Furan-Based Organic Semiconductors for Photovoltaics

Dmytro Perepichka

Dept Chemistry, McGill University, Montreal, Canada

Organic photovoltaics (OPVs) have made remarkable progress over the past two decades, enabled in large part by the chemistry of thiophene-based[1] pi-conjugated materials. However, the potential benefits of furan-based materials, such as biorenewable sourcing of precursors, better biodegradability, and enhanced pi-conjugation,[2] have not been fully explored due to discouraging initial results.[3] In this presentation, I will discuss recent advances in the molecular engineering of furan-based OPV materials with high photostability. I will present our discovery of the previously unknown mechanism of anaeronic photodegradation in non-fullerene OPV acceptors.[4]I will demonstrate how permutation of furan and thiophene units over the central core and the linkers can significantly affect the electronic properties of these n-type semiconductors and their performance in OPV devices.[5] Specifically, we will show how properly placed furan units can increase the power conversion efficiency of OPV devices from <10% to >14%, while also improving their photostability compared to thiophene-based materials. These results demonstrate the potential of furan-based materials as a promising alternative to thiophene-based semiconductors in OPV technology.

[1] *Handbook of Thiophene-Based Materials: Applications in Organic Electronics and Photonics* (Eds. I.F. Perepichka, D. F. Perepichka), Wiley-VCH **2009**.
[2] O. Gidron, A. Dadvand,Y. Sheynin,M. Bendikov, D. F. Perepichka, *Chem. Commun.* **2011,** *47,* 1976; O. Gidron, M. Bendikov, *Angew. Chem. Int. Ed.* **2014,** *53,* 2546.
[3] B. Zheng, L. Huo, *Small Methods* **2021,** *5,* 2100493.
[4] Y. Che, M. R. Niazi, R. Izquierdo, D. F. Perepichka, Mechanism of the Photodegradation of A-D-A Acceptors for Organic Photovoltaics, *Angew. Chem. Int. Ed*. **2021**, *60*, 24833.
[5] Y. Che et al. Design of Furan-Based Acceptors for Organic Photovoltaics, *Angew. Chem. Int. Ed*. **2023**, *62*, e202309003.

Dmytro Perepichka is W. C.MacDonald Professor of Chemistry at McGill University, Montreal. He obtained his PhD in 1999 from the Institute of Physical Organic & Coal Chemistry in Donetsk (Ukraine) and was a post-doctoral fellow at Durham University and UCLA before starting his group at INRS-Energy and Materials in Canada. In 2005, he moved to McGill where he was promoted to Full Professor in 2014. His group focuses on π-electron functional materials, including small molecules, polymers, and 2D materials. He published >200 papers and received the Research Excellence Award in Material Chemistry (2015) and the T.K. Sham Award (2022) from the Canadian Society of Chemistry.