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UV Crosslinkable Polythiophene for Nano-imprinting and Photolithography Toward Ordered Bulk Heterojunction in Organic Photovoltaics

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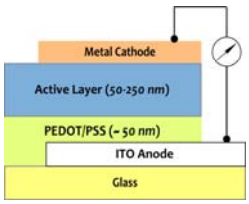
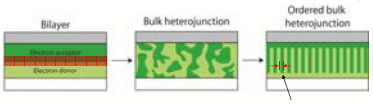
Ordered BHJ for more efficient OPVs



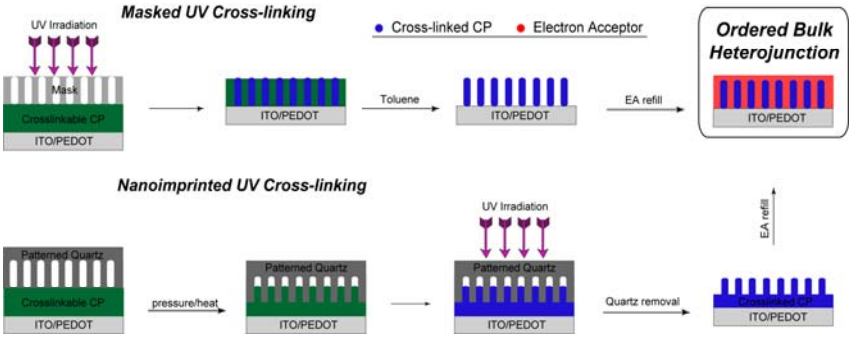
Exciton travel distance in organic material is on the order of 10-20 nm, thus the morphology of the organic active layer is critical to achieve high performance in OPVs. An ordered bulk heterojunction (BHJ) morphology with phase separation on the order of 10-20 nm (as shown below) will collect all excitons at the interface and give uninterrupted paths to all separated charges to reach the corresponding electrodes.



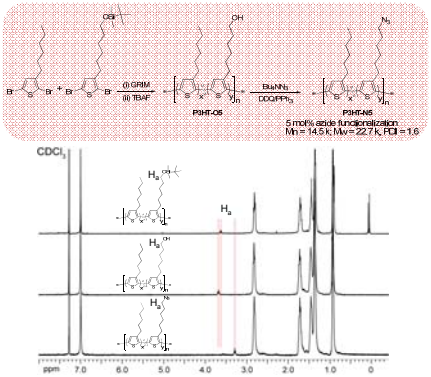
$PCE_{max} \approx 2\%$ $PCE_{max} \approx 8\%$ 10-20 nm desired For >10% efficiencies

Strategies:
- Nanopatterning
- Nanoimprinting
- Photolithography

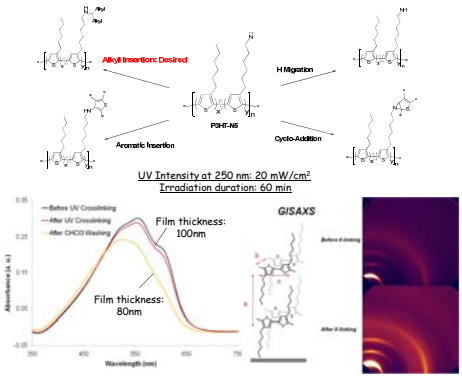
Nanotechnologies toward ordered BHJ



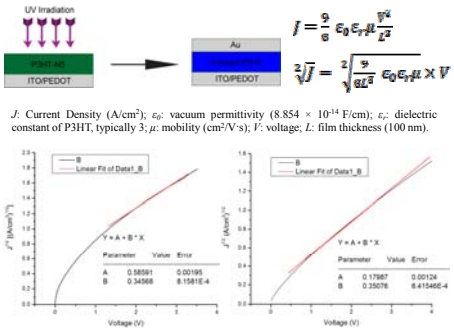
Materials Synthesis



UV Cross-linking Studies

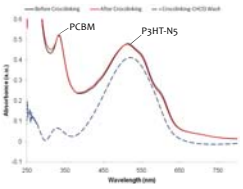


Charge Mobility Measurements

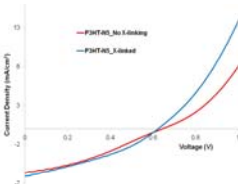


Cross-linking BHJ Blends with PCBM

UV-Vis Studies

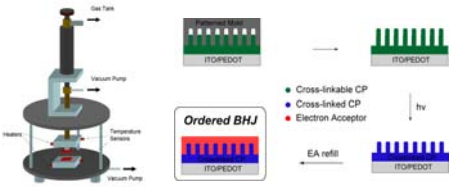


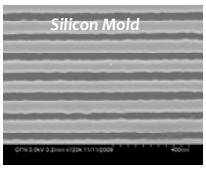
Device Performance

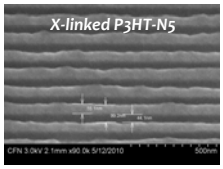


Device #	J_{SC} (mA/cm²)	V_{OC} (V)	FF (%)	η (%)
P3HT-N5_No X-linking	5.70	0.64	32.9	1.20
P3HT-N5_X-linked	6.21	0.62	34.5	1.33

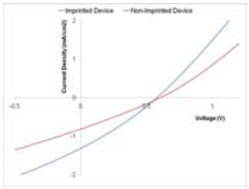
Home-Made Imprinting Device







Performance of Imprinted Devices



	Non-Imprinted Device	Imprinted Device
J_{SC} (mA/cm²)	0.96	1.3
V_{OC} (V)	0.58	0.59
FF (%)	28	28
η (%)	0.16	0.22

Results are average of 6 devices, respectively.

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