Electrochemical Radical Reactions: From Direct Electrolysis to Molecular Catalysis

Hai-Chao Xu

Xiamen University, 422 South Siming Road, Xiamen 361005, China
haichao.xu@xmu.edu.cn

Organic electrosynthesis, an essential tool for green chemistry, utilizes traceless electrons as "reagents" to drive synthetic transformations. Over the past decade, it has received growing attention in the context of improving the efficiency and sustainability of organic synthesis.[1] The continuously tunable nature of electrode potentials makes electrochemistry a powerful platform for facilitating electron transfer reactions.

In this lecture, I will present our decade-long efforts in the development of electrochemically driven radical reactions. Radical intermediates are generated either through direct electrolysis (via electron transfer at the electrode surface) or through molecular electrocatalysis.[2] In the electrocatalytic approach, reactive radical species are produced in the bulk solution rather than at the electrode interface, thereby mitigating issues such as electrode passivation and high local radical concentrations. This strategy significantly broadens the scope and practicality of electrochemical radical reactions.

More recently, we have advanced this work by integrating photoredox catalysis with electrochemistry,[3] leading to the development of molecular photoelectrocatalysis.[4, 5] This emerging strategy combines the benefits of electrochemical control with light-driven activation to achieve novel reactivity under mild conditions.[6]

Reference

[1] L. Ackermann, *Electrochemistry in Organic Synthesis*, 1st edition ed., Georg Thieme Verlag KG, Stuttgart, **2022**.
[2] P. Xiong, H.-C. Xu, *Acc. Chem. Res.* **2019**, *52*, 3339-3350.
[3] H. Yan, Z.-W. Hou, H.-C. Xu, *Angew. Chem. Int. Ed.* **2019**, *58*, 4592-4595.
[4] P. Xiong, H.-C. Xu, *Acc. Chem. Res.* **2025**, *58*, 299-311.
[5] C. Huang, P. Xiong, X.-L. Lai, H.-C. Xu, *Nat. Catal.* **2024**, *7*, 1250-1254.
[6] M. C. Lamb, K. A. Steiniger, L. K. Trigoura, J. Wu, G. Kundu, H. Huang, T. H. Lambert, *Chem. Rev.* **2024**, *124*, 12264–12304.

2002-2006	B.S., Xiamen University
2006-2010	Ph.D., Washington University in St. Louis
2011-2013	Post-doctoral fellow at Yale University
2013-2014	Assistant professor, Xiamen University
2014-present	Professor, Xiamen University