

New Organic Dyes and Ruthenium dye containing Fluorene Moiety for Solar Cells Application

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Abstract

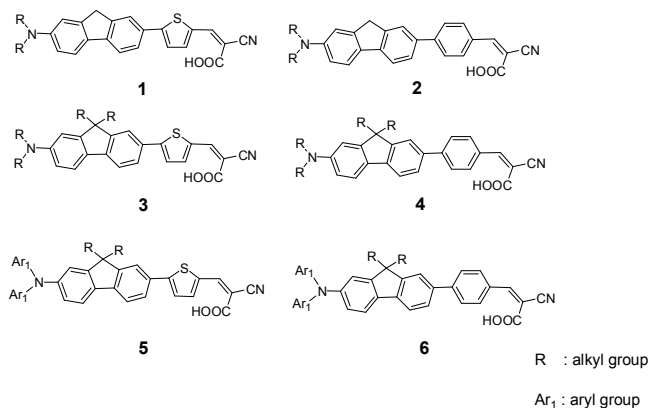
Series of dyes containing a fluorene moiety in the spacer have been designed, synthesized, and characterized. These dipolar compounds contain an arylamine or dialkylamine as the electron donor, a 2-acrylic acid as the electron acceptor, and a conjugated spacer between the donor and the acceptor. Typical dye-sensitized solar cells (DSSCs), with an appropriate illumination area, were fabricated with a liquid electrolyte composed of iodide reagent in polar solvent. The device performance data were obtained under AM 1.5 illumination. DSSCs using these materials as the sensitizers exhibited good performance (η), ranging from 4.58 %-5.82 %, which reached 67 %-85 % with respect to that of the standard cell from N719-based device fabricated under similar condition. The patent was published and pending.

Beside the organic dyes, the new Ru-complex dye that contained the bipyridine ligand based on the fluorene moiety, F509, was synthesized. The efficiency of F509 reached 7.20% was similar to N719. The patent was granted.

The general configuration of organic dye



The structures of novel organic dyes

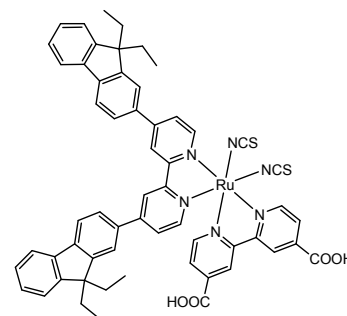


Cell Performance of organic dyes

Entry	J_{SC} (mA/cm ²)	V_{OC} (V)	FF	η (%)
1	6.28	0.61	0.66	2.54
2	8.40	0.60	0.63	3.15
3	13.16	0.69	0.64	5.82
4	11.00	0.68	0.58	4.68
5	10.28	0.69	0.65	4.90
6	10.30	0.70	0.63	4.58
N719	14.12	0.74	0.65	6.81

Experiments were conducted using TiO₂ photoelectrodes with approximately 18 μ m thickness and 0.25 cm² working area on the FTO (15 Ω /sq.) substrates.

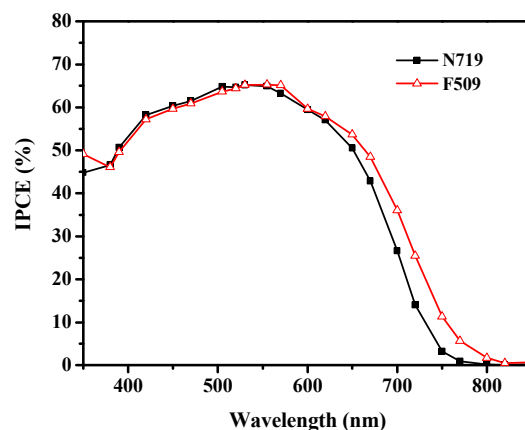
The structure of novel Ru-dye, F509



Cell Performance and IPCE of F509

Entry	J_{SC} (mA/cm ²)	V_{OC} (V)	FF	η (%)
F509	16.56	0.67	0.65	7.20
N719	16.39	0.69	0.63	7.12

Experiments were conducted using TiO₂ photoelectrodes with approximately 18 μ m thickness and 0.25 cm² working area on the FTO (15 Ω /sq.) substrates.



Conclusion

- We have successfully synthesized dipolar compounds where the electron-donating aryl(alkyl)amine and electron-accepting 2-cyanoacrylic acid were linked by fluorene-containing spacer.
- The best performance of the device reaches ~85 % of N719-based DSSC (6.81 %) fabricated and measured under similar conditions.
- It only takes three synthetic steps to produce the dye 3 which has the best performance of the DSSC.
- The IPCE of F509 was better than N719. Therefore, the higher J_{sc} of F509 lead to the higher efficiency.