Supporting Information

Multicolor photoluminescence of a hybrid film via dual-emitting strategy of inorganic fluorescent Au nanocluster and organic room-temperature phosphorescent copolymer

Xi Wang, Yun Xu, Xiang Ma and He Tian**

Key Laboratory for Advanced Materials and Institute of Fine Chemicals, School of Chemistry and Molecular Engineering, East China University of Science and Technology, Shanghai 200237, China. E-mail: X. M., maxiang@ecust.edu.cn & tianhe@ecust.edu.cn

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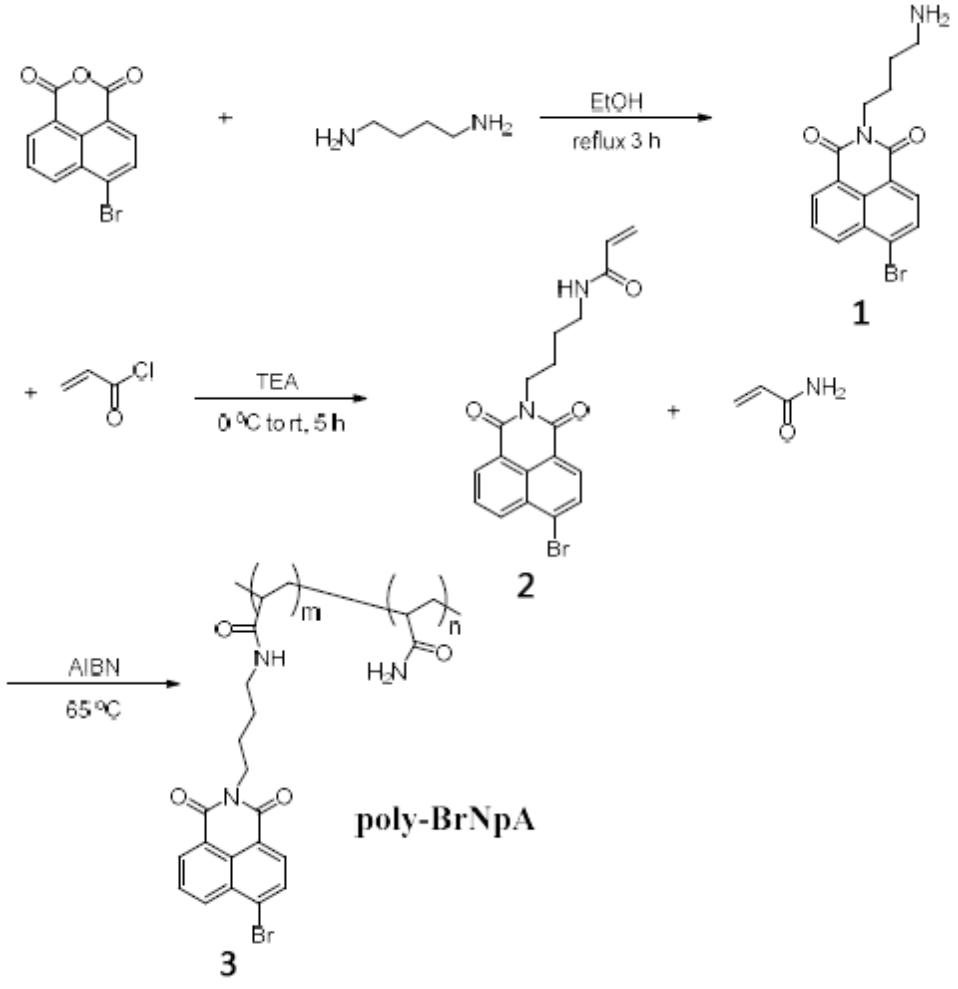

Figure S1. Preparation routine of poly- BrNpA.

Synthesis of 2-(4-aminobutyl)-6-bromo-1H-benzo [de]isoquinoline-1,3(2H)-dione. (1) ^{1}H NMR (400 MHz, D_2O, δ) 8.24 (d, J = 8.5 Hz, 1H, Ar H), 8.19 (d, J = 7.4 Hz, 1H, Ar H), 7.91 (d, J = 7.9 Hz, 1H, Ar H),

7.82 (d, J = 7.9 Hz, 1H, Ar H), 7.64 (t, J = 7.9 Hz, 1H, Ar H), 3.97 (t, J = 6.5 Hz, 2H, CH_2), 3.06 (t, J = 6.9 Hz, 2H, CH_2), 1.81-1.66 (m, 4H, CH_2). ^{13}C NMR (100 MHz, DMSO-d_6, δ) 162.97, 162.92, 132.71, 131.67, 131.43, 131.05, 129.78, 129.25, 128.88, 128.25, 122.67, 121.89, 38.55, 24.71. HRMS (ESI) (m/z): $[M+H]^+$ calcd for $[C_{16}H_{16}BrN_2O_2]^+$, 347.0395; found, 347.0384.

Synthesis of N-(4-(6-bromo-1, 3-dioxo-1 H-benzo [de]isoquinolin-2(3H)-yl) butyl) acrylamide (2) and poly-BrNpA. (3)

(2): ^1H NMR (400 MHz, DMSO-d6, δ) 8.50 (d, J = 7.2 Hz, 1H, Ar H), 8.47 (d, J = 8.4 Hz, 1H, Ar H), 8.26 (d, J = 7.9 Hz, 1H, Ar H), 8.15 (d, J = 7.9 Hz, 1H, Ar H), 8.09 (s, 1H, NH), 7.94 (s, 1H, Ar H), 6.18 (dd, J = 17.1, 10.1 Hz, 1H, CH), 6.03 (dd, J = 17.1, 2.1 Hz, 1H, CH), 5.54 (dd, J = 10.1, 2.1 Hz, 1H, CH), 4.01 (t, J = 7.1 Hz, 2H, CH_2), 3.15 (dd, J = 12.7, 6.6 Hz, 2H, CH_2), 1.70 – 1.59 (m, 2H, CH_2), 1.50 (dd, J = 14.9, 7.1 Hz, 2H, CH_2). ^{13}C NMR (100 MHz, DMSO-d_6, δ) 164.50, 162.89, 162.84, 132.59, 131.84, 131.58, 131.34, 130.96, 129.75, 129.13, 128.78, 128.24, 124.88, 122.70, 121.92, 38.40, 26.73, 25.21. HRMS (ESI) (m/z): $[M+H]^+$ calcd for $[C_{19}H_{18}BrN_2O_3]^+$, 401.0501; found, 401.0505.

(3): ^1H NMR (400 MHz, D_2O, δ) 8.20-6.91 (m, broad, 5H, aromatic protons), 2.38-2.07 (broad, principal chain protons), 1.82-1.40 (broad, principal chain protons). GPC (H_2O): Mn (PDI) = 4.6 kDa (6.23).

Preparation of poly-BrNpA-AuNC@histidine-PAM composite. The composite was prepared by mixing the PAM (0.14g, Mw=400000-800000), polymer **3** (0.001 g, 0.0025 mmol) and AuNC@histidine (0-1400μl, 8.4mg/ml) in DI water, and then stirring for 15 minutes at room temperature. Adopt a centrifuge method to avoid bubbles. Then rest for 1 hour. Such obtained PAM solution are smeared on glass to prepare PAM films by natural withering.

Preparation of poly-BrNpA-AuNC@histidine-PVP composite. The composite was prepared by mixing the PVP (0.14g, Mw=50000-60000), polymer **3** (0.001 g, 0.0025 mmol) and AuNC@histidine (100μl, 8.4mg/ml) in DI water, and then stirring for 15 minutes at room temperature. Adopt a centrifuge method to avoid bubbles. Then rest for 1 hour. Such obtained PVP solution are smeared on glass to prepare PVP films by natural withering.

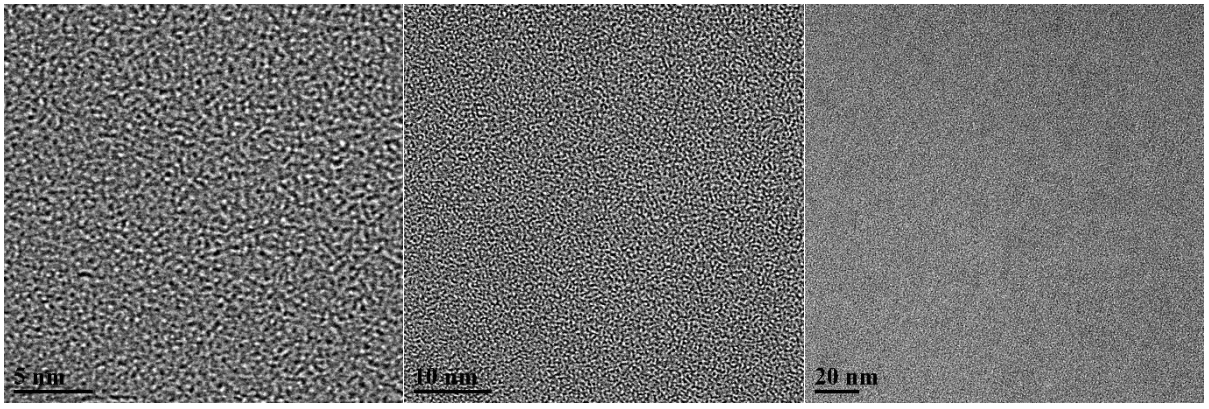

Figure S2. The TEM spectra of AuNC@ histidine.

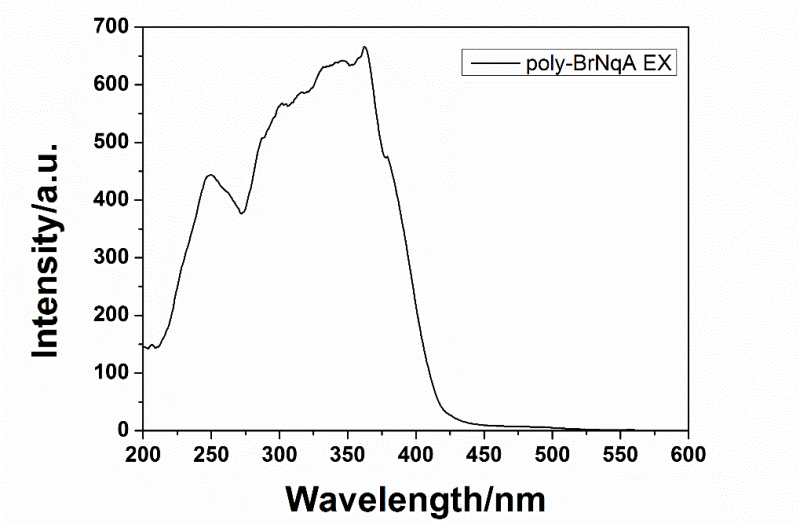

Figure S3. The excitation spectrum of poly-BrNpA, λ_{em} =580nm; (phosphorescence mode; excitation slit = 10 nm; emission slit = 10 nm; Measurements were carried out in the amorphous solid state.)

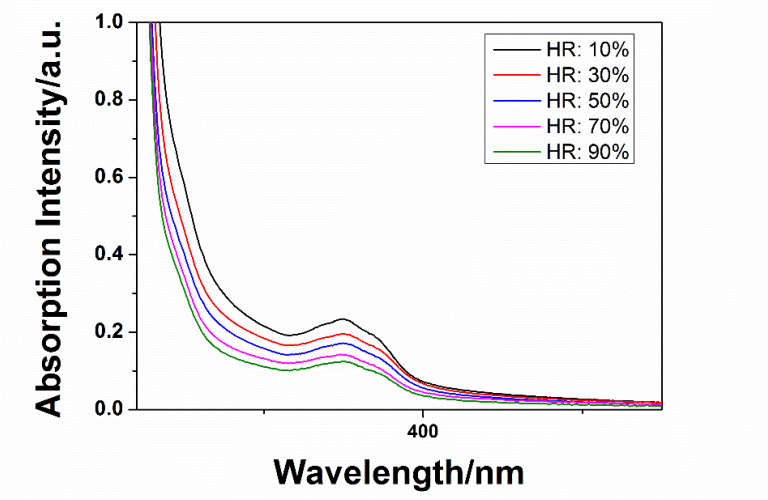

Figure S4. The absorption spectrum of poly-BrNpA/AuNC@histidine in different humidity.

Table S1. The different mole proportions of triadic system, and calculated CIE coordinates from the PL spectra of the PVA composite films shown in Figure 2(c).

No	poly-BrNpA /mg	AuNC@histidine/ μl	PVA/mg	H_2O/ μl	Ratio a'/b' (w/w)	CIE coordinates
1	1	0	140	1400	1:0	(0.4415, 0.3784)
2	1	100	140	1300	1:0.84	(0.3629, 0.3285)
3	1	200	140	1200	1:1.68	(0.331, 0.32)
4	1	300	140	1100	1:2.52	(0.3227, 0.3062)
5	1	400	140	1000	1:3.36	(0.3001, 0.2931)
6	1	500	140	900	1:4.2	(0.2875,0.2975)
7	1	600	140	800	1:5.06	(0.2785,0.2895)
8	1	700	140	700	1:5.88	(0.276, 0.2849)
9	1	800	140	600	1:6.72	(0.274, 0.2837)
10	1	900	140	500	1:7.56	(0.2707, 0.2783)
11	1	1000	140	400	1:8.4	(0.2714, 0.2766)
12	1	1100	140	300	1:9.24	(0.2636, 0.2752)
13	1	1200	140	200	1:10.08	(0.2646, 0.2728)
14	1	1300	140	100	1:10.92	(0.2516, 0.2653)
15	0	1400	140	0	0:11.76	(0.2277, 0.2565)

Table S2. Calculated CIE coordinates from the PL spectra changes under different humidity shown in

Figure 2(e).

No	humidity	CIE coordinates
1	10%	(0.3961, 0.3296)
2	20%	(0.3698, 0.3163)
3	30%	(0.3639, 0.3116)
4	40%	(0.3336, 0.3101)
5	50%	(0.3136, 0.3074)
6	60%	(0.2992, 0.297)
7	70%	(0.2885, 0.2941)
8	80%	(0.2725, 0.2868)
9	90%	(0.2541, 0.2814)

Table S3. Hydrogen bonding between the components.

Polymer	AuNC@ histidine	BrNqA	PAM
PVA	√	√	√
PVP	√		√
PAM	√	√	√

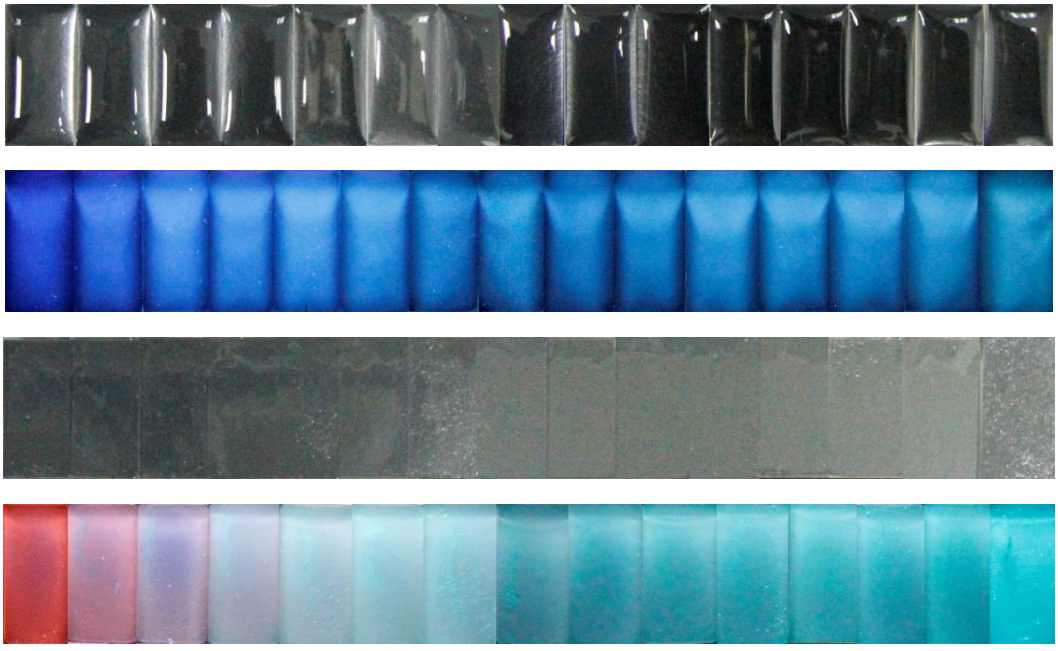

Figure S5. The luminescence photos of dual-emission films of different proportions in PVA, conditions as follows: aqueous solution on the quartz plates under daily light, aqueous solution on the quartz plates

under λ=365 nm UV irradiation, dry film under daily light, dry film under λ=365 nm UV irradiation (from top to down).

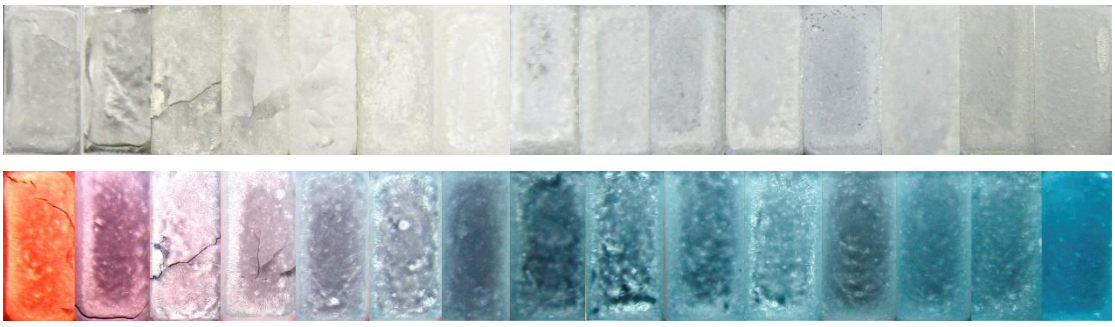

Figure S6. The luminescence photos of dual-emission PAM films of different proportions in dry film under daily light (top) and dry film under λ=365 nm UV irradiation (down)

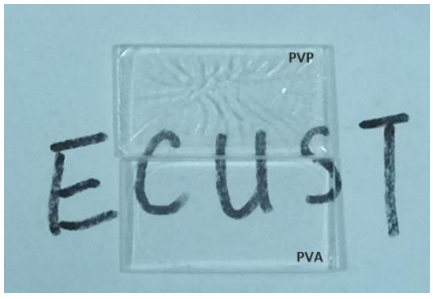

Figure S7. The luminescence photos of dual-emission PVP films in dry film under daily light.