ChemISTry Colloquia

Using supramolecular machinery to enhance the efficiency of photo-electrochemical cells

Tessel Bouwens

Department of Chemical Engineering
Delft University of Technology

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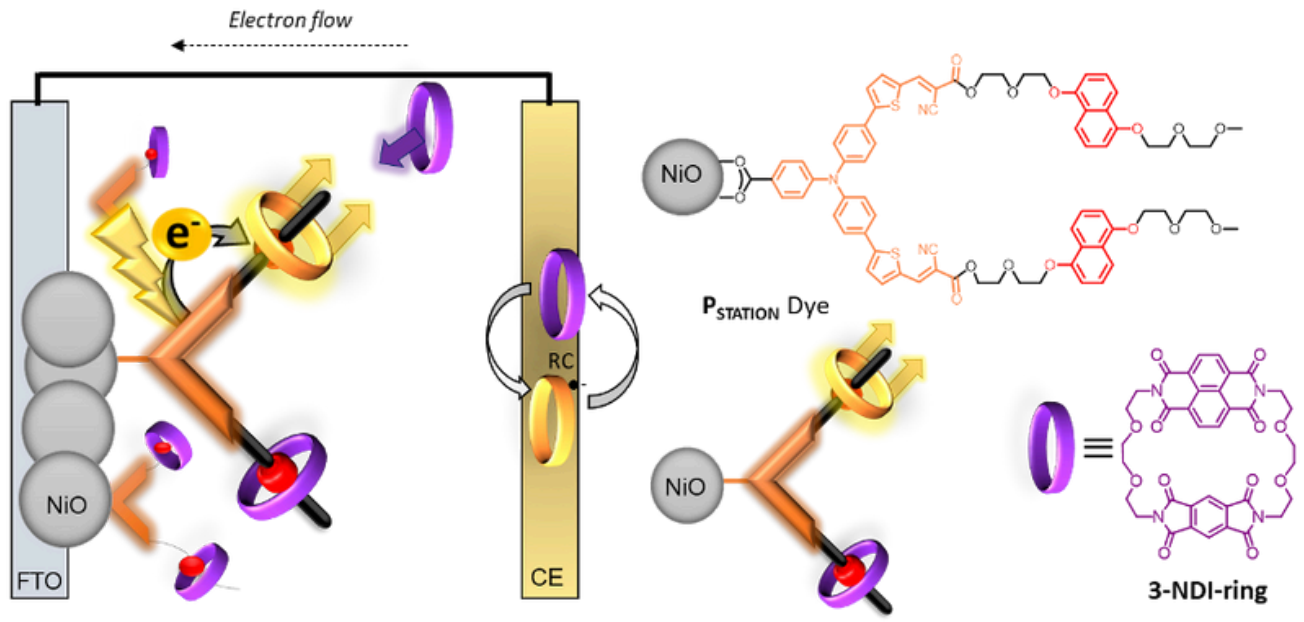
Harnessing solar energy under diffuse light conditions is a challenge that can be addressed with solar cell devices, such as photoelectrochemical cells (PECs). However, PECs suffer from efficiency losses due to electron-hole recombination. Inspired by natural photosynthesis, we apply supra-molecular machinery as a strategy to inhibit recombination through the organization of molecular components by making use of a (pseudo)rotaxane topology. Photoswitchable pseudorotaxanes are used to actively create a charge-separated state by launching charged rings away from the surface that contain the holes. The PECs based on supramolecular machinery demonstrated a 16-fold and 5-fold increase in power conversion efficiency compared to devices featuring two control dyes that do not facilitate pseudorotaxane formation. This bio-inspired approach to integrate supramolecular machinery in PECs demonstrates the impact of molecular organization on the performance of devices for solar conversion technologies.



[1] T. Bouwens, T. M. A. Bakker, K. Zhu, J. Hasenack, M. Dieperink, A. M. Brouwer, A. Huijser, S. Mathew & J. N. H. Reek, *Nat. Chem*. **2023**, 15, 213–221.

[2] T. Bouwens, S. Mathew, J. N. H. Reek, *Faraday Discuss.* **2019**, *215*, 393–406.

[3] T. Bouwens, T. M. A. Bakker, K. Zhu, A. Huijser, S. Mathew, J. N. H. Reek, Adv. Sci. **2024**, *11*, 2306032.

Tessel Bouwens just started as an assistant professor at TU Delft in the Netherlands. She completed her PhD in 2021 under the supervision of Prof. Joost Reek at the University of Amsterdam. She worked as an NWO Rubicon Postdoctoral Fellow at the Department of Chemistry, University of Cambridge, UK for two years and is now back in the Netherlands. In her research, Bouwens employs supramolecular strategies in artificial-leaf research. She uses the concepts used in nature to design new devices for solar energy conversion technologies with a supramolecular approach.