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Supplementary materials

Effects of Side Groups on Kinetics of Charge Carrier Recombination in Dye Molecule-Doped Multilayer Organic Light-Emitting Diodes

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Experimental results for dye molecule-doped multilayer OLEDs with other molecular systems (2 and 3) are listed as below by use of steady state and transient EL characterization to support the conclusion and discussion in the main text.

Table s1. List of small molecules with different side groups

Sample	R_1	R_2	Melt point (℃)
2a	n-Bu	H	146.0-147.0
2b	n-Bu	CH_3	170.0-171.0
2c	n-Bu	F	145.5-146.5
2d	n-Hexyl	CF_3	166.0-167.0
3a	t-Bu	p-$COOCH_3$	222.5-224
3b	t-Bu	p-C_6H_6	264-265
3c	H	2,5-OCH_3	140.5-141.5

Table s2. List of device performance and related parameters

Sample	Slope (S) (10^6μs)	Intercept (A)	γ ($10^{-12}cm^3s^{-1}$)	EL efficiency (cd/A)
2a	2.22	1.66	7.80 ± 0.05	2.6
2b	2.08	2.09	4.53 ± 0.05	1.9
2c	1.97	2.16	3.63 ± 0.05	1.2
2d	2.67	3.04	3.36 ± 0.05	1.0
3a	2.76	2.40	6.34 ± 0.05	1.4
3b	2.04	2.43	3.39 ± 0.05	1.2
3c	3.42	4.71	2.54 ± 0.05	0.8

* The unit is 10^6 $(cm^3/s)^{1/2}$ for S, and $(cm^3s)^{1/2}$ for A.

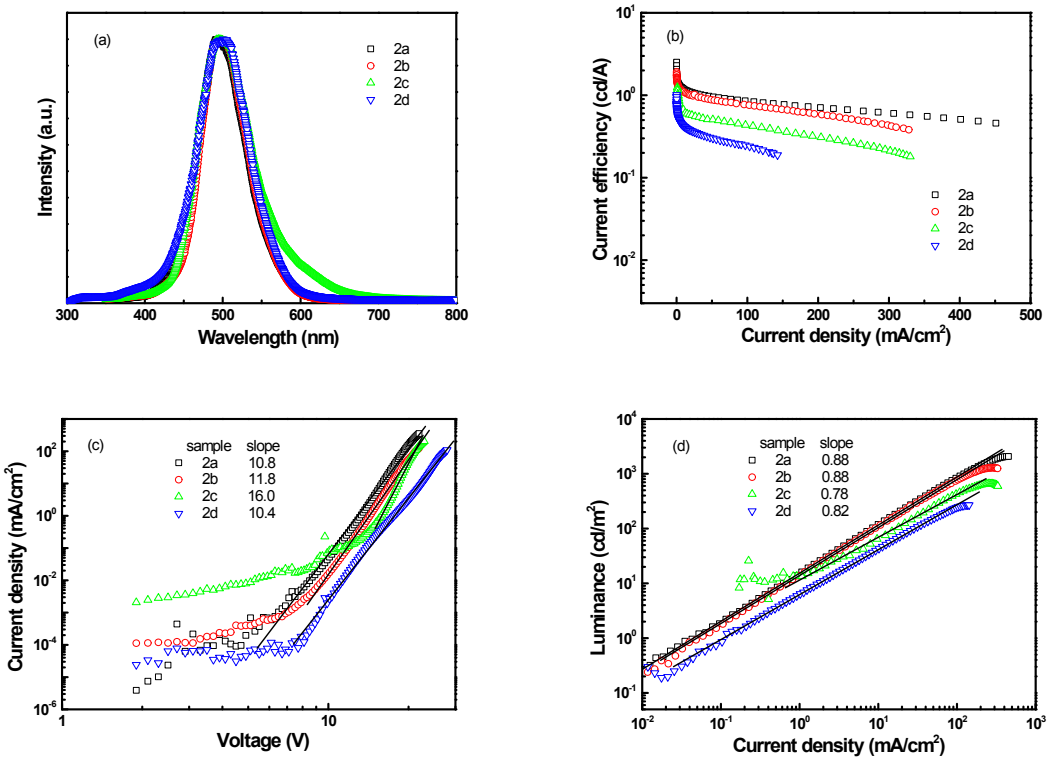

Figure s1. Device performance for multilayer OLEDs with molecule 2 doping. (a) EL spectra, (b) Current efficiency-current density, (a) Current density-voltage and (b) Luminance-current density

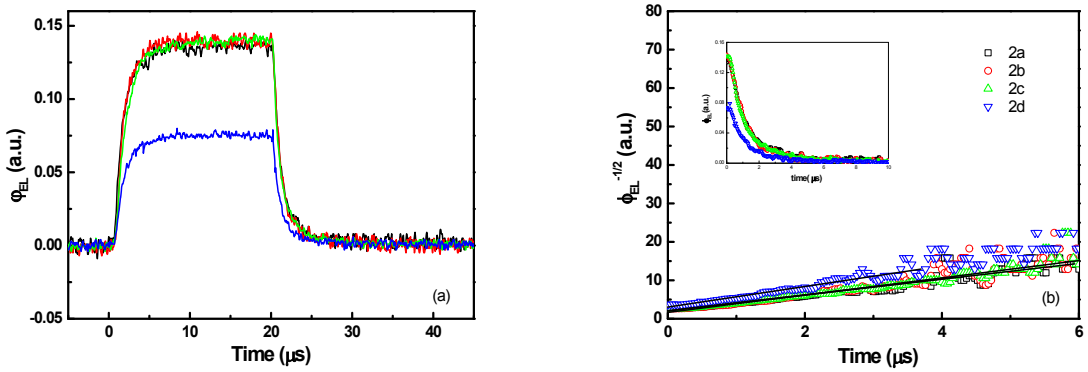

Figure s2. Transient EL characterization for multilayer OLEDs with molecule 2 doping. (a) Transient EL intensity-time and (b) comparison of the transient EL decay in dye molecule-doped OLEDs at the same equilibrium current density of 220 mA/cm² plotted in $(\varphi_{EL})^{-1/2}$ versus time scale. The $\varphi_{EL}(t)$ decay curves are shown in the inserted. Here t=0 corresponds to the voltage fall of the pulse.

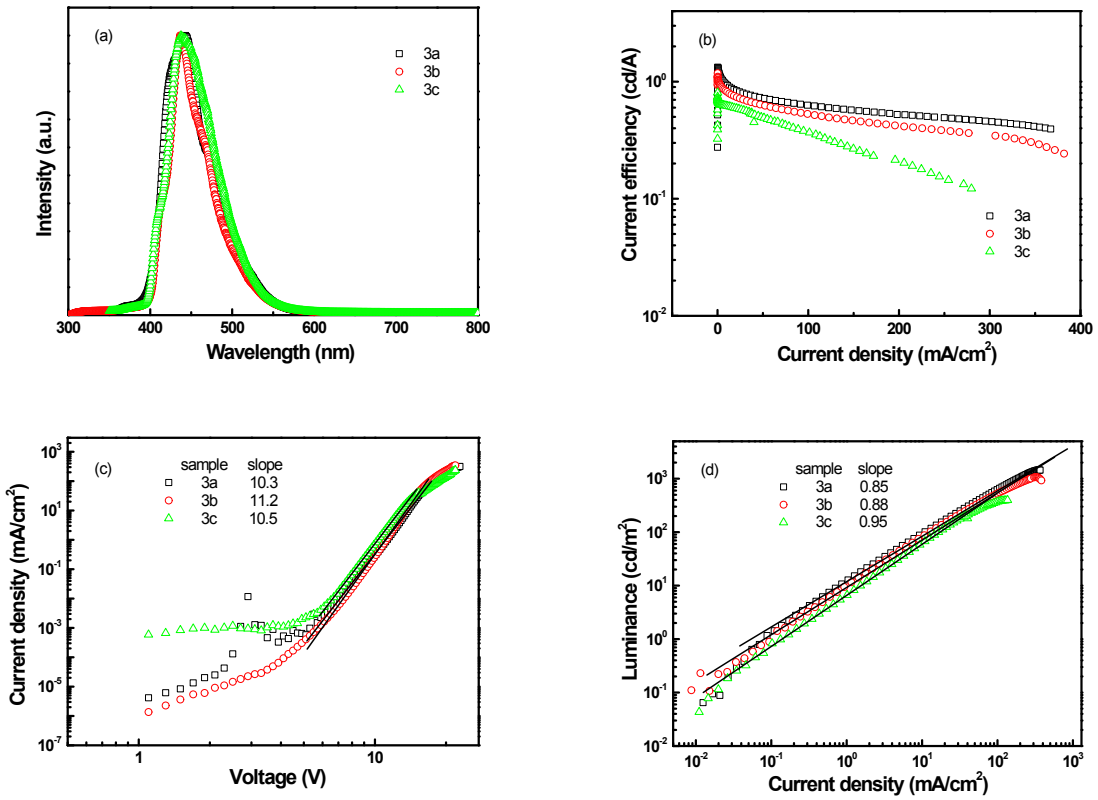

Figure s3. Device performance for multilayer OLEDs with molecule 3 doping. (a) EL spectra, (b) Current efficiency-current density, (a) Current density-voltage and (b) Luminance-current density

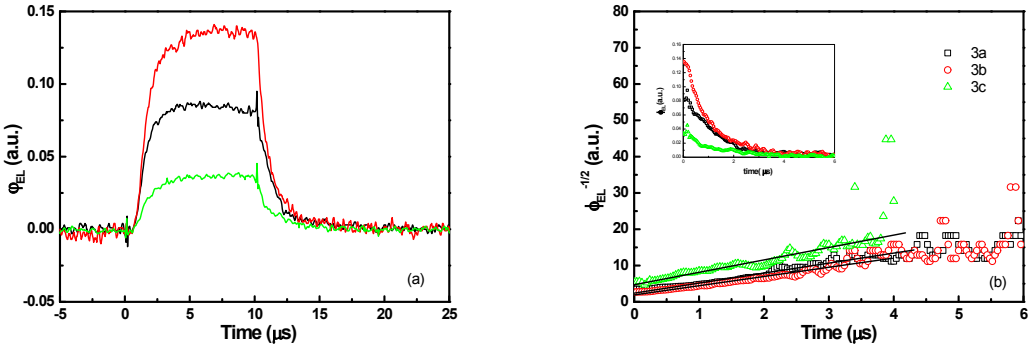

Figure s4. Transient EL characterization for multilayer OLEDs with molecule 3 doping. (a) Transient EL intensity-time and (b) comparison of the transient EL decay in dye molecule-doped OLEDs at the same equilibrium current density of 200 mA/cm² plotted in $(\varphi_{EL})^{-1/2}$ versus time scale. The $\varphi_{EL}(t)$ decay curves are shown in the inserted. Here t=0 corresponds to the voltage fall of the pulse.