Pyrene-based Crystalline and Liquid Crystalline Organic Semiconductor Materials

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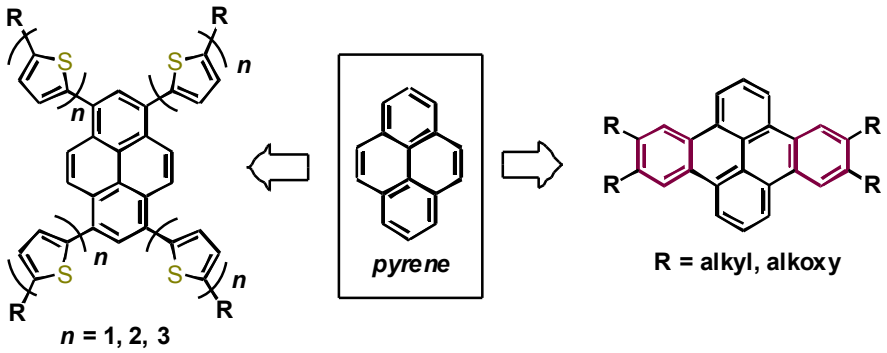
Organic semiconductors play the essential role of charge transport layer in organic field-effect transistors (OFETs), and have been intensively studied because of their unique advantages over conventional silicon-based materials, including low fabrication cost, large area coverage, and mechanical flexibility.[1,2,3] Molecules containing condensed, flat aromatic hydrocarbon cores, such as pentacene and rubrene, have shown to be particularly promising for application in OFETs. An OFET using a rubrene single crystal showed a high charge carrier mobility, and solid-state structure characterisation revealed a tightly-packed crystalline structure with close intermolecular π-stacking contacts. Thiophene-based materials exhibit a variety of intermolecular interactions, and are another important class of organic semiconductors, demonstrated to have both high performance and good stability.[1,3]

Despite these types of organic materials showing good promise as organic semiconductors for OFETs, there remains the need to identify new molecules with superior performance, good processability and high purity. Using the polycyclic aromatic hydrocarbon (PAH) pyrene as a starting point, we have used two approaches to synthesise pyrene derivatives with extended conjugated frameworks. One approach involves the coupling of four thiophene arms of different lengths to the pyrene core.[2] A second approach extends the pyrene through the fusion of two additional benzo groups, resulting in highly stable dibenzo[*e,l*]pyrene. The larger PAH exhibits greater π-stacking interactions that can drive the formation of discotic liquid crystalline phases and highly-ordered monolayers at surfaces. The synthesis, solution spectroscopy, solid-state structures and some preliminary OFET measurements for these pyrene-based materials will be presented.



References

1. H. Klauk, *Chem. Soc. Rev.* 39 (2010) 2643.
2. P. Anant, N. T. Lucas, J. M Ball, T. D. Anthopoulos, J. Jacob, *Synth. Met.* 160 (2010) 1987.
3. A. R. Murphy, J. M. M Fréchet, *Chem. Rev.* 107 (2007) 1066.