Development of Advanced High-Performance Organic Photovoltaic Device

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EDIS2008 Satellite meeting “Recent Activities of IDER units”

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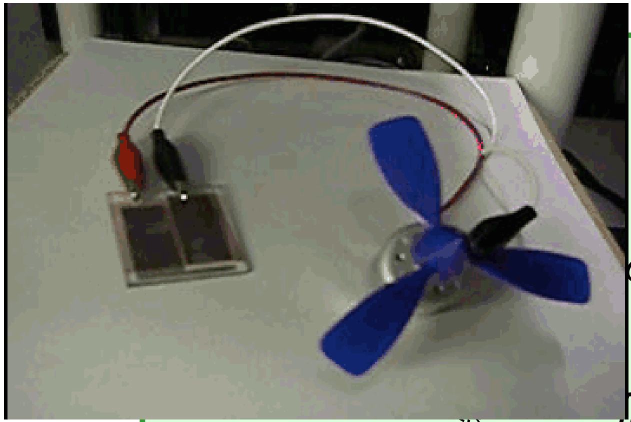
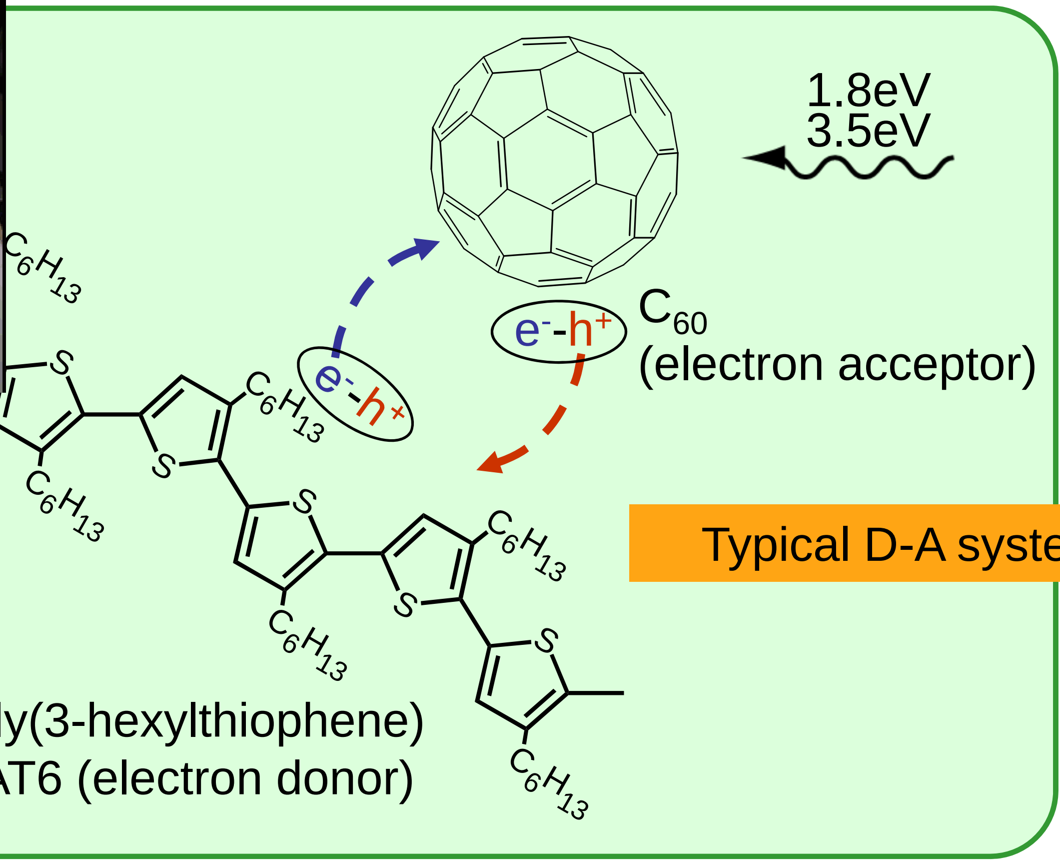
GCOE CEDI Osaka Univ.

π-Conjugated Polymer-Fullerene Systems

Famous phenomenon, such as photo-induced charge transfer, is fundamental mechanism in polymer photovoltaic devices

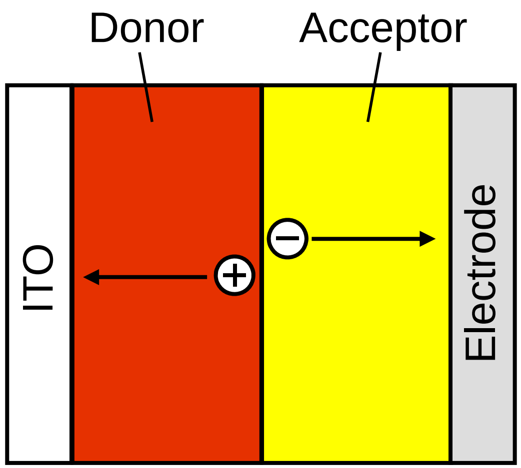




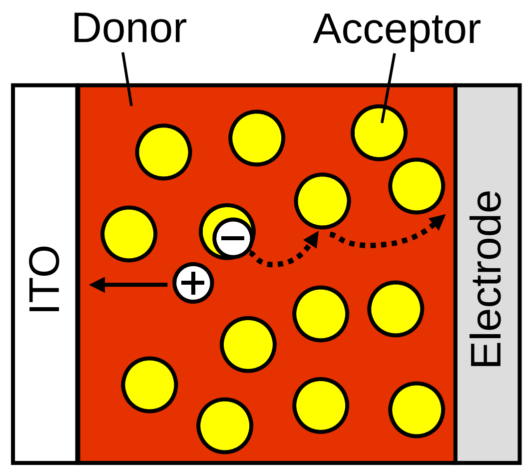
Typical D-A systems

Ref. [1] S. Morita, et al.: Solid State Commun. **82** (1992) 249.
[2] K. Yoshino, et al.: Solid State Commun. **85** (1993) 85.
[3] N. S. Sariciftci, et al.: Science **270** (1995) 1789.

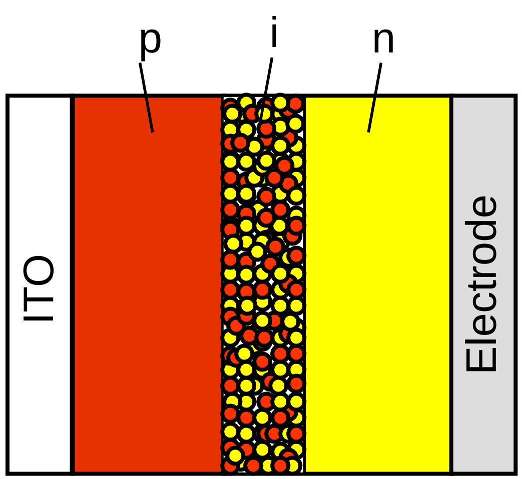
Fundamental Structures of D-A Type Photovoltaic Cells



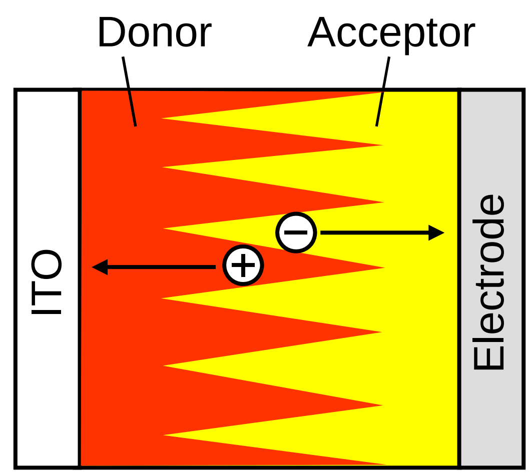
(a) Bi-layer type



(b) Bulk Heterojunction

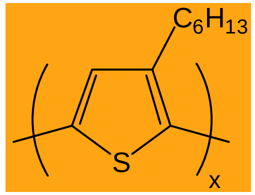


(c) p-i-n Junction Type



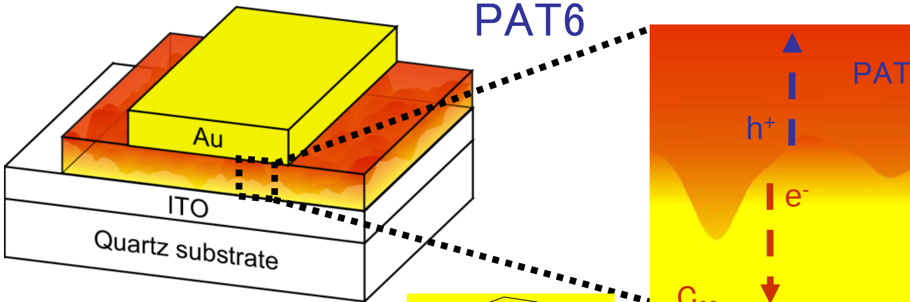
(d) Interpenetrating Junction

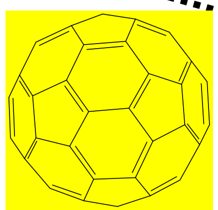
Device Performance of Interpenetrating Junction Devices



PAT6

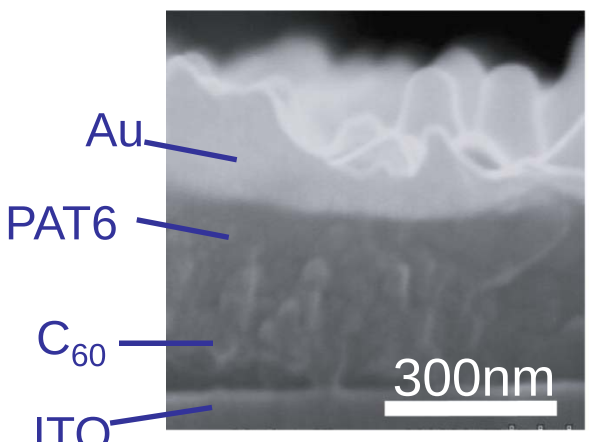
High hole mobility
Wide range absorption

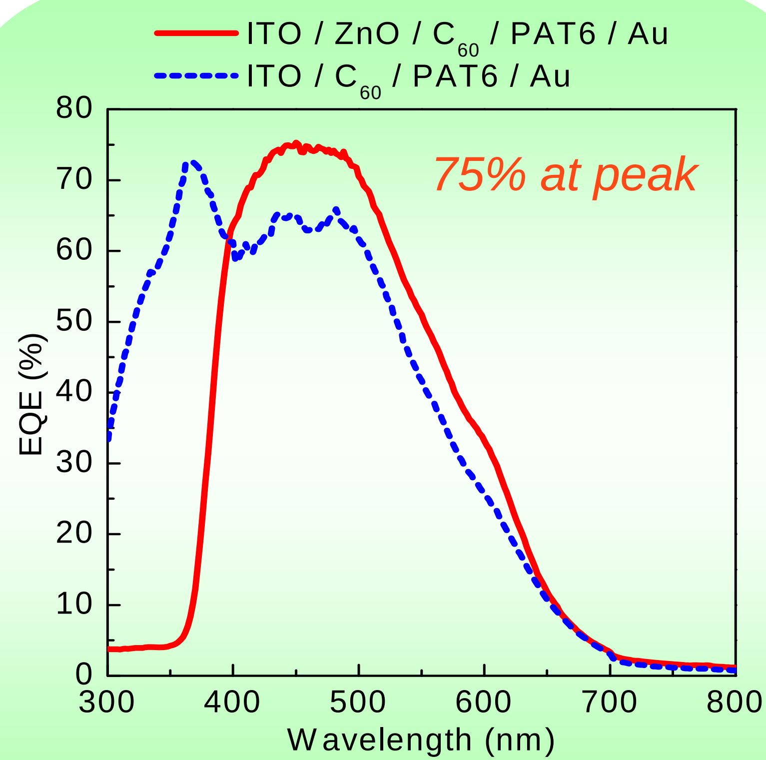




C_{60}

High electron mobility

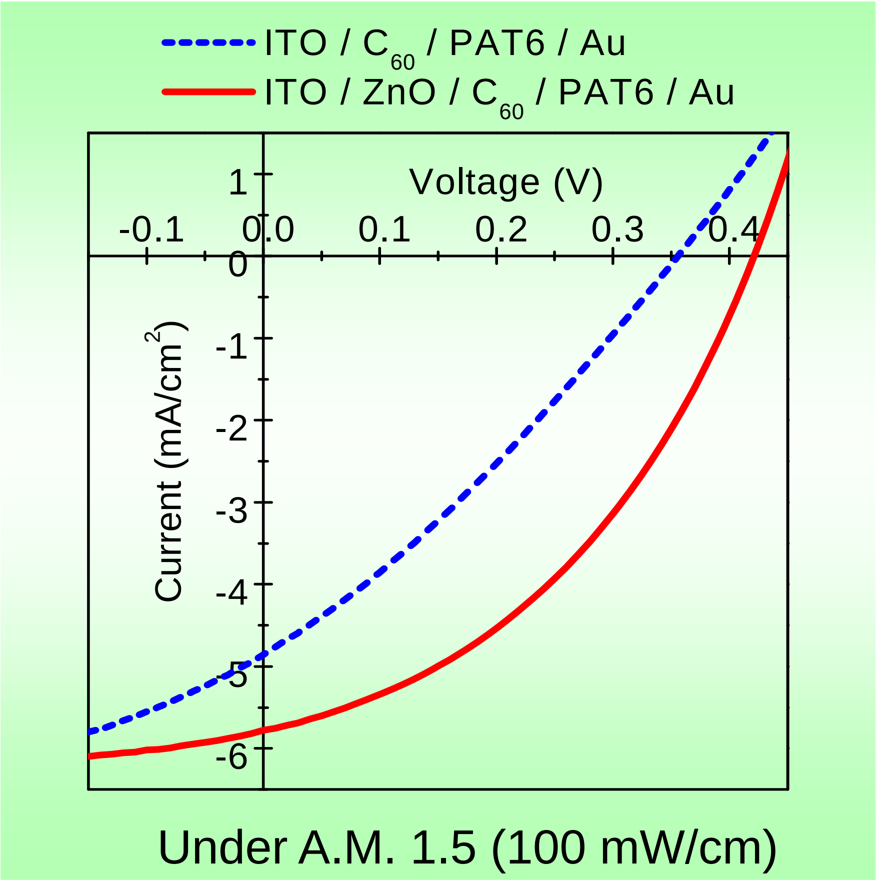


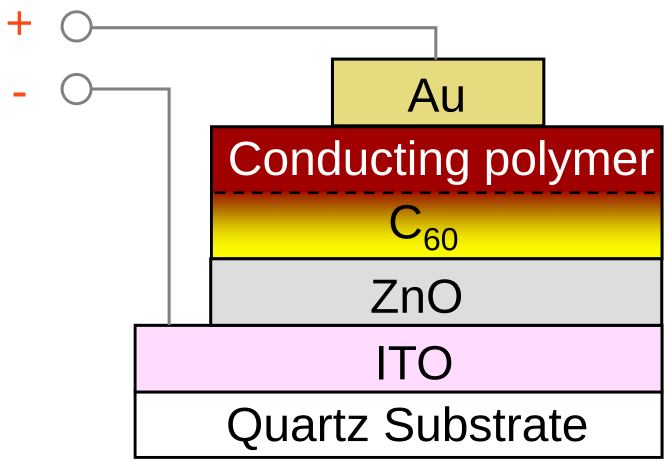


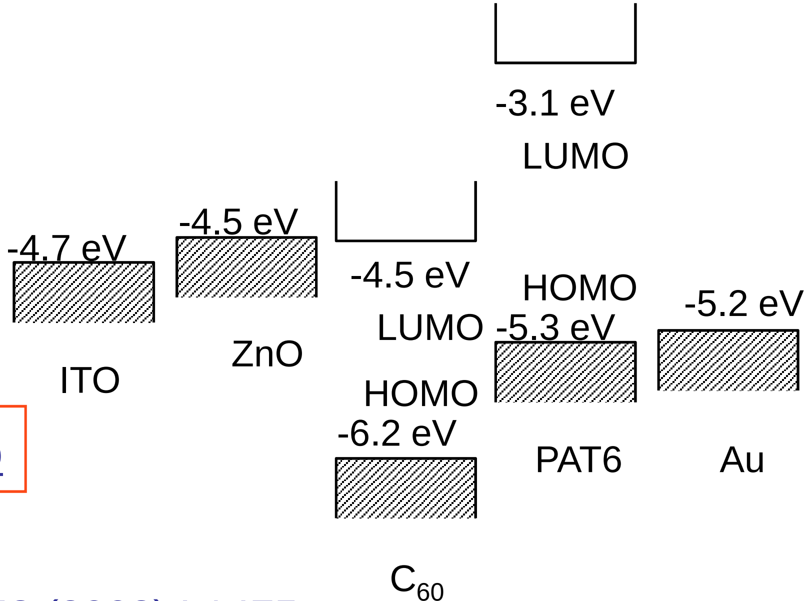
EQE spectra

EQE: External Quantum Efficiency

Device Performance of Interpenetrating Junction Devices



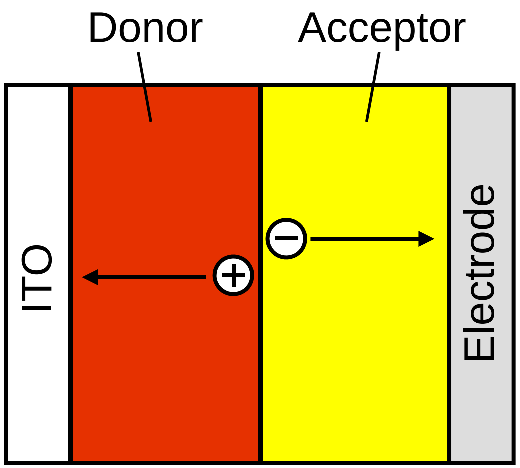




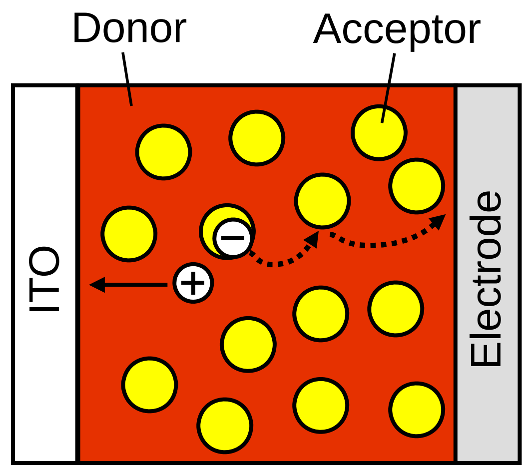
Energy conversion efficiency: 1.0%

Ref.) T. Umeda, et al., Jpn. J. Appl. Phys. **42** (2003) L1475.
T. Shirakawa, et al., J. Phys. D: Appl. Phys. **37** (2004) 847.

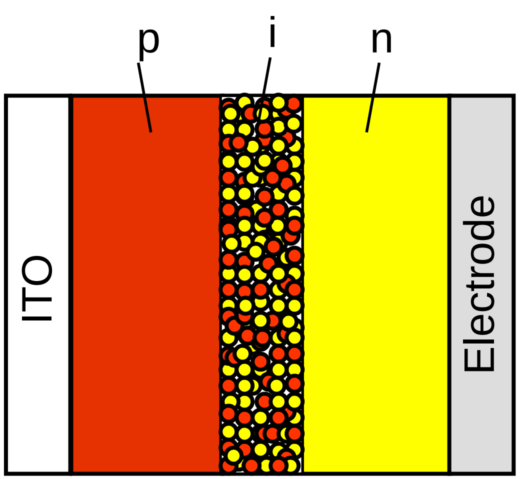
Fundamental Structures of D-A Type Photovoltaic Cells



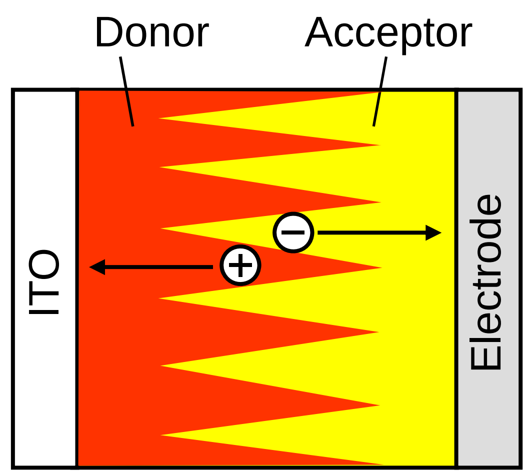
(a) Bi-layer type



(b) Bulk Heterojunction



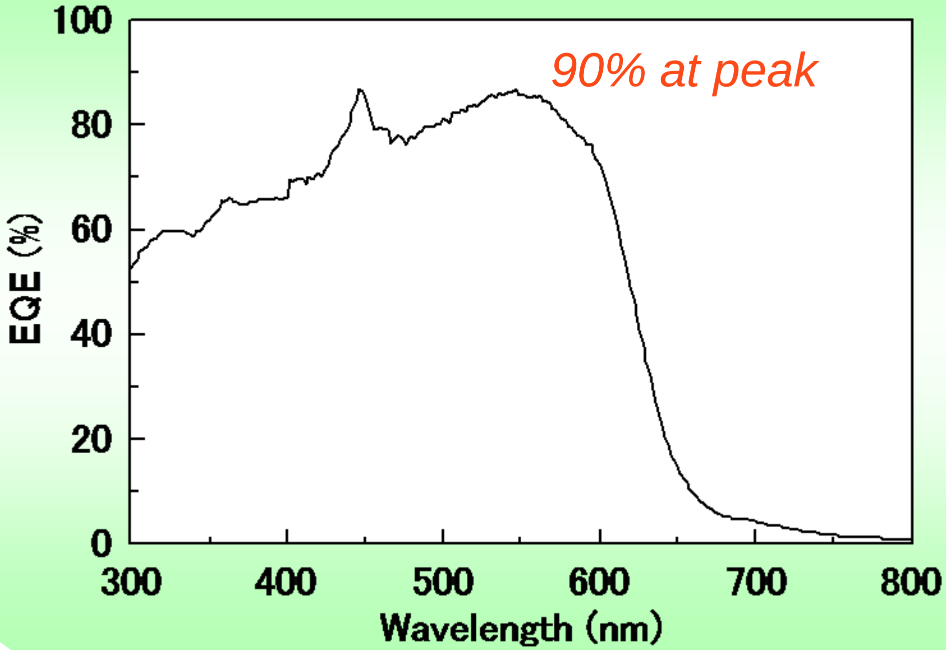
(c) p-i-n Junction Type

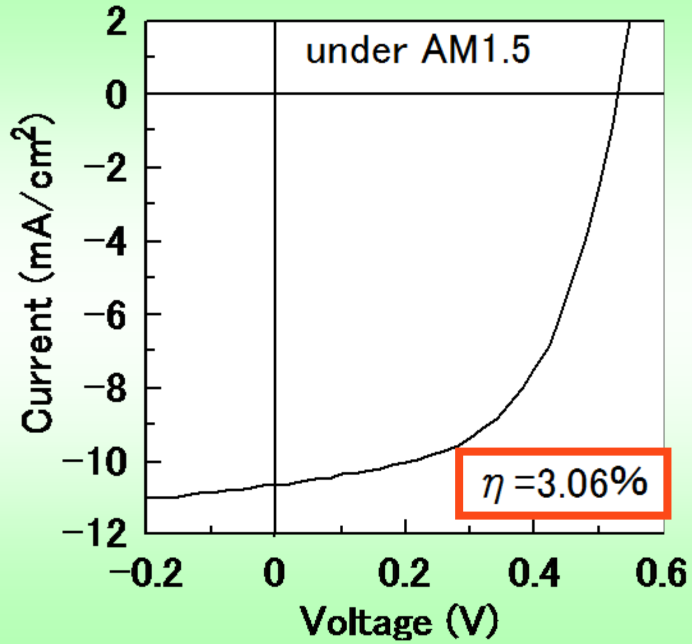


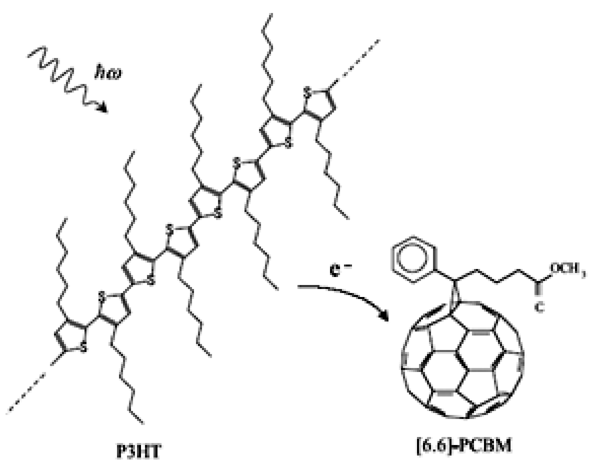
(d) Interpenetrating Junction

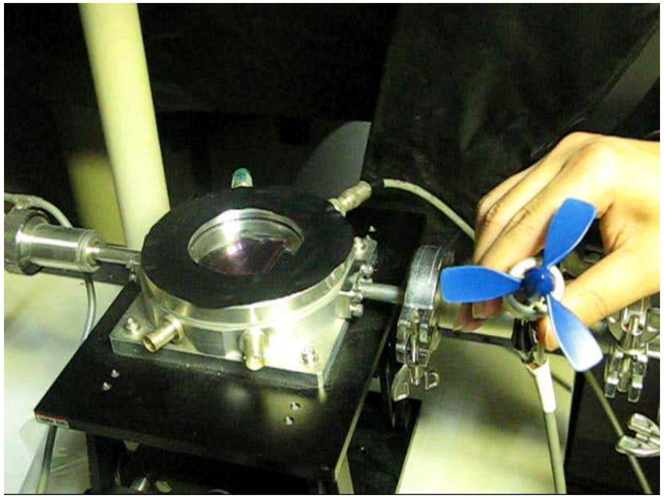
Device Performance of Bulk Heterojunction Devices

ITO/PEDOT:PSS/PAT6:PCBM/Al









Previous Publications

Fundamental Study

A.Fujii et al., Jpn. J. Appl. Phys. 43 (2004) 5573

Solvent Effects

A.Fujii et al., Jpn. J. Appl. Phys. 43 (2004) 8312

Design of Inverse type Structure

T. Umeda et al., Jpn. J. Appl. Phys. 42 (2003) L1475

Fundamental Interface Studies

T. Umeda et al., Jpn. J. Appl. Phys. 44 (2005) 4155

Mixed Solvent Effects

H. Mizaukami et al., J. Phys. D: Appl. Phys. 39 (2006) 1521

ITO Surface Modification Effects

Y. Hashimoto et al., Jpn. J. Appl. Phys. 44 (2005) 1978

Co-evaporation Layer and Wide Range Sensitivity

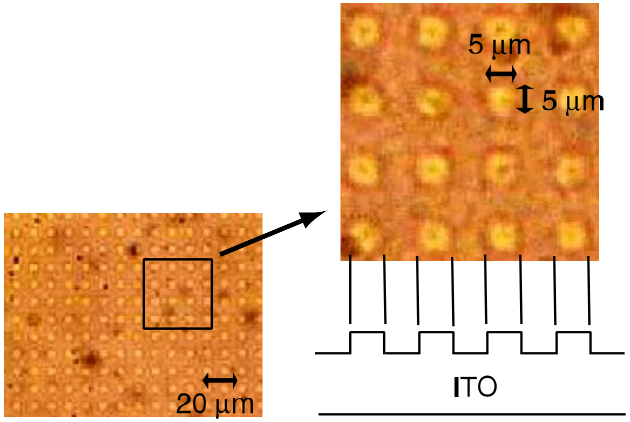
T. Umeda et al., Jpn. J. Appl. Phys. 44 (2006) 538

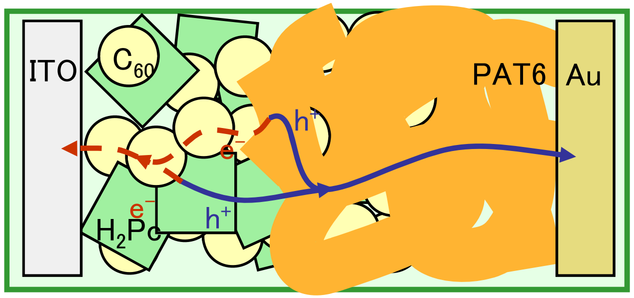
Insertion of Oxide Semiconductor Layer

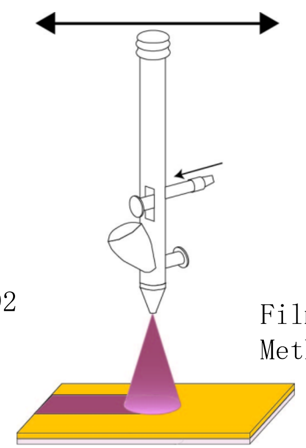
T. Shirakawa et al., J. Phys. D: Appl. Phys. 37 (2004) 847

Film Fabrication by Spray Method

H. Noda et al., Jpn. J. Appl. Phys. 45 (2006) 2792



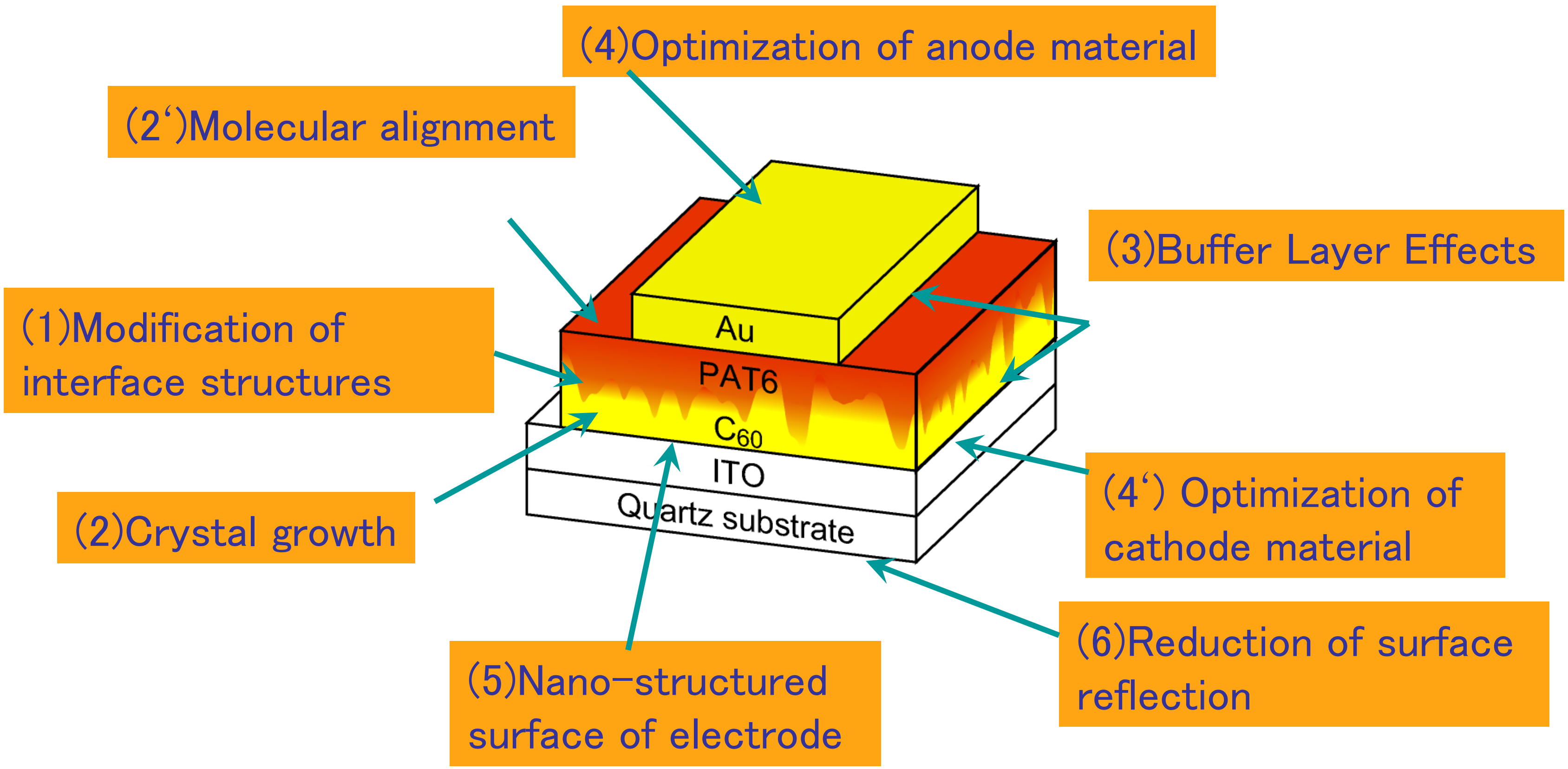




Film Fabrication by Spray Method

Future Plans

We try to Investigate as follows for realizing high performance organic photovoltaic devices.



The detailed studies are now in progress.

Collaboration in our IDER unit