CASE WESTERN RESERVE UNIVERSITY

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

is pleased to present,

THE 2024 HIGLEY LECTURE

BRUCE E. LOGAN, PH.D., NAE, CAE - Penn State University

Date: *Thursday, March 28th, 2024*

Lunch *at 12:00pm, followed by* ***Seminar*** *at 12:45pm, Adelbert Hall, Toepfer Room*

Reception *at 4:00pm, Bingham Building, Geotech Lab, Room 286*

Innovations in Green Hydrogen using Novel Water Electrolyzers and Microbial Electrolysis Cells

Abstract: Hydrogen gas is central to many plans to decarbonize our energy infrastructure to address climate change but the H_2 must be made without CO_2 emissions from fossil fuels. Two methods of green H_2 production are discussed in this presentation: water electrolyzers (WE) supplied with impaired (salty) water and renewable electricity; and microbial electrolysis cells (MECs) fueled by biomass. Thin-film composite (TFC) membranes that are mass manufactured for seawater desalination using reverse osmosis present an interesting opportunity for WE applications. These membranes enable the use of impaired waters due to their high rejection of salt ions but effective transport of water ions (protons and hydroxide ions). H_2 production using certain TFC membranes in WE can be comparable to traditional ion exchange membrane systems based on cell overpotentials and rates. The structural layer of the TFC membrane contributes to energy losses (and thus internal resistance) but additional active layers can be added with no energy loss impact to reduce chloride ion transport. An alternative approach to WE is based on using biomass for H_2 generation in MECs by using bacteria to generate an electrical current that can be used to drive electrochemical evolution of H_2 gas. Recent advances have been made by my group in reducing internal resistance, thus enabling MECs to produce much higher H_2 gas generation rates per energy input into the system. Overall, these different two electrochemically based processes could enable more economical directions in green H_2 production to help decarbonize our energy infrastructure.

Dr. Bruce E. Logan is Director of the Institute of Energy and the Environment, an Evan Pugh University Professor in Engineering, and the Stan and Flora Kappe Professor of Environmental Engineering in the Department of Civil and Environmental Engineering at Penn State University. His current research efforts are in bioelectrochemical systems, renewable energy production, the development of an energy sustainable water infrastructure, and education on energy, carbon emissions, and climate. Dr. Logan has mentored over 140 graduate students and post docs and hosted over 40 international visitors to his laboratory. He is the author or co-author of several books and over 550 refereed publications (>115,000 citations, h-index=164; Google scholar). Logan is a member of the US National Academy of Engineering (NAE), an international member of the Chinese Academy of Engineering (CAE), and a fellow of the American Association for the Advancement of Science (AAAS), the International Water Association (IWA), the Water Environment Federation (WEF), and the Association of Environmental Engineering & Science Professors (AEESP). Logan is a guest professor at several universities including Tsinghua University and Harbin Institute of Technology (HIT), with ties to several other universities in Saudi Arabia, the UK, and Belgium. He received his Ph.D. in 1986 from the University of California, Berkeley, was on the faculty of the University of Arizona before joining Penn State in 1997.

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