Bandgap Science for Organic Solar Cells

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Abstract

Conversion efficiency of organic thin-film solar cell reached 12%. In 1991, I proposed *pin* junction incorporating co-deposited *i*-interlayer consisting of two kinds of organic semiconductors (so-called bulkheterojunction), which is an indispensable for present organic solar cells [1,2].

In this paper, bandgap science for organic thin-film solar cells [3], including (i) 'seven-nines' purification of organic semiconductors [3], (ii) *pn*-control of organic semiconductors by impurity doping [4-6], (iii) Doping mechanism investigated by Kelvin band-mapping [7], (vi) *pn*-control of the photovoltaic co-deposited films [8,9], (v) Ionization sensitization of doping [10], (vi) ppm-doping effects in the simplest n^+p-homojunction organic photovoltaic cells [11], will be presented.

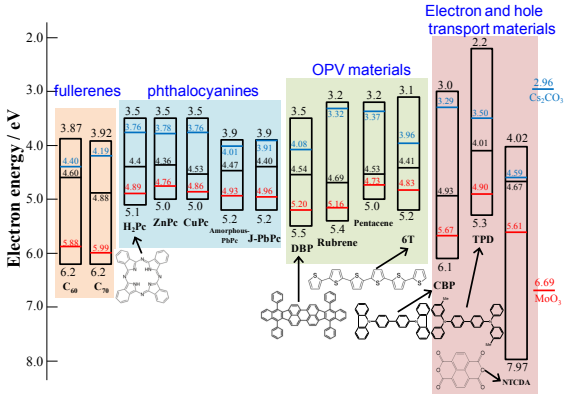


Fig. 1. Energy diagrams of various organic semiconductor films. The black, red, and blue lines show the E_F for non-doped, MoO_3(acceptor)-doped, and Cs_2CO_3(donor)-doped

Recent Publications

1. Hiramoto M et al. (1991) Three-layer organic solar cell with an interlayer of mixed pigments. Appl. Phys. Lett. 58:1062-1064.
2. Hiramoto M et al. (1992) p-i-n like behavior in three-layered organic solar cells having a co-deposited interlayer of pigments. J. Appl. Phys. 72: 3781-3787.
3. Hiramoto M et al. (2014) Bandgap science for organic solar cells. Electronics 3:351-380.
4. Kubo M et al. (2011) Conduction type control of fullerene films from n- to p-type by molybdenum oxide doping. Appl. Phys. Lett. 98:073311 (3 pages).
5. Kubo M et al. (2011) *pn*-Homojunction formation in single fullerene films. AIP Advances 1:032177(5pages).
6. Shinmura Y et al. (2012) *pn*-Control and *pn*-homojunction formation of metal-free phthalocyanine by doping. AIP Advances 2:032145(6 pages).
7. Shinmura Y et al. (2014) Mapping of band bending for doped C_{60} films. Appl. Phys. Express 7:071601(4 pages).
8. Ishiyama N et al. (2011) Doping-based control of the energetic structure of photovoltaic co-deposited films. Appl. Phys. Lett. 99:133301(3 pages).
9. Ishiyama N et al. (2011) Tandem organic solar cells formed in co-deposited films by doping. 14:1793-1796.
10. Shinmura Y et al. (2014) Ionization sensitization of doping in co-deposited organic semiconductor films. Appl. Phys. Lett. 105:183306(5 pages).
11. Ohashi C et al. (2015) ppm-Doping effects in the simplest n^+p-homojunction organic photovoltaic cells. Org. Electron. 27:151-154.



Biography

Masahiro Hiramoto received a Ph.D in Chemistry from Osaka University in 1986. He started the research on organic semiconductors and organic solar cells in 1988 in Graduate School of Engineering, Osaka University. He joined the Institute for Molecular Science in 2008 as Professor. He has published over 130 papers. He is an inventor of the blended junction and tandem junction for organic solar cells.

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Notes/Comments: