. Transient Decay Curves of PAM in Other Methods

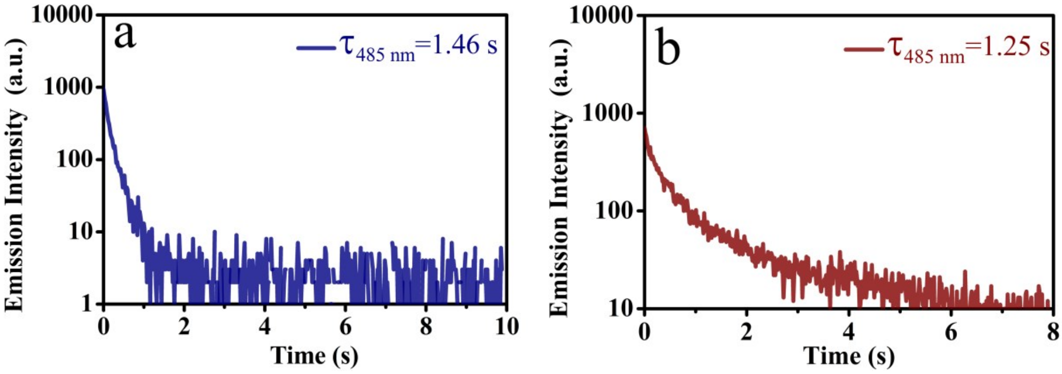

Figure S6. Transient luminescence decays of PAMs obtained in different methods. (a, b) Fitting curves of PAM obtained from hydrothermal heating method and oil bathing method whose triplet lifetime respectively were 1.46 s and 1.25 s.

Section S8. Synthetic Method and Structure of PAM and Copolymers

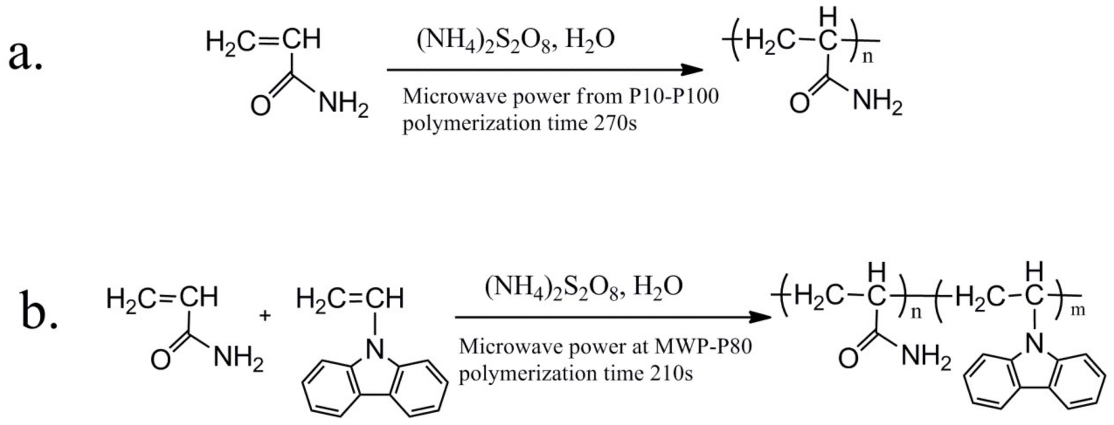

Figure S7. Synthetic methods and polymer Structure assisted by MWP of PAM(a) and copolymers(b).

Section S9. Photophysical Properties of Copolymers at Different Molar Ratios

Table S22 Photophysical properties of Copolymers at molar ratios from 1:12.5 to 1:75

Copolymers at different molar ratios	λ_a (nm)	λ_b (nm)			Φ_P (%)
		λ_1	λ_2	λ_3	
1:12.5	370	414	440	462	27.3
1:25	370	414	440	462	21.5
1:37.5	365	414	440	462	24.6
1:50	375	414	442	462	28.0
1:62.5	376	414	442	462	30.7
1:75	368	414	440	462	27.3

Section S10. Schematic Illustration of Copolymer

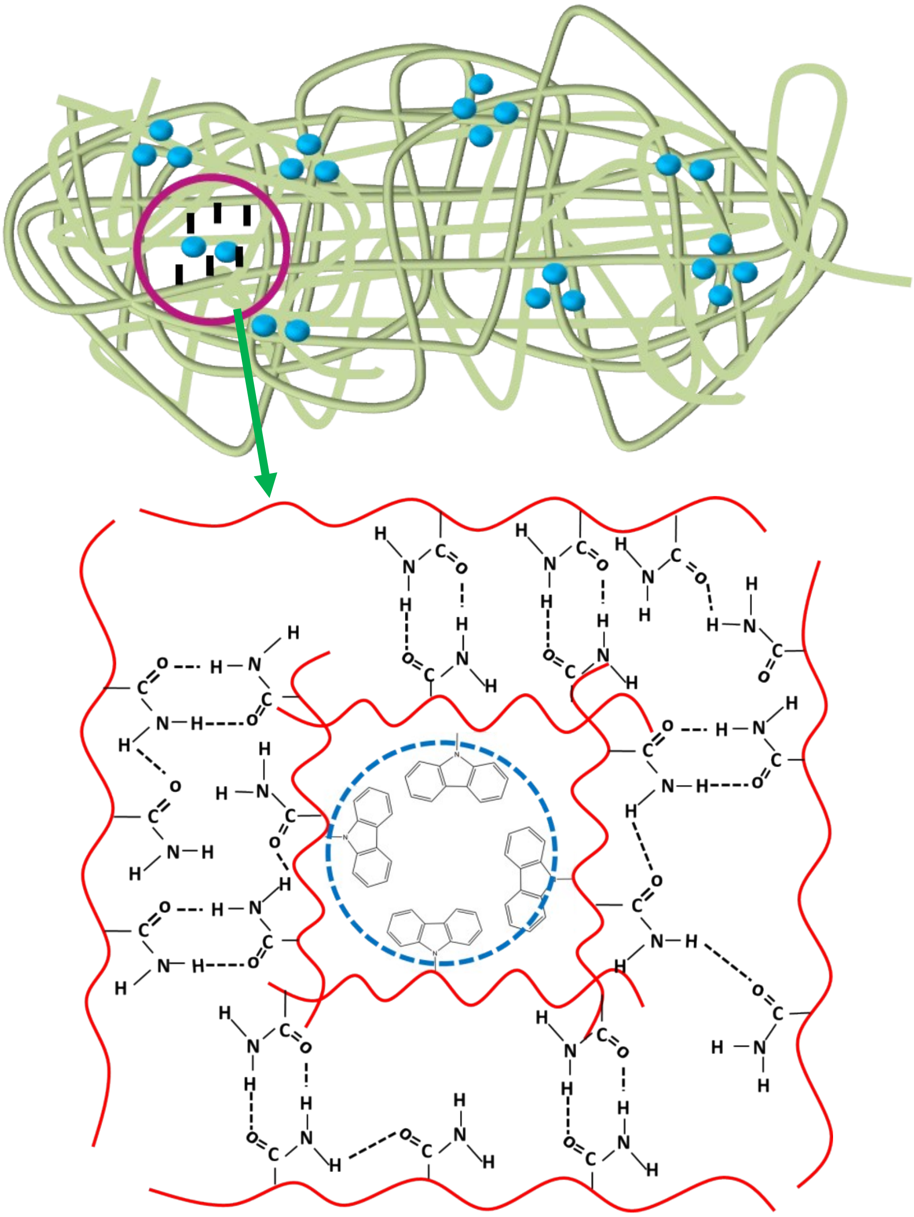

Figure S8. Schematic illustration of copolymer and proposed detailed structure of adjacent polymer chains. Amorphous structure of copolymers (vinyl carbazole (blue aggregates)) and detailed structure between adjacent polymer chains were displayed.