

Donor-Acceptor Polymers for Applications in Organic Electronics and Photovoltaics.

Rocío Ponce Ortiz,^a Paula Mayorga Burrezo,^a Juan Casado Cordón,^a J. Teodomiro López Navarrete,^a Xugang Guo,^b Nanjia Zhou,^b Antonio Facchetti,^b and Tobin J. Marks^b

^aDepartment of Physical Chemistry, University of Malaga

^bDepartment of Chemistry, Northwestern University

e-mail: rocioponce@uma.es

Developing new high-mobility polymeric semiconductors with good processability and excellent environmental stability is essential for organic electronics. Although diverse synthetic strategies have been approach to enhance the device stability, one of the most widely used consists in the alternation of donor and acceptor moieties in the conjugated skeleton, which allows fine tuning of the polymer frontier molecular orbitals.

For OTFT applications, low-lying HOMOs are essential to resist air oxidation and thus increase device stability. However, if the HOMO energy is too low, the resulting barrier to hole injection may compromise the transistor performance. Thus, a delicate balance between these two effects must be achieved. Following this strategy, we synthesized and characterized two families of donor-acceptor polymers (Figure 1) which presented remarkable performances ($\sim 0.2 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$) and air stability in OTFTs.^[1,2]

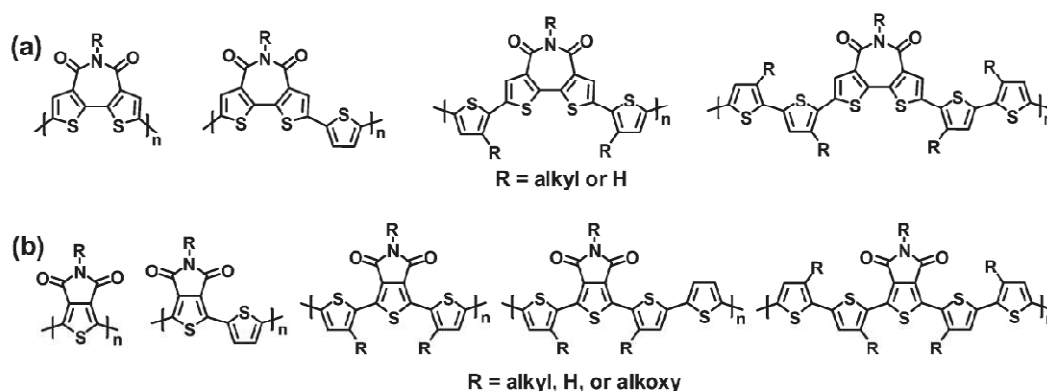


Figure 1.- Chemical structures of bithiophene imide (BTI)-based polymer semiconductors (a) and thieno[3,4-c]pyrrole-4,6-dione (TPD)-based polymer semiconductors (b).

Furthermore, solar cells were fabricated with power conversion efficiencies of up to 8.7% and remarkable fill factors of 76-80%.^[3] This excellent performance was attributed to highly ordered, closely packed and properly oriented microstructures with optimal horizontal and vertical phase gradation. Note also that these polymers present moderate bandgaps; therefore it is expected that efficiencies above 10% should be feasible by bandgap modification.

[1] X. Guo, R. Ponce Ortiz, Y. Zheng, Y. Gu, Y.-Y. Noh, K.-J. Baeg, A. Facchetti, T. J. Marks *J. Am. Chem. Soc.* **2011**, 133, 1405-1418.

[2] X. Guo, R. Ponce Ortiz, Y. Zheng, M.-G. Kim, S. Zhang, Y. Gu, G. Lu, A. Facchetti, T. J. Marks *J. Am. Chem. Soc.* **2011**, 133, 13685-13697.

[3] X. Guo, N. Zhou, S. J. Lou, J. Smith, D. B. Tice, J. W. Hennek, R. Ponce Ortiz, J. T. López Navarrete, S. Li, J. Strzalka, L. X. Chen, R. P. H. Chang, A. Facchetti, T. J. Marks, *Nature Photonics* **2013** (DOI: 10.1038/NPHOTON.2013.207)