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Editorial

Unleashing the Potential to Electrify Process Chemistry: From Bench to Plant

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Synthetic electrochemistry might be an old discipline, yet it is undergoing a significant increase in popularity enabled by the availability of standardized, commercially available equipment and a number of critical reviews in the literature making the topic much more accessible to the non-expert.[1] From a simplicity and sustainability perspective, the potential advantages are clear: given that chemical reactivity is driven by the movement of electrons, electrochemistry provides the opportunity to manipulate those electrons without the addition of toxic, expensive, hazardous, or difficult-to-remove reagents.

Beyond improved methods for performing known transformations is the potential to develop entirely new reactions, which is essential for process chemists in industry in terms of opening new areas of chemical space, and to develop shorter or safer routes to compounds of interest, with the attendant sustainability and cost benefits. Despite all this, the number of electrochemical organic syntheses that have reached plant scale is limited, in part because of the complexity of parameters unfamiliar to the traditional synthetic chemist that must be considered and optimized in reaction development and scale-up as well as perceived challenges in scalability.[2]

To help increase opportunities for greater uptake of synthetic electrochemistry by industry, *Organic Process Research & Development* presents this special issue, "Unleashing the Potential to Electrify Process Chemistry: From Bench to Plant", comprising eight articles that bring new perspectives on the topic. A notable theme throughout is the translation of batch process into flow processes to enable scale-up, discussing the key parameters to study.

Seidler et al. describe batch optimization of L-cystine electroreduction via screening of electrodes and the progression to Design of Experiments (DoE) in flow to evaluate reaction parameters (DOI: 10.1021/acs.oprd.1c00153). Chen and co-workers discuss lessons learned in the scale-up of an electrochemical synthesis of a cyclobutane intermediate en route to an energetic material (DOI: 10.1021/acs.oprd.0c00270). Zhong et al. compare batch and flow reactor configurations for an alcohol oxidation en route to levetiracetam, demonstrating the superiority of the divided flow cell in terms of productivity and stereochemical fidelity (DOI: 10.1021/acs.oprd.1c00036). Petti and co-workers demonstrate the advantage of flow processing in their in situ phosgene-free oxidative method to access isocyanates from oxamic acids and to access a range of ureas and related products that are not accessible under batch conditions (DOI: 10.1021/acs.oprd.1c00112). Yan et al. describe the integration of electrochemistry and photochemistry in flow to access acridinium photocatalysts in a two-step procedure via late-stage selective C−H functionalization to enable the introduction of a range of alkyl groups into the dye (DOI: 10.1021/acs.oprd.1c00038). Quertenmont and co-workers describe the optimization of a Kolbe reaction that is relevant to the synthesis of nootropic agents and its translation to a continuous process, including a comparison of sustainability metrics with patented processes (DOI: 10.1021/acs.oprd.1c00188). Two Perspectives give new insights on the field: Vantourout discusses underexploited opportunities for paired electrocatalyzed reactions (DOI: 10.1021/acs.oprd.1c00046), and Wills and coauthors addresses the state of the art in high-throughput electrochemistry, describing the opportunity for high-throughput experimentation to reduce barriers to evaluating the many parameters necessary for successful development of electrochemical processes (DOI: 10.1021/acs.oprd.1c00167).

We are excited to see the field's growth and increase in uptake of synthetic electrochemistry. We look forward to more examples of scale-up of this technology to address synthetic and sustainability challenges and to see the full potential of electrochemistry unleashed.

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Notes

Views expressed in this editorial are those of the authors and not necessarily the views of the ACS.

Biographies

Kevin Lam is a Reader/Associate Professor of Medicinal Chemistry at the University of Greenwich. He completed his Ph.D. in Organic Electrosynthesis under the supervision of Prof. Istvan Marko at the Catholic University of Louvain. His research focuses on the

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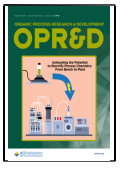

development of novel electrochemical methods to activate small organic molecules.

Katherine M. P. Wheelhouse is a process chemist in Chemical Development at GlaxoSmithKline. She joined the department in 2008 following completion of a D.Phil. with Prof. Timothy Donohoe at the University of Oxford and specializes in industrial applications of chemical catalysis with a broad interest in the adoption of technology for sustainable pharmaceutical manufacture.

REFERENCES

(1) For example, see: (a) Möhle, S.; Zirbes, M.; Rodrigo, E.; Gieshoff, T.; Wiebe, A.; Waldvogel, S. R. Modern Electrochemical Aspects for the Synthesis of Value-Added Products. *Angew. Chem., Int. Ed.* **2018**, *57*, 6018−6041. (b) Kingston, C.; Palkowitz, M. D.; Takahira, Y.; Vantourout, J. C.; Peters, B. K.; Kawamata, Y.; Baran, P. S. A Survival Guide for the "Electro-curious". *Acc. Chem. Res.* **2020**, *53*, 72−83. (c) Schotten, C.; Nicholls, T. P.; Bourne, R. A.; Kapur, N.; Nguyen, B. N.; Willans, C. E. Making Electrochemistry Easily Accessible to the Synthetic Chemist. *Green Chem.* **2020**, *22*, 3358−3375.

(2) (a) Tanbouza, N.; Ollevier, T.; Lam, K. Bridging Lab and Industry with Flow Electrochemistry. *iScience* **2020**, *23*, 101720. (b) Leech, M. C.; Garcia, A. D.; Petti, A.; Dobbs, A. P.; Lam, K. Organic Electrosynthesis: From Academia to Industry. *React. Chem. Eng.* **2020**, *5*, 977−990.

https://doi.org/10.1021/acs.oprd.1c00434
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