

A Facile Synthesis of 1,3,6,8-Pyrenesulfonic Acid Tetrasodium Salt as Hydrosoluble Fluorescence Ink for Anti-counterfeiting Applications

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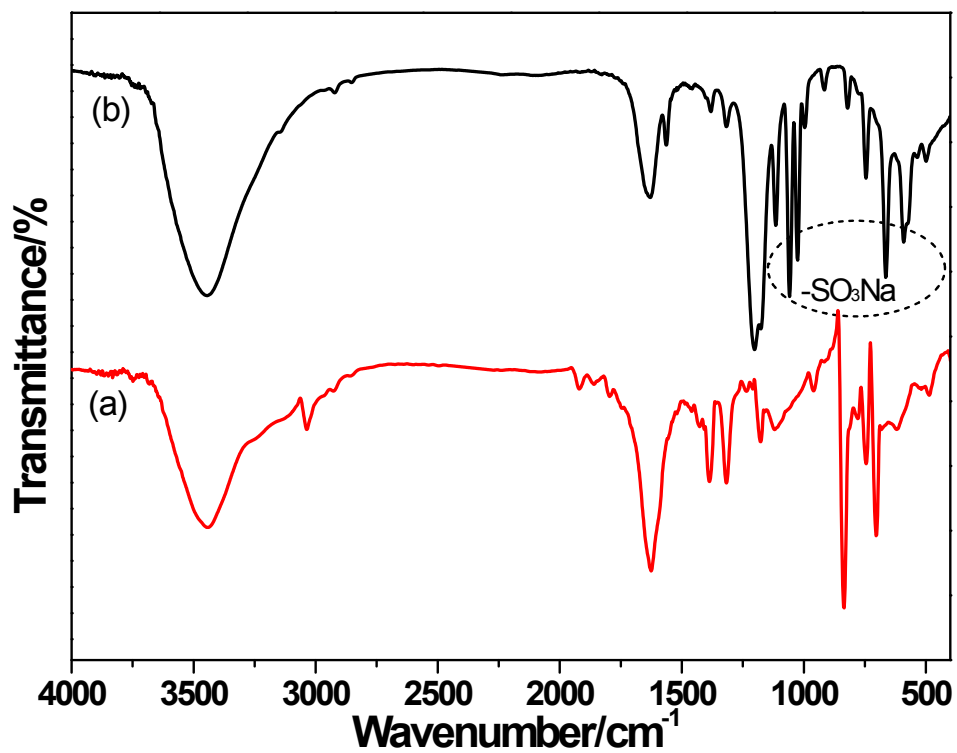


Fig. S1 FT-IR spectra of (a) pyrene and (b) 1,3,6,8-Pyrenesulfonic Acid Tetrasodium Salt (PTSA).

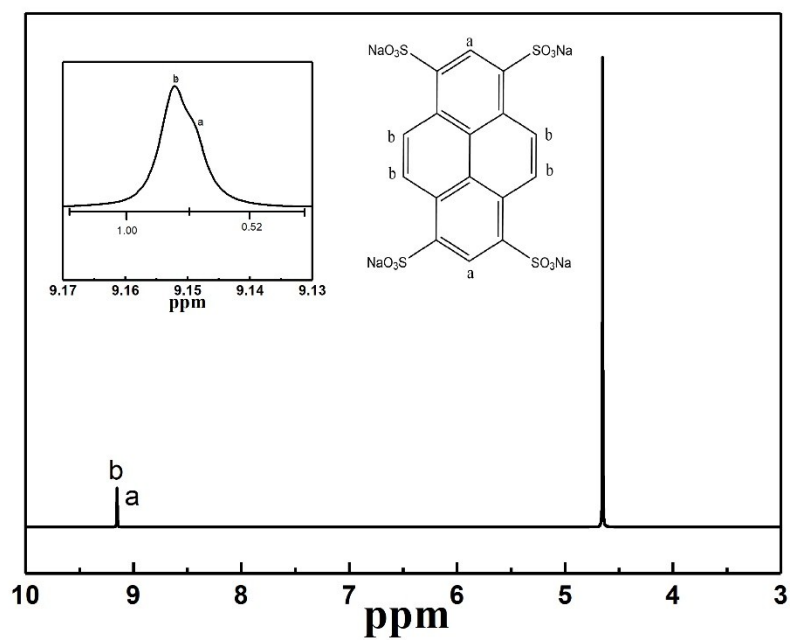


Fig. S2 ^1H NMR spectra of PTSA.

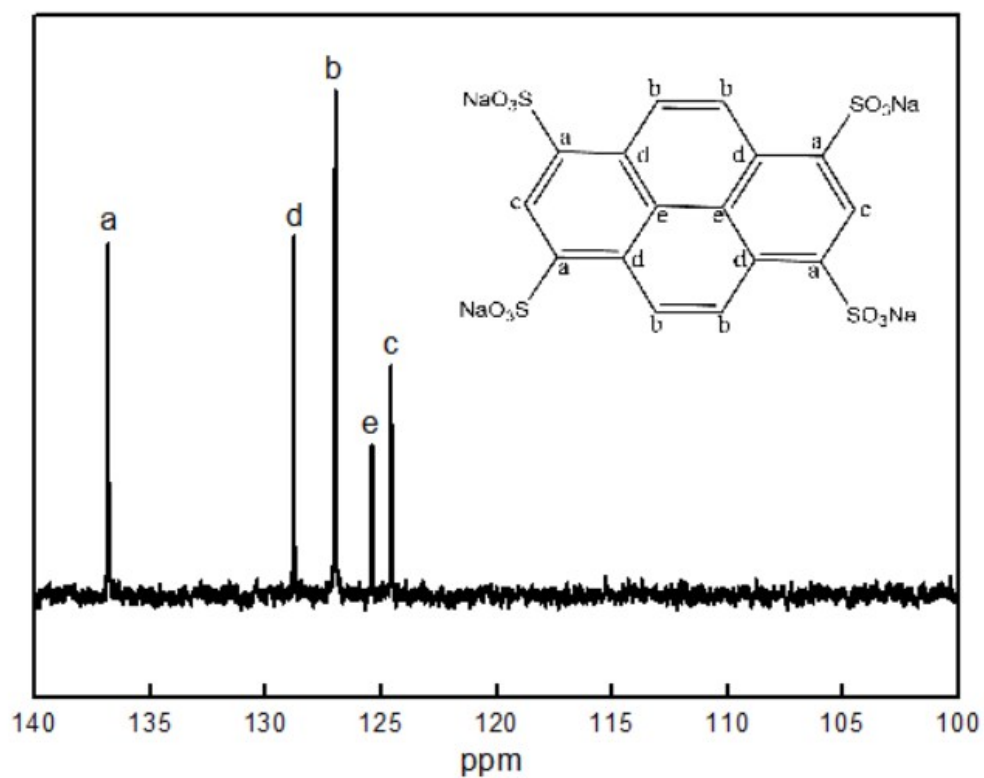


Fig. S3 ^{13}C NMR spectra of PTSA.

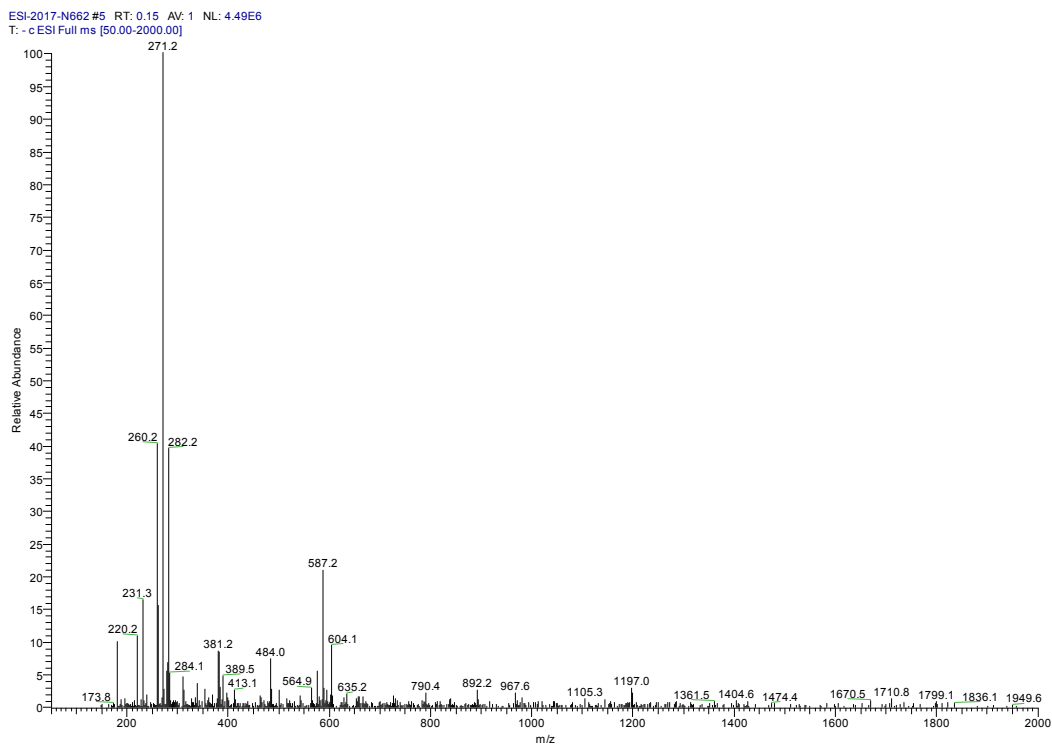


Fig. S4 MS (ESI) spectra of PTSA.

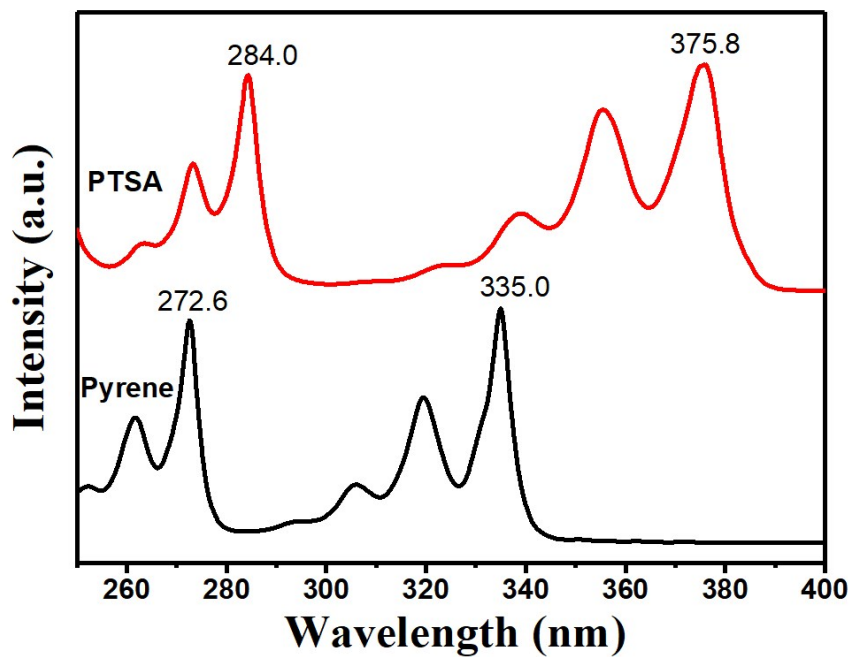


Fig. S5 UV-Vis spectrum of pyrene (dissolved in ethanol) and PTSA (dissolved in H₂O).

Table S1. Viscosity value of red, green and blue inks during printing simulation.

Sample	0.1 s ⁻¹ (before squeegee)	1000 s ⁻¹ (during squeegee)	0.1 s ⁻¹ (after squeegee)	Recovery time(s)
Red Ink	7.4	0.4	7.4	106
Green Ink	7.0	0.4	7.0	45
Blue Ink	7.4	0.4	7.4	47

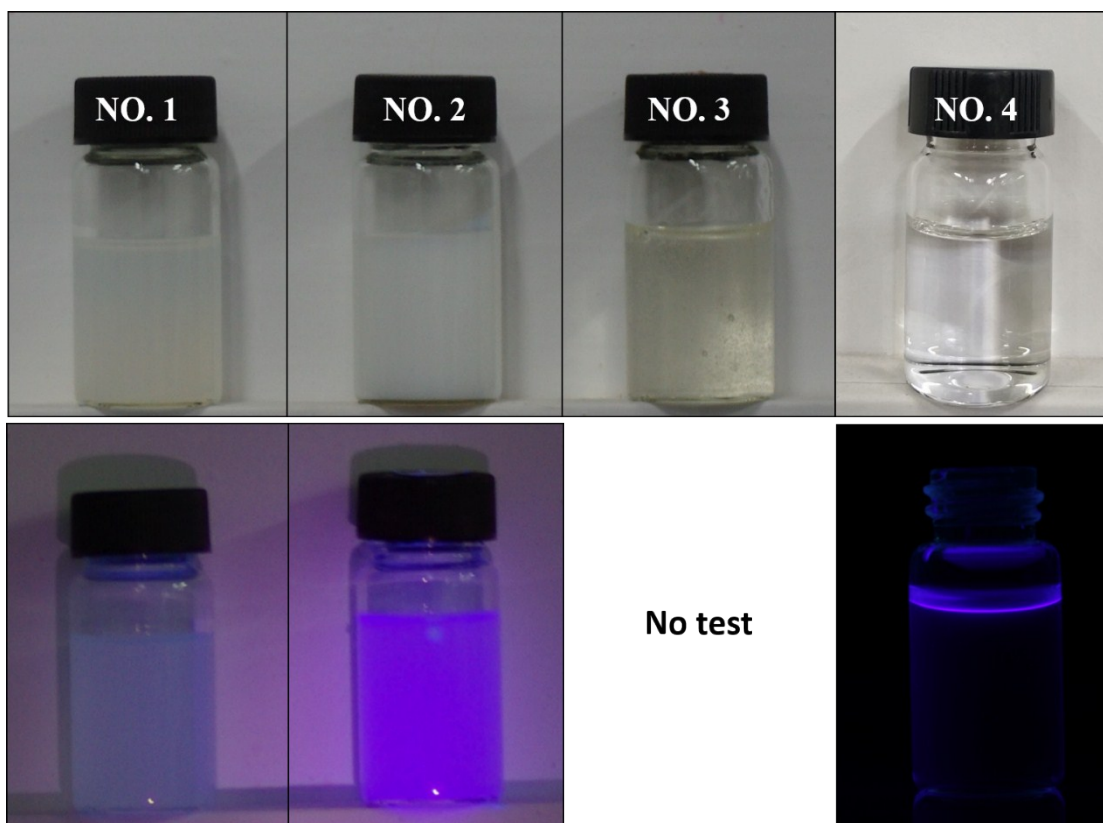


Fig. S6 Images of the PTSA inks with various ink binders before and after being exposed in 365 nm UV light.

Table S2. The composition of the colorless, red, green, and blue inks used for printing.

Inks	PTSA/mg	HEC/mg	Pigment/mg	H ₂ O/mL
Colourless	45	0.15	-	15
Red	300	300	50	10
Green	300	300	50	10
Blue	300	300	50	10

“-” was represented no test.

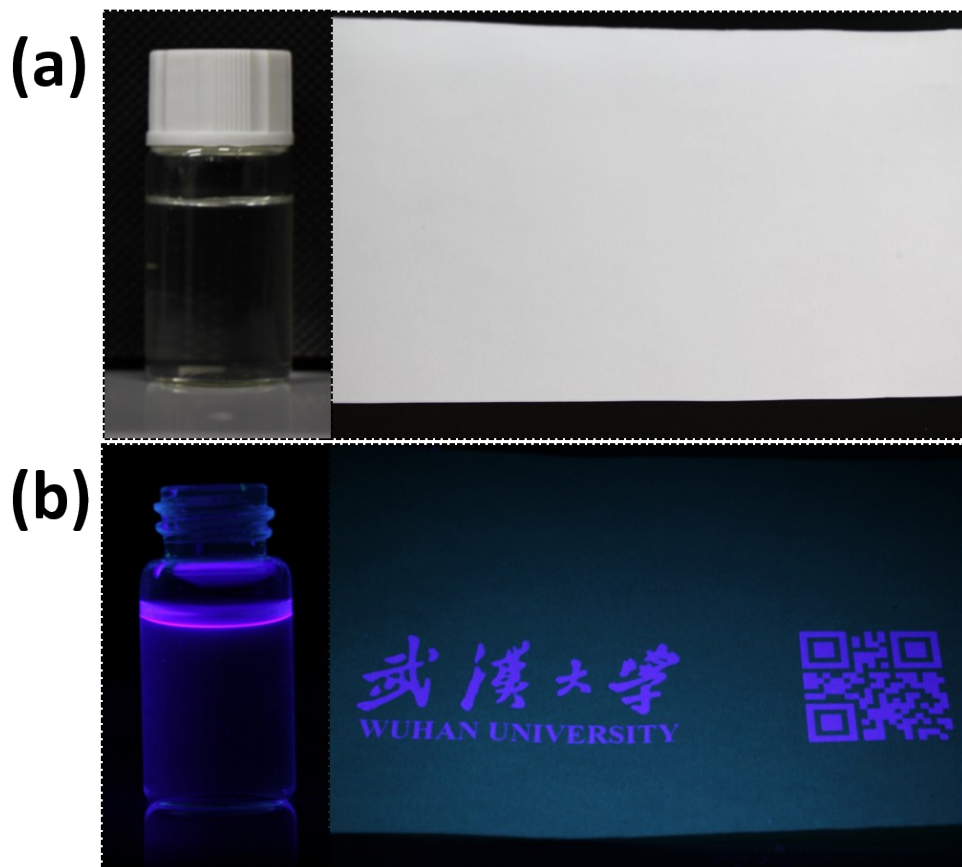


Fig. S7 Stability test of the ink-jet printing inks after being stored for 30 days (a) under white light, (b) under 365 nm UV light.

Table S3. Optical density and color changes (L^* , a^* , b^* , ΔE^*) based on paper substrate before and after being exposed in 365 nm UV light.

Sample	L^*	a^*	b^*	ΔE^*	Optical density
Red ink	31.51	8.04	0.18	0	1.23
Red ink-UV	30.65	9.96	-26.65	26.91	-
Green ink	42.68	-18.96	-26.94	0	1.51
Green ink-UV	41.12	-1.01	-37.87	21.07	-
Blue ink	53.41	-20.72	10.91	0	0.74
Blue ink-UV	49.74	-18.91	-42.34	53.41	-
Colourless ink	-	-	-	-	-
Colourless ink-UV	30.35	6.14	-20.02	-	-

“-” was represented no test.