Development of organic semiconductors for organic opto-electronics

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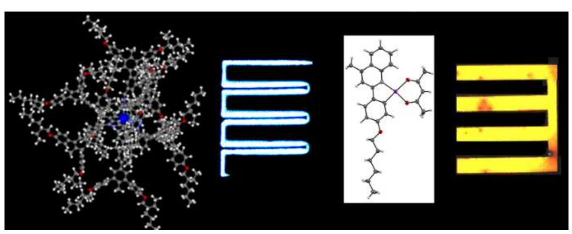
Organic semiconductors are the key active components in organic opto-electronics [*e.g.*, organic light-emitting diodes (OLEDs),[1,2] solar cells, photodiodes (OPDs),[3] field-effect transistors (OFETs), sensors and lasers]. Depending on the applications, these materials may need to be highly luminescent, electro-active and electrochemically stable, thermally stable and/or with high charge carrier mobility and desired HOMO and LUMO energy levels. If processed from solution, organic semiconductors require sufficient solubility to form good-quality thin films.

Efficient luminescent organic semiconductors have fundamental importance and significant industrial interests in OLEDs application like our next generation TVs and hand-held devices such as smart phones, tablets and gaming devices displays. Given the super display quality of OLEDs, it is important to note that in these OLED displays, each monochromatic sub-pixel needs to be driven and modulated by a transistor, typically using a high mobility polycrystalline silicon-based transistor backplane. Processing the backplane is, however, more complex and expensive than those of deposition of the OLED components, meaning, the use of polycrystalline silicon backplane defeats the key low-cost advantages of OLEDs. To overcome this, new approaches have been developed and among these, organic light-emitting field-effect transistors (OLEFETs)[2] show great potential as they enable to integrate the switching and emission functions in a single device.

Because of a trade-off nature of the switching and emission functions, this makes the development of efficient OLEFET chromophores challenging as to achieve high charge mobility in a device, active organic semiconductors need to be closely/well packed in the film, which is, generally, detrimental to light emission, explaining why most organic semiconductors reported with high mobilities are not suitable for OLEFETs as they suffer from poor light emitting efficiency. Similarly, most existing highly efficient OLED materials are not suitable for OLEFETs due to low charge carrier mobilities.[4]

In this presentation, our strategies to achieve high charge carrier mobility (with high ON/OFF ratio) and high external quantum efficiency (with high brightness) of OLEFETs will be shown. Our progress on materials development/synthesis will be discussed. OLEFET characteristics based on these materials will be reported.[5]



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