Supporting Information (SI)

Development of a Waste-Derived Lignin-Porphyrin Bio-Polymer with Enhanced Photoluminescence at High Water Fraction with Wide pH Range and Heavy Metal Sensitivity Investigations

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Fig. S1 ³¹P NMR spectrum of AL

Fig. S2 ¹H and ¹³C NMR spectrum of CTPP and AL-CTPP

Fig. S3 Dynamic light scattering (DLS) results showing the variation in particle size diameter with increasing water content of AL-CTPP

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Fig. S8 PL spectra of AL-CTPP with pH 3–4, $f_w = 0.2-0.5$

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Fig. S23 UV-vis spectrum and linear plot of AL-CTPP with various concentration of ZnCl₂

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Fig. S26 UV-vis spectrum and linear plot of AL-CTPP with various concentration of MnCl₂

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Table S1 Emission lifetimes (nanosecond) of CTPP and AL-CTPP in various water fraction and pH after excitation at 375 nm and monitoring at 652 nm

Table S2 Emission lifetimes (nanosecond) of CTPP and AL-CTPP in various water fraction and pH after excitation at 375 nm and monitoring at 652 nm



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Fig. S14 PL spectra of AL-CTPP at $f_w = 0.80$, pH5, varying concentration from 4.375–70.0µg/mL



Fig. S15 PL spectra of AL-CTPP at $f_w = 0.80$, pH6, varying concentration from $4.375-70.0 \mu g/mL$



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Fig. S26 UV-vis spectrum and linear plot of AL-CTPP with various concentration of CuCl₂

CTDD	Fw =	Fw=	Fw =	Fw =	Fw =	Fw =	Fw=	Fw =
CIPP	0.95	0.80	0.70	0.60	0.55	0.50	0.40	0.20
pH3	N/D	3.67	5.83	11.30	11.37	11.13	11.14	10.41
		0.24	0.36	0.58	0.63			
pH4	N/D	3.94	7.93	10.25	11.26	11.18	10.91	10.50
		0.31	0.38	0.65				
pH5	N/D	4.78	8.51	10.90	11.32	11.20	11.02	10.50
		0.33	0.38					
pH6	N/D	5.49	10.88	11.29	11.30	11.29	10.97	10.53
		0.39	0.45					
pH7	N/D	5.49	11.35	11.20	11.39	11.21	10.96	10.57
		0.40	0.61					

Table S2 Emission lifetimes (nanosecond) of CTPP and AL-CTPP in various water fraction and pH after excitation at 375 nm and monitoring at 652 nm

AL-	Fw =	Fw =	Fw =	Fw =	Fw =	Fw =	Fw=	Fw =
CTPP	0.95	0.80	0.70	0.60	0.55	0.50	0.40	0.20
pH3	2.14	6.32	6.36	9.99	11.31	11.38	10.49	10.39
	0.82	1.25	1.38	1.31	1.80	2.00		
pH4	2.19	6.79	7.36	10.02	11.15	11.79	10.78	10.46
	1.01	1.95	1.69	1.96	2.55	6.49		
pH5	2.68	6.72	7.78	10.32	11.24	12.12	10.99	10.47
	1.15	1.97	1.49	2.26	2.66	7.52		
pH6	3.18	7.14	8.08	11.25	12.06	12.19	10.99	10.59
	1.26	2.06	1.96	2.82	5.36	7.53		
pH7	3.54	7.81	8.27	11.10	12.17	12.93	11.03	10.61
	1.35	2.17	2.12	2.97	6.32	8.18		

	4.375 μg/mL Fw	17.5 μg/mL Fw	35.0 µg/mL Fw	70.0 µg/mL Fw
	= 0.8	= 0.8	= 0.8	= 0.8
pH3	6.37	6.93	6.32	2.72
	1.60	1.40	1.25	0.98
pH4	7.33	6.85	6.79	3.17
	2.17	1.99	1.95	1.09
pH5	7.89	6.74	6.72	3.18
	2.28	2.07	1.97	1.23
pH6	8.20	7.45	7.14	3.25
	2.34	2.11	2.06	1.26
pH7	9.96	8.69	7.81	4.90
	2.38	2.29	2.17	1.39

Table S2 Emission lifetimes (nanosecond) of AL-CTPP in 0.8 and 0.95 water fraction with various concentration and pH after excitation at 375 nm and monitoring at 652 nm

	4.375 μg/mL Fw	17.5 μg/mL Fw	35.0 μg/mL Fw	70.0 μg/mL Fw
	= 0.95	= 0.95	= 0.95	= 0.95
pH3	5.29	2.68	2.14	1.66
	1.09	0.93	0.82	0.66
pH4	4.46	2.80	2.19	1.70
	1.55	1.15	1.01	0.82
pH5	5.79	2.99	2.68	2.03
	2.38	1.20	1.15	0.92
pH6	6.86	3.87	3.18	2.05
	2.36	1.29	1.26	0.93
pH7	6.86	5.41	3.54	2.06
	2.71	1.65	1.35	0.94