Supporting Information

Synthesis of dyes CC101-CC103

Compounds **1, 2, 3, 5a, 5b** and **5c** were synthesized following the literatures.[1,2,3]

(E)-ethyl 2-cyano-2-(2-methyl-4H-chromen-4-ylidene)acetate (4).

Under N_2 atmosphere, a mixture of **3** (13.1 g, 81.9 mmol), ethyl 2-cyanoacetate (11.3 g, 100 mmol), ammonium acetate (1.54 g), acetic acid (6 mL) was refluxed in toluene (50 mL) for 18 h. Then water was added into the reaction mixture and the mixture was extracted with CH_2Cl_2. The organic layer was removed by rotary evaporation. The residue was purified by column chromatography on silica gel to give **3** as yellow liquid (12.9 g, 62%). ^{1}H-NMR (400 MHz, Acetone-d$_6$) δ 8.07 (d, *J* = 7.9 Hz, 1H), 7.75 (t, *J* = 8.7 Hz, 1H), 7.52 (d, *J* = 8.4 Hz, 1H), 7.48 – 7.37 (t, *J* = 8.1 Hz, 1H), 6.15 (s, 1H), 4.30 – 4.19 (q, *J* = 11.2 Hz, 2H), 2.41 (s, 3H), 1.07 (m, *J* = 12.2 Hz, 3H). GCT/TOF HRMS-EI (m/z): $[M]^+$ calcd for $C_{15}H_{13}NO_3$, 255.0895; found, 255.0894.

(Z)-ethyl2-cyano-2-(2-((E)-2-(1,2,2,4-tetramethyl-1,2,3,4-tetrahydroquinolin-6-yl)vinyl)-4H-chromen-4-ylidene)acetate (6a).

4 (500 mg, 1.96 mmol), **5a** (434 mg, 2 mmol) and piperidine (0.5 mL) were refluxed in acetonitrile (30 mL) for 8 h. The reaction solution was removed by rotary evaporation. The residue was purified by column chromatography on silica gel to give **6a** as red liquid (650 mg, 73%). ^{1}H-NMR (400 MHz, Acetone-d$_6$) δ 7.50 – 7.38 (m, *J* = 16.5 Hz, 7H), 7.09 (d, *J* = 16.1 Hz, 1H), 7.00 (d, *J* = 16.1 Hz, 1H), 6.18 (s, 1H), 4.24 (q, *J* = 11.2 Hz, 2H), 2.96 – 2.94 (m, 4H), 1.85 (d, *J* = 13.0 Hz, 2H), 1.25 (s, 6H), 1.07 (m, *J* = 12.2 Hz 6H). GCT/TOF HRMS-EI (m/z): $[M]^+$ calcd for $C_{29}H_{30}N_2O_3$, 454.2256; found, 454.2254.

(Z)-ethyl2-cyano-2-(2-((E)-2-(7-methoxy-1,2,2,4-tetramethyl-1,2,3,4-tetrahydroquinolin-6-yl)vinyl)-4H-chromen-4-ylidene)acetate (6b).

A procedure similar to that for **6a** but with compound **5b** (780 mg, 2 mmol) instead of compound **5a**. **6b** as red liquid(711 mg, 75%). ^{1}H-NMR (400 MHz, Acetone-d$_6$) δ 7.84 (s, 1H), 7.50 – 7.38 (m, 4H), 7.09 (d, *J* = 16.1 Hz, 1H), 7.00 (d, *J* = 16.1 Hz, 1H), 6.76 (s, 1H), 6.18 (s, 1H), 4.24 (q, *J* = 11.2 Hz, 2H), 3.89 (s, 3H), 2.96 – 2.94 (m, 4H), 1.85 (d, *J* = 13.0 Hz, 2H), 1.25 (s, 6H), 1.07 (m, *J* = 12.2 Hz, 6H). GCT/TOF HRMS-EI (m/z): $[M]^+$ calcd for $C_{30}H_{32}N_2O_4$, 484.2362; found, 484.2364.

(Z)-ethyl2-cyano-2-(2-((E)-2-(2,4-dihexyl-7-methoxy-1,2-dimethyl-1,2,3,4-tetrahydroquinolin-6-yl)vinyl)-4H-chromen-4-ylidene)acetate (6c).

A procedure similar to that for **6a** but with compound **5c** (494 mg, 2 mmol) instead of compound **5a**. **6c** as red liquid(856 mg, 70%). ^{1}H-NMR (400 MHz, Acetone-d_6) δ 7.84 (s, 1H), 7.55 – 7.37 (m, 4H), 7.08 (d, *J* = 16.0 Hz, 1H), 6.99 (d, *J* = 16.1 Hz, 1H), 6.75 (s, 1H), 6.20 (s, 1H), 4.30 – 4.19 (q, *J* = 11.2 Hz, 2H), 3.90 (s, 3H), 2.98 – 2.94 (m, 4H), 1.85 (d, *J* = 13.0 Hz, 2H), 1.59 – 1.45 (m, *J* = 16.2 Hz, 7H), 1.32 – 1.25 (m, *J* = 13.2 Hz, 19H), 0.88 (t, *J* = 11 Hz, 6H). GCT/TOF HRMS-EI (m/z): $[M]^+$ calcd for $C_{40}H_{52}N_2O_4$, 624.3927; found, 624.3927.

(Z)-2-cyano-2-(2-((E)-2-(1,2,2,4-tetramethyl-1,2,3,4-tetrahydroquinolin-6-yl)vinyl)-4H-chromen-4-ylidene) acetic acid (7a).

6a (650 mg, 1.43 mmol) and 2 M aqueous solution of LiOH (5 mL) were heated to 40 ^oC over night. Then water was added into the reaction mixture and the mixture was extracted with CH_2Cl_2. The organic layer was removed by rotary evaporation. The residue was purified by column chromatography on silica gel to give **7a** as red solid (530 mg, 87%). ^{1}H-NMR (400 MHz, Acetone-d_6) δ 7.50 – 7.38 (m, *J* = 16.5 Hz, 7H), 7.09 (d, *J* = 16.1 Hz, 1H), 7.00 (d, *J* = 16.1 Hz, 1H), 6.18 (s, 1H), 2.96 – 2.94 (m, 4H), 1.85 (d, *J* = 13.0 Hz, 2H), 1.25 (s, 6H), 1.07 (m, *J* = 12.2 Hz 3H). GCT/TOF HRMS-EI (m/z): $[M]^+$ calcd for $C_{27}H_{26}N_2O_3$, 426.1943; found, 426.1942.

(Z)-2-cyano-2-(2-((E)-2-(7-methoxy-1,2,2,4-tetramethyl-1,2,3,4-tetrahydroquinolin-6-yl)vinyl)-4H-chromen-4-ylidene)acetic acid (7b).

A procedure similar to that for **7a** but with compound **6b** (711 mg, 1.5 mmol) instead of compound **6a**. **6b** as red liquid(580 mg, 85%). ^{1}H-NMR (400 MHz, Acetone-d_6) δ 7.84 (s, 1H), 7.50 – 7.38 (m, 4H), 7.09 (d, *J* = 16.1 Hz, 1H), 7.00 (d, *J* = 16.1 Hz, 1H), 6.76 (s, 1H), 6.18 (s, 1H), 3.89 (s, 3H), 2.96 – 2.94 (m, 4H), 1.85 (d, *J* = 13.0 Hz, 2H), 1.25 (s, 6H), 1.07 (m, *J* = 12.2 Hz 3H). GCT/TOF HRMS-EI (m/z): $[M]^+$ calcd for $C_{28}H_{28}N_2O_4$, 456.2049; found, 456.2049.

(Z)-2-cyano-2-(2-((E)-2-(2,4-dihexyl-7-methoxy-1,2-dimethyl-1,2,3,4-tetrahydroquinolin-6-yl)vinyl)-4H-chromen-4-ylidene)acetic acid (7c).

A procedure similar to that for **7c** but with compound **6c** (856 mg, 1.4 mmol) instead of compound **6a**. **6c** as red liquid(650 mg, 78%). ^{1}H-NMR (400 MHz, Acetone-d$_6$) δ 7.84 (s, 1H), 7.55 – 7.37 (m, 4H), 7.08 (d, *J* = 16.0 Hz, 1H), 6.99 (d, *J* = 16.1 Hz, 1H), 6.75 (s, 1H), 6.20 (s, 1H), 3.90 (s, 3H), 2.98 – 2.94 (m, 4H), 1.85 (d, *J* = 13.0 Hz, 2H), 1.59 – 1.45 (m, *J* = 16.2 Hz, 7H), 1.32 – 1.25 (m, *J* = 13.2 Hz, 16H), 0.88 (t, *J* = 11 Hz, 6H). GCT/TOF HRMS-EI (m/z): [M]$^+$ calcd for $C_{37}H_{46}N_2O_3$, 566.3508; found, 566.3508.

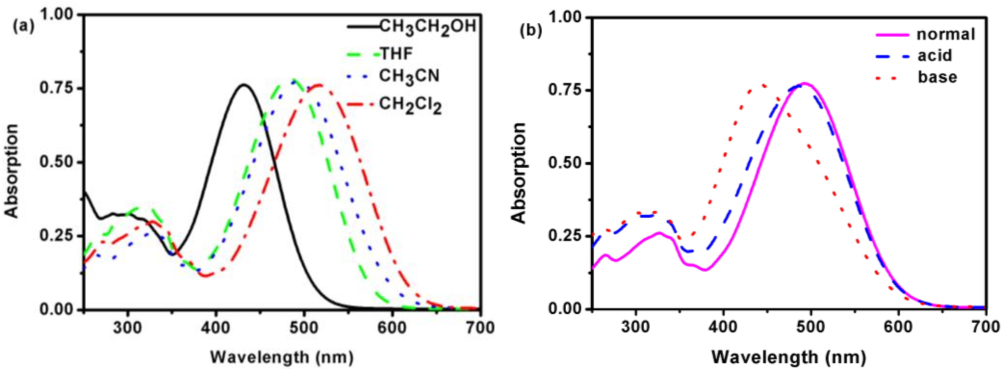
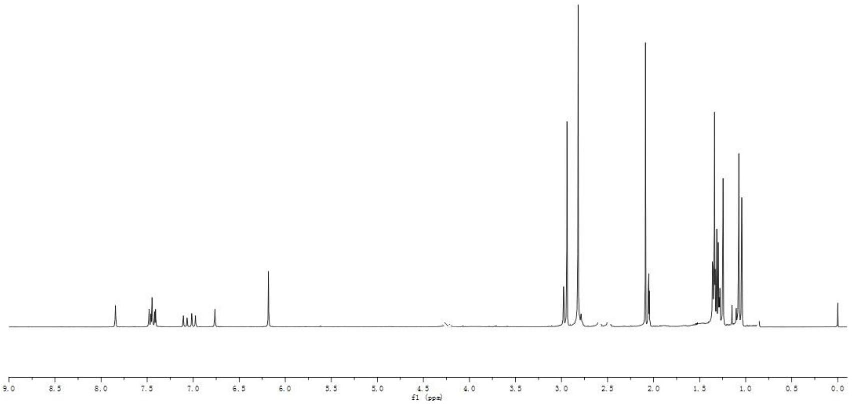


Fig.S1 a) UV-Vis spectra of CC101 in different solvents (CH_3CH_2OH, THF, CH_3CN and CH_2Cl_2); b) UV-Vis spectra of CC101 in CH_3CN in the presence of acid (acetic acid, 2 × 10^{-5} M) or base (LiOH, 2 × 10^{-5} M)

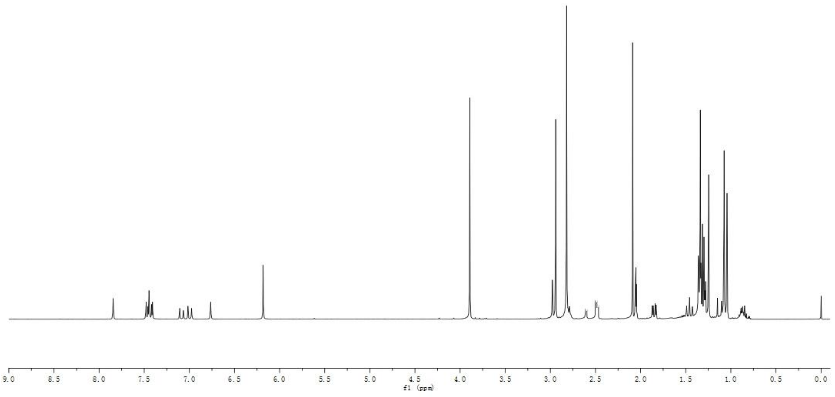
dye	λ_{max} (nm)	oscillator strength f
CC101	384	0.3055
	495	1.0698
CC102	381	0.2763
	490	1.0847
CC103	381	0.2980
	492	1.0933

Fig.S2 Computed excitation wavelength and oscillator strength at a B3LYP/6-31G(d) level under vacuum condition.

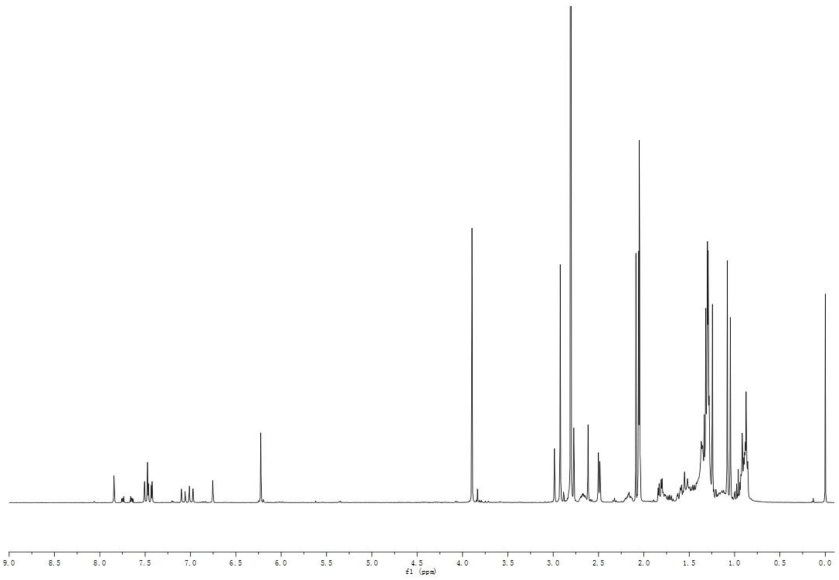
Compound 7a



Compound 7b



Compound 7c



Reference

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