Ph project: *Synthesis of Biosourced Materials for Organic Photovoltaics*

Laboratory: CINaM / IMMF

Team CHROMA

Supervisor: Dr Olivier Siri

Co-supervisor: Dr Elena Zaborova

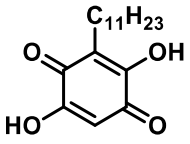
E-mail : elena.zaborova@univ-amu.fr / olivier.siri@univ-amu.fr

Context

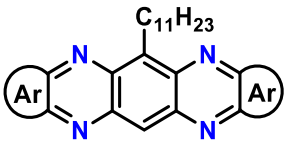
Organic photovoltaics (OPVs) represents a promising approach to exploit solar energy because of their attractive features, such as low cost, light weight, and flexibility for large-area fabrication. OPVs have increased in their device performance, with power conversion efficiency now beyond 18% [1]. Such significant advances in the technology stem from the optimized design of new materials, improved synthetic methodologies, and progress in device architectures and fabrication procedures. The active layer of bulk heterojunction OPVs consists of a blend of a π-conjugated donor material (a polymer or a small molecule) and an acceptor material. Pentacene – the reference organic molecule for organic electronic – is an acene which allows to reach a high mobility, approaching 3-5 $cm^2/(V.s)$ [2]. However, its photooxidation, dimerization as well as low-solubility problem and an environmentally unfriendly synthesis make this material unsuitable for industrial OPV. In this context, the development of new stable, green and low-cost pentacene analogues suitable for commercial use, still remains a major challenge.

Description

Previous works reported that introduction of one or more nitrogen(s) instead of C-H groups in acenes lower both HOMO as well as LUMO levels and makes resulted *N*-heteroacenes stable at ambient conditions [3]. Our group have a large expertise in the synthesis of *N*-heteroacenes from 2,5-dihydroxy-1,4-benzoquinone [4-5]. The next step is to exploit this know-how by using a key precursor from nature that will allow to develop a new bio-sourced synthetic pathway giving access to soluble and stable *N*-heteroacenes for OPV. *Embelia ribes*, commonly known as false black pepper, is a plant which contains 2.5-3 % *w/w* of an orange red compound named embelin (2,5-dihydroxy-3-undecyl-'1,4-benzoquinone). This molecule appears to be a precursor of choice for the preparation of new *N*-heteroacenes by condensation with a library of 1,2-diaminoaromatics developed in the CHROMA team. The versatility of our approach will enable us to control the key parameters of *N*-heteroacenes for organic electronics (size, gap, solubility, etc.). The candidate will be involved in synthesis, purification, characterization and evaluation of the optoelectronic properties of these compounds. OPV cells will be prepared with selected materials to evaluate their photovoltaic properties.



Embelin



N-Heteroacenes

Reference

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[4] O. Siri et al. *Langmuir* **2014**, *30*, 5700-5704. doi.org/10.1021/la404214u.
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