The Bioelectrocatalytic Bridge: Coupling Anodic and Cathodic Reactions for Advanced Sensing and Electrosynthesis

Wassim El Housseini
Post-doctoral fellow, Minteer Group
Department of Chemistry
Missouri S&T

Chemistry Seminar on Electroenzymatic systems for selective catalysis

Monday December 1 at 4 pm in 126 Schrenk

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

Abstract: Electroenzymatic systems offer a versatile route to couple selective catalysis with precise electrochemical control, enabling sustainable synthesis and sensing under mild conditions. By integrating enzymatic transformations within electrochemical architectures, it becomes possible to synchronize oxidation and reduction processes through controlled electron flow. This approach has been applied to catalytic hydrogenation reactions in continuous-flow reactors, where paired electrochemical design allows efficient cofactor recycling and enhanced reaction rates. Redox polymer networks have further been designed to couple glucose oxidation and oxygen reduction, improving both signal stability and sensitivity in bioelectrocatalytic sensors. Extending these concepts to isotopic chemistry, electroenzymatic tools now allow stereoselective deuteration of pharmaceutical precursors through in-situ NAD(P)H regeneration and enzymatic hydrogen transfer. Together, these examples demonstrate how tuning interfacial electron dynamics and cofactor cycling can drive complex biotransformations while minimizing energy loss, establishing a foundation for the next generation of sustainable and programmable bioelectrocatalytic platforms.

About the speaker: Wassim El Housseini is a postdoctoral researcher in the Minteer Lab at the Missouri University of Science and Technology. He earned his Ph.D. in Chemistry from the University of Lorraine (France) in collaboration with the CNRS, where he developed hybrid bioelectrocatalytic reactors for NAD(P)H regeneration and enzymatic synthesis. Before his doctoral work, El Housseini completed a Master of Science in Chemical Engineering at Sorbonne University (Paris, France) and a Master of Science in Physical Chemistry of Materials at the Lebanese University (Beirut, Lebanon), where he also earned his bachelor's degree in chemistry. His research explores the intersection of electrochemistry and biocatalysis, focusing on redox polymer dynamics, enzyme–electrode interfaces, and flow reactor design for sustainable electrosynthesis and bioenergy conversion. His work has enabled key advances in catalytic hydrogenation reaction glucose–oxygen biofuel systems, hydrogen isotope exchange for pharmaceutical synthesis, and CO_2 reduction. El Housseini has published in leading journals including JACS Au, Chemical Engineering Science, ChemElectroChem, and ACS Sensors, and regularly presents his work at international conferences of the International Society of Electrochemistry (ISE) and the Bioelectrochemical Society (BES).