

Electrochemistry in Thin Layer: A Technique for Miniaturized Electrosynthesis and Electroanalysis

Dr. Mohammad Rafiee

Assistant professor, Chemistry,
University of Missouri-Kansas City



Chemistry
Seminar on
*Electrosynthesis
and Electroanalysis*

**Monday
April 21 at 4
pm in 126
Schrenk**

Please contact
Dr. Amitava
Choudhury at
choudhurya@mst.edu
for further
information.

MISSOURI
S&T

Abstract: Electrochemistry offers unique approaches for promoting and mechanistically studying chemical reactions and has garnered increasing attention across various areas of chemistry. This expansion necessitates the enhancement of traditional electrochemical cells, which are intrinsically constrained by mass transport limitations. Herein, we present an approach for designing an electrochemical cell by limiting the reaction chamber to a thin layer of solution, comparable to the thickness of the diffusion layer. This thin-layer electrode (TLE) provides a modular platform to bypass the constraints of traditional electrolysis cells and perform electrolysis reactions on the timescale of electroanalytical techniques.¹ The utility of the TLE for electrosynthetic applications is benchmarked using NHPI-mediated electrochemical C-H functionalization.² The application of microscale electrolysis for studying drug metabolites is demonstrated by elucidating the oxidation pathways of paracetamol and acebutolol.³ Moreover, hosting a microelectrode within the TLE enables real-time probing of the profiles of redox-active components in these rapid electrosynthesis reactions. We also showcase the combination of the thin-layer electrode (TLE) and microelectrode (ME) to study the elementary steps involved in the mechanism of electrochemically driven Ni-catalyzed biaryl coupling, addressing some of its limitations.

1. B.T. Punchihewa, L. Khalafi, M. Rafiee, *Curr. Opin. Electrochem.* **2024**, *44*, 101445.
2. B.T. Punchihewa, V. Minda, W.G. Gutheil, M. Rafiee, *Angew. Chem. Int. Ed.* **2023**, *62*, e202312048.
3. N. Nikzad, B.T. Punchihewa, V. Minda, W.G. Gutheil, M. Rafiee, *Anal. Chem.* **2024**, *96*, 20026-20032.

About the speaker: **Mohammad Rafiee** earned his BS and Ph.D. degrees from Bu-Ali Sina University (Iran), where he carried out research on electrosynthesis. In 2008, he started his academic career at the Institute for Advanced Studies in Basic Sciences (IASBS), focusing on the development of electrodes modified with mediators for electrosynthetic applications. In 2014, he joined Prof. Shannon Stahl's group (University of Wisconsin-Madison) and pursued a collaborative study on mediated electrochemical reactions and electrosynthesis. In 2019, he joined the University of Missouri-Kansas City as an Assistant Professor. His research focuses on electrosynthesis and molecular electrochemistry, as well as enhancing pedagogical approaches to incorporate electrochemistry into the undergraduate curriculum.

Honors:

Award for Excellence in Mentoring Undergraduate Researchers (2024)

This award is presented to UMKC faculty members who actively support undergraduate students' scholarly research and contribute to their long-term professional development.

UMKC Trustees' Faculty Scholar Award (2023)

This award recognizes faculty members who demonstrate exceptional promise for future research and/or creative achievements.

UMKC Early Career Award (2021)

Funded by the Emeritus College endowment, this award is given to early-career faculty members in recognition of their excellence in research and teaching.

National Foundation of Elite Fellowship (2009)

This fellowship is awarded to young Iranian scientists who have demonstrated significant innovation or invention in the fields of science and technology.

Khwarizmi Young Award (2008)

This national award, given by the Iranian Research Organization for Science and Technology (IROST), recognizes young individuals who have made notable contributions to scientific research.