Phthalocyanine-Based 2D Conjugated Polymers

Mingchao Wang
Renhao Dong, Xinliang Feng
Center for Advancing Electronics Dresden (cfaed) and Faculty of Chemistry and Food Chemistry, Technische Universität Dresden, Mommsenstasse 4, 01069 Dresden, Germany.
Mingchao.wang@tu-dresden.de

Two-dimensional conjugated polymers (2D CPs) are emerging as a unique class of 2D polymers with in-plane π-conjugation,[1] which have exhibited unique properties such as intrinsic crystallinity, porosity, conductivity/mobility, tailorable band gaps, etc. and displayed great potential in (opto)electronic and energy devices. However, understanding the intricate interplay between the chemical structure and charge transport remains a challenge.[2] In addition, the lack of rational design on the chemical structure—which effectively tailors the energy levels/gap and electronic structures of the frontier orbitals—hampers the development of highly conductive 2D CPs. Herein, we have rationally designed and synthesized a series of semiconducting phthalocyanine-based 2D CPs with low optical band gaps down to ~1 eV and charge carrier mobilities up to ~50 cm^2/Vs. The combination of Hall effect measurements, Terahertz spectroscopy and calculated electronic band structures provide a rational approach on how to assess structure-/doping-electronic property relationships.[2,3] These works highlight the great potential of high-mobility 2D CPs semiconductors for (opto)electronics.

References

[1] M. Wang, R. Dong, X. Feng, Chem. Soc. Rev., 50 (2021) 2764.
[2] M. Wang, M. Ballabio, M. Wang, H.-H. Lin, B. P. Biswal, X. Han, S. Paasch, E. Brunner, P. Liu, M. Chen, M. Bonn, T. Heine, S. Zhou, E. Canovas, R. Dong, X. Feng, J. Am. Chem. Soc., 141(2019) 16810–16816.
[3] M. Wang, M. Wang, H.-H. Lin, M. Ballabio, H. Zhong, M. Bonn, S. Zhou, T. Heine, E. Cánovas, R. Dong, X. Feng, J. Am. Chem. Soc., 142 (2020), 21622−21627.

Figures

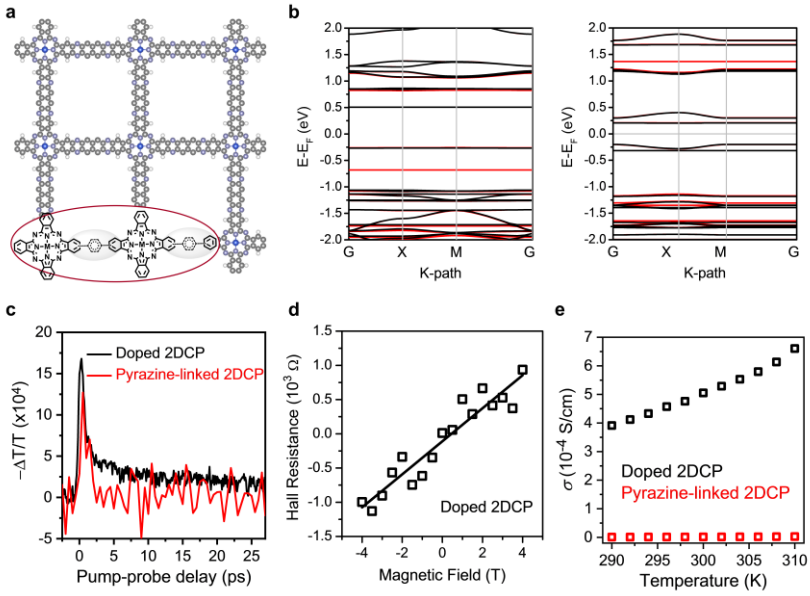

Figure 1: (a) Phthalocyanine-based 2D CPs. (b) Electronic band structures of different 2D CPs. (c–e) Terahertz spectroscopy, Hall effect and variable-temperature conductivity of pristine and doped pyrazine-linked 2D CPs.