Polymers under Multiple Constraints

Polymer- & Soft-Matter-Seminar

MONDAY,
20th June 2016

at: **5.15pm**

VDP4 1.27,
Von-Danckelmann-Platz 4,
06120 Halle

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"SIDE-CHAIN ENGINEERING IN HIGH PERFORMANCE P-TYPE ORGANIC SEMICONDUCTORS FOR PRINTED OPV"

The Victorian Organic Solar Cell Consortium (VICOSC) has had a two-pronged approach to the development of printed OPV. One arm has focused on the scale-up of the printing process, translating laboratory-based process to commercially relevant systems. This work has used commercial materials and off the shelf printers, where available, to develop a materials agnostic printing process.[1] New materials, with suitable properties, can be "dropped-into" the program. A parallel program has developed new materials via a rigorous stage-gated process resulting in high performance n- and p-type organic semiconductors for our use.

We are interested in the impact of chromophore side chains on materials performance. There is a growing understanding that these non-core substituents have a dramatic influence on the performance of OPV materials, where modifications alter, for example, the relative solubility between components, π–π stacking, interactions of the polymer chain with fullerene acceptors, and others. A better understanding of these interactions will allow better materials design.

In our first example, we added solubilizing groups to a known chromophore to enhance solubility and performance of a BDT-BT polymer, Figure 1a. The unexpected outcome of synthesis development and device optimization was the improvement of OPV device performance from 2% PCE to over 9% (now 9.4% OCE).[2]

In more recent work, we have optimized side-chain placement in a known chromophore to develop **BTR**, by ensuring the side-chains are regio-regular, which should allow the chromophore to lie flat, Figure 1b.[3] The unexpected outcome was a nematic liquid crystalline material with significantly improved performance (now 9.6% OCE), excellent charge transport properties, reduced geminate recombination rates and excellent performance with active layers up to 400nm

I will discuss the development of side-chain engineering on materials development in general and our development of high performance polymers and molecular materials resulting in materials with > 9% PCE in OPV.

[1]. Hwang, K.; Jung, Y.-S.; Heo, Y.-J.; Scholes, F. H.; Watkins, S. E.; Subbiah, J.; Jones, D. J.; Kim, D.-Y.; Vak, D., *Adv. Mater.* **2015**, *27(7)*, 1241–1247. **DOI**: 10.1002/adma.201404598

[2]. Subbiah, J.; Purushothaman, B.; Chen, M.; Qin, T.; Gao, M.; Vak, D.; Scholes, F. H.; Chen, X.; Watkins, S. E.; Wilson, G. J.; Holmes, A. B.; Wong, W. W. H.; Jones, D. J., *Adv. Mater.* **2015,** *27* (4), 702-705. **DOI**: 10.1002/adma.201403080

[3]. Sun, K.; Xiao, Z.; Lu, S.; Zajaczkowski, W.; Pisula, W.; Hanssen, E.; White, J. M.; Williamson, R. M.; Subbiah, J.; Ouyang, J.; Holmes, A. B.; Wong, W. W.; Jones, D. J., *Nat Commun* **2015,** *6*, 6013. **DOI**: 10.1038/ncomms7013