Diketopyrrolopyrrole oligomer for solution process solar cells

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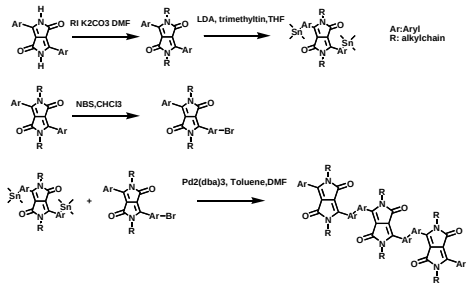
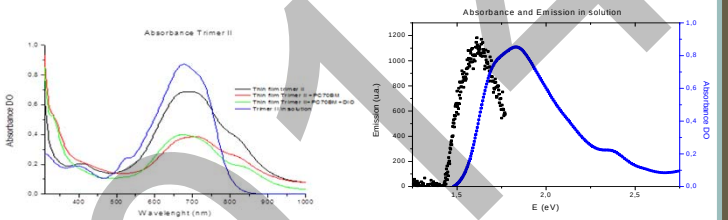
Introduction: Small molecule organic semiconductors are receiving much attention for the organic solar cell application. This is mainly due to their easy purification and structural manipulation compared to their polymer counterparts. [1,2] Among them, the diketopyrrolopyrrole (DPP) family succeed to stand out thanks to their broad optical absorption, ability to lower the energy frontier and high charge carrier mobility. [3,4]

Synthesis of DPP trimer :

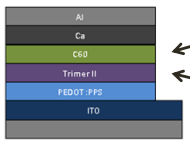


Stille coupling synthesis

Optical properties



Bilayer devices

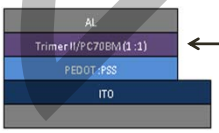


Evaporation deposition

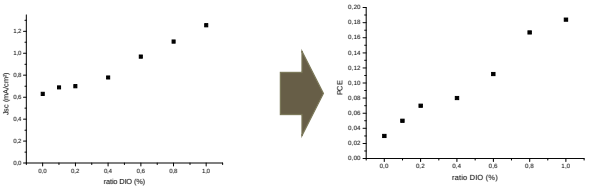
Solution process deposition

Solvent		Jsc (mA/cm²)	Voc (V)	FF	PCE (%)
Chloroform	average	1,23	0,60	0,40	0,30
	max	1,29	0,67	0,50	0,43
o-dichlorobenzene	average	1,69	0,59	0,43	0,43
	max	1,71	0,64	0,47	0,51

Bulk heterojunction devices: Addition of DIO



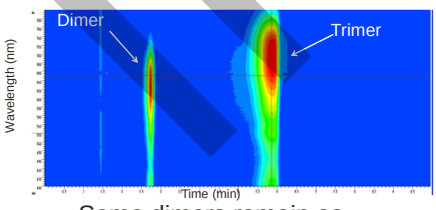
Solution spin coated: Trimer:$PC_{70}BM$ 1:1 disolved in chloroform and various ratio DIO (1,8-diiodooctane)



Low efficiency can be explained by three reasons :

Impurities :

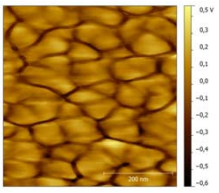
Separation by HPLC→ UV-Visible 2D map



Some dimers remain as impurity

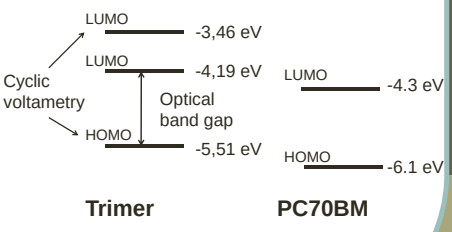
Bad Morphology

AFM images of trimer's active layer from best bulk heterojunction devices:



Large grains (100nm) formation → important recombinations

Energy levels:



Too low LUMO level → No electron transfer

Conclusion and perspectives: For now, bilayer structure gives the best performance with a PCE around 0.5%. In bulk heterojunction, the morphology may not allow good collection of charge carriers and good charge generation. By using additives like diiodooctane, the repartition between the two compounds can be controlled and brings better performance. The project will pursue on the addition of new additives.

[1] Xiaowei Zhan, *Chem. Soc. Rev.*, 2012, **41**, 4245–4272,
[2] Bäuerle Peter, *Angewandte Chemie International Edition*, 2012, 51, 2020-2067,
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