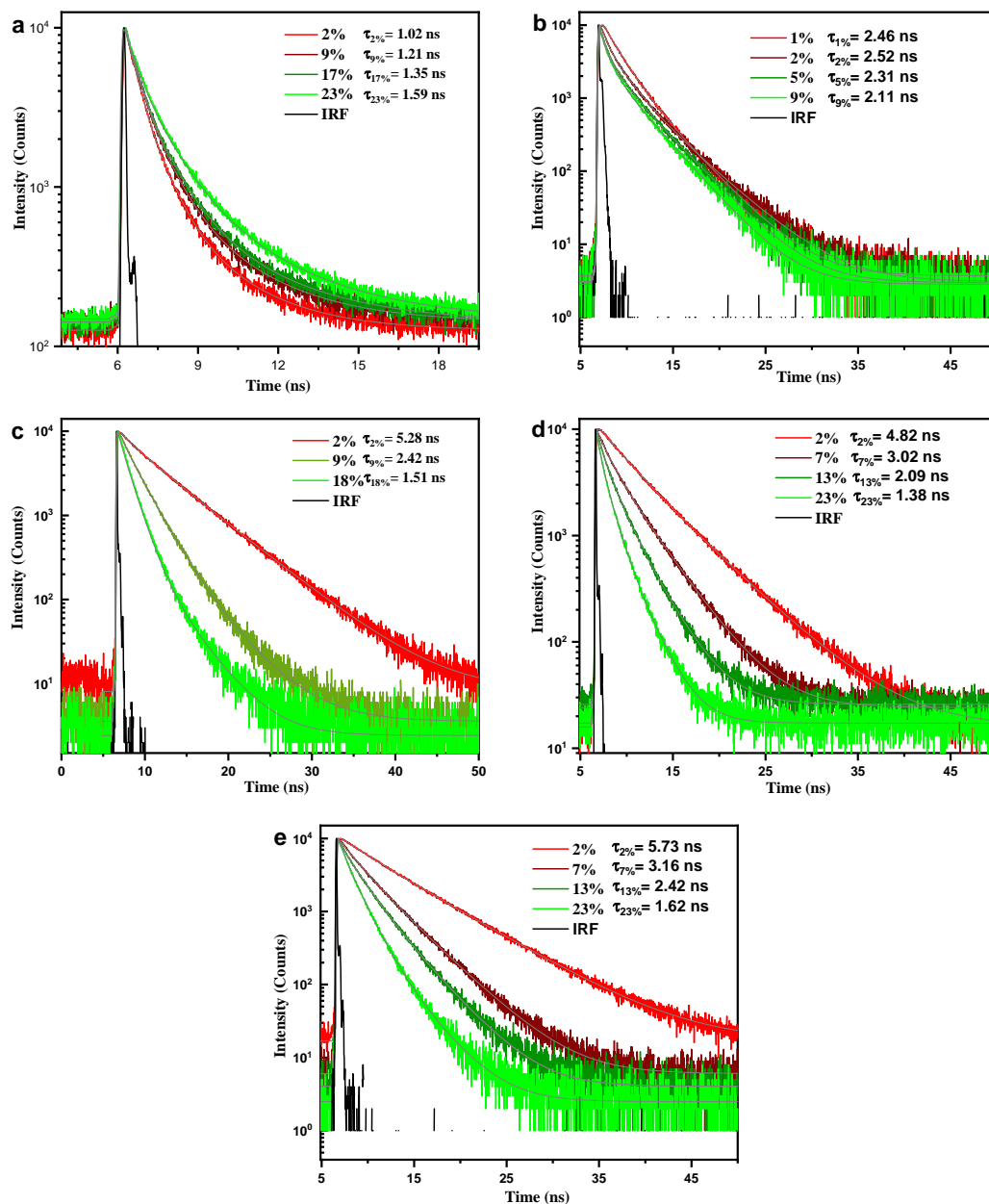
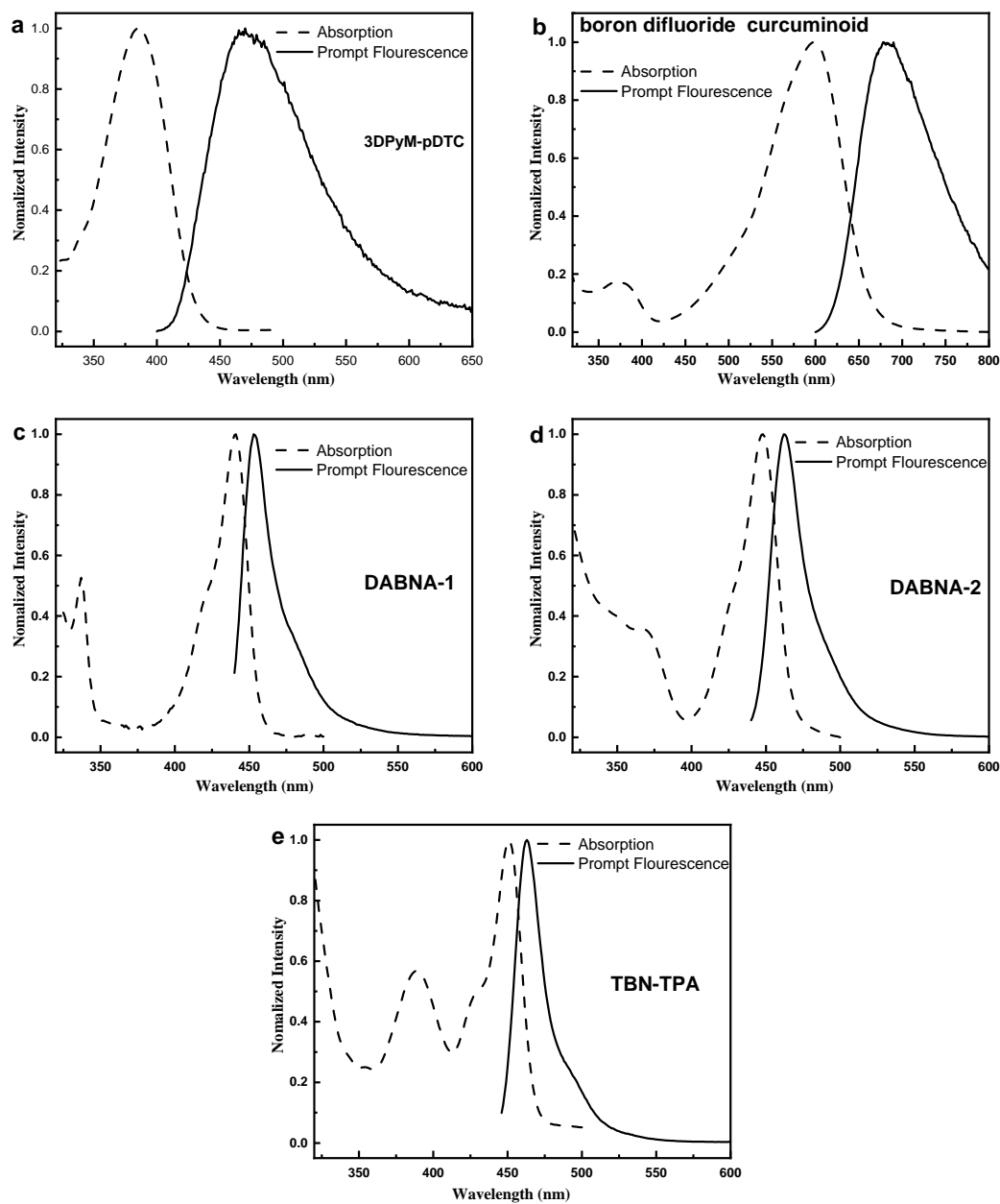


Extended Data Fig. 1|Molecular structure of the synthesized molecules used in this study.



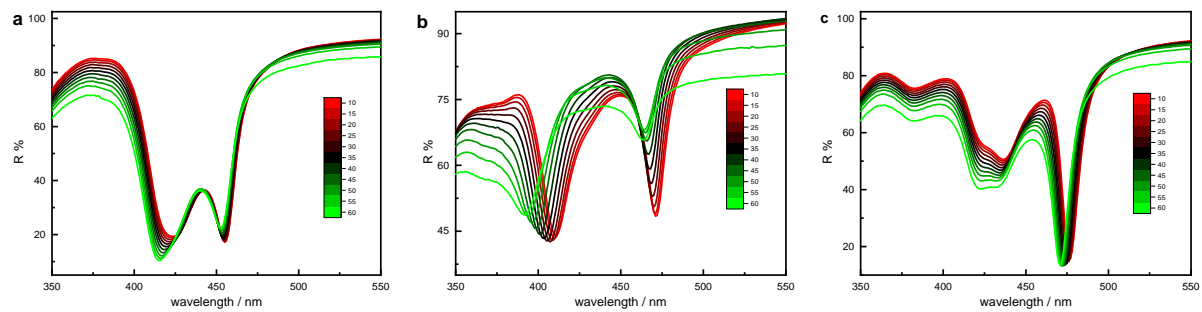
Extended Data Fig. 2| Time resolved photoluminescence of the five molecules. a-e, Prompt emission decays of 3DPyM-pDTC (a), boron difluoride

curcuminoid derivative (b), DABNA-1 (c), DABNA (d) and TBN-TPA (e) at different concentrations.

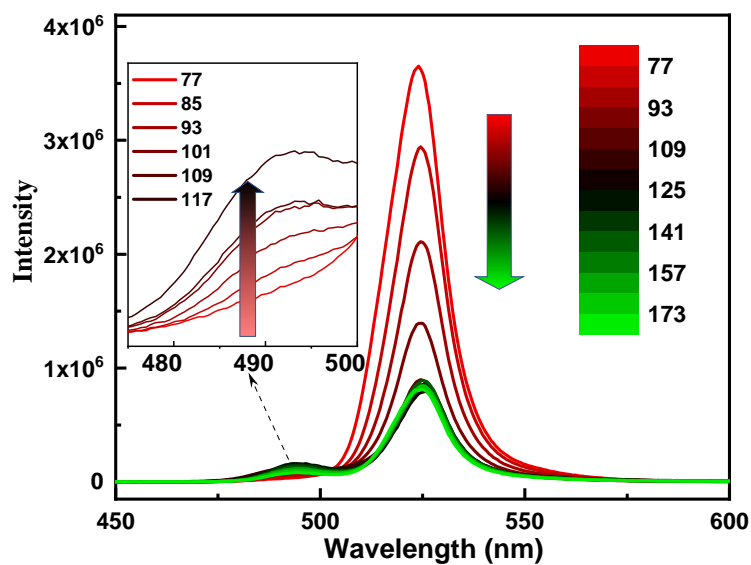


Extended Data Fig.3| Steady state photoluminescence of the five molecules.
a-e, Absorption (dashed black) and prompt emission (solid black) at room

temperature of 3DPyM-pDTC (a), boron difluoride curcuminoid derivative (b), DABNA-1 (c), DABNA (d) and TBN-TPA (e) in organic films.

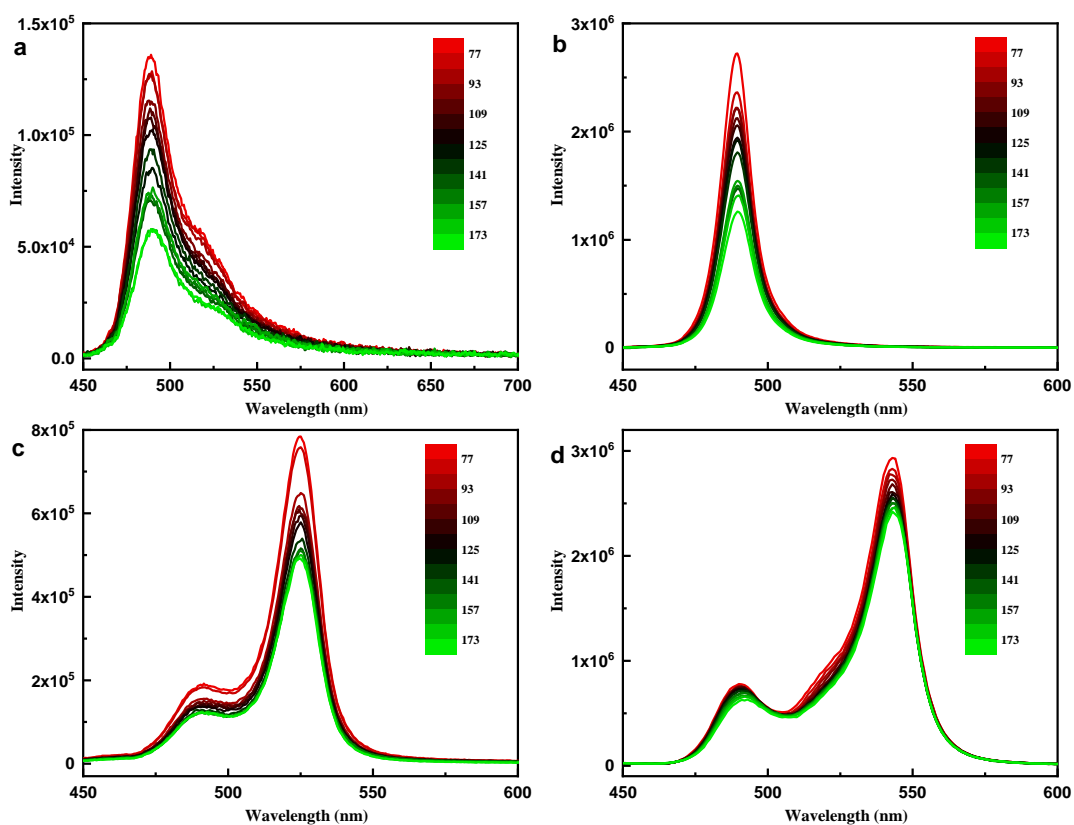


Extended Data Fig. 4| Angle resolved reflectance of cavities. Angle dependent reflectance (TE mode) of cavities containing DABNA-1 (a), DABNA-2 (b) and TBN-TPA (c) films.

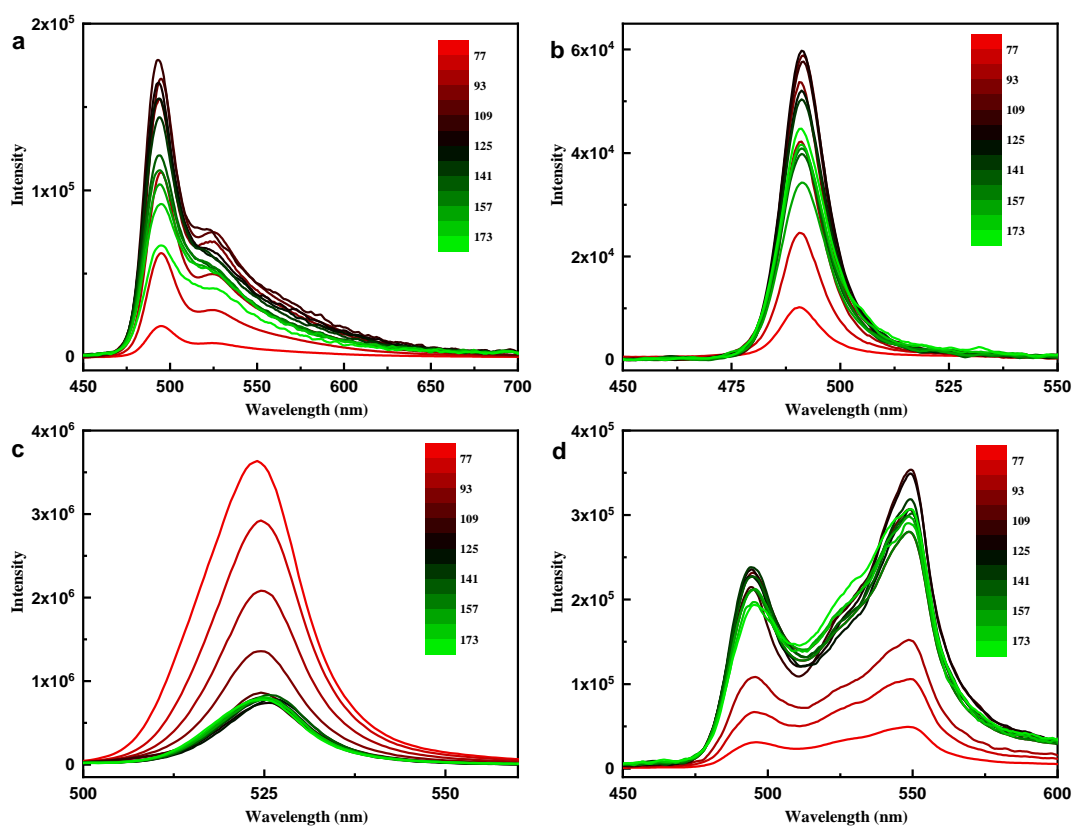


Extended Data Fig. 5|Highlighting the variation between coupled and uncoupled delayed emission. Temperature-dependent (gate delay 100 ns) emission from Cavity2. The insert shows the emission from uncoupled

molecules in Cavity2. As the temperature rises, polariton emission diminishes but uncoupled emission is enhanced.



Extended Data Fig. 6 | Integrated intensity of prompt emission (I_{PF}).
 Temperature dependent prompt emission of a neat film (a), Cavity1 (b), Cavity2 (c) and Cavity3 (d).



Extended Data Fig. 7 | Integrated intensity of delayed emission (I_{DF}). a-d, Deconvoluted temperature dependent delayed emission of neat film (a), Cavity1 (b), Cavity2 (c) and Cavity3 (d); In order to get I_{DF} (which should only contain

fluorescence and P⁺ emission), shown spectra are deconvoluted with the phosphorescence from a neat film.

Extended Data Table 1|The energy levels, Rabi splitting and energy gap of different molecules inside cavities.

	DABNA-1	DABNA-2	TBN-TPA
E_x (eV)	2.834	2.786	2.744
E_c (eV)	2.818	2.793	2.755
$\square\Omega_R$ (meV)	247	400	311
ΔE_{ST} (meV)	180	140	140

The values stated is the result of a fit of the data in Supplementary Figure 3 by the coupled oscillator model (see Methods).

Extended Data Table 2|The relative rate change in DABNA-2 neat film and Cavities1-3 at different temperatures.

T / K	Neat film		Cavity1		Cavity2		Cavity3	
	k_f/k_{77k}	$\ln(k_f/k_{77k})$	k_f/k_{77k}	$\ln(k_f/k_{77k})$	k_f/k_{77k}	$\ln(k_f/k_{77k})$	k_f/k_{77k}	$\ln(k_f/k_{77k})$
77	1	0	1	0	1	0	1	0
85	4.69	1.55	3.07	1.12	0.98	-0.08	4.89	1.58
93	12.2	2.51	8.43	2.13	0.89	-0.11	14.4	2.66
101	43.6	3.77	22.0	3.09	0.78	-0.25	50.6	3.92
109	100	4.61	62.8	4.14	0.76	-0.28	110	4.71
117	303	5.71	138	4.93	0.93	-0.07	152.6	5.03
125	869	6.77	215	5.37	1.02	0.02	477	6.17
133	1584	7.37	329	5.79	1.22	0.20	1177	7.07
141	2744	7.92	759	6.63	1.35	0.30	2201	7.70
149	4950	8.51	2214	7.70	1.70	0.53	3671	8.21
157	9147	9.12	3289	8.10	2.20	0.79	6757	8.82
165	13449	9.51	3641	8.20	4.17	1.43	9376	9.14
173	16076	9.69	5220	8.56	12.68	2.54	15595	9.65
181	21853	9.99	7103	8.87	23.54	3.16	21530	9.98