UAA College of Engineering
University of Alaska Anchorage

UAA Professional Development Seminar Series

Fuel-Flexible Fuel Cells: A Potential Solution for Backup and Remote Power Applications

Presented by Dr. Ryan O'Hayre

ABSTRACT: Fuel cells provide one of the most efficient means for converting the chemical energy stored in a fuel to electrical energy. Fuel cells offer improved energy efficiency and reduced pollution compared to heat engines. A complete fuel cell system amounts to a small chemical plant for the production of power. The first half of this professional development seminar provides students with an introduction to the fundamental aspects of fuel cell operating principles, devices, systems, and applications, with a special focus on their potential for backup and remote power—a particularly relevant application for Alaska.

The second part of this lecture will introduce students to recent exciting advancements in fuel cell and related electrochemical devices based on emerging proton-conducting ceramic materials. Compared to existing fuel cell technologies, protonic-ceramic devices are far less mature. However, they are particularly well suited to operate on diverse fuel sources and for "battery-like" reversible operation. We will review recent research efforts at the Colorado School of Mines focused on developing protonic ceramics for these applications, including hydrocarbon-tolerant protonic ceramic fuel cells for electricity generation (PCFCs), protonic ceramic electrolyzers for fuel synthesis (PCECs), and reversible protonic-ceramic electrochemical cells for energy storage (RePCECs).

Dr. Ryan O'Hayre: Prof. O'Hayre's group at the Colorado School of Mines develops new materials and devices to enable alternative energy technologies, with a particular focus on ceramic fuel cells and electrolyzers. Current fundamental research interests extend to aspects of high-temperature catalysis, electrochemistry, solid-state-ionics, electronic and ionic oxides. Prof. O'Hayre is lead author of Fuel Cell Fundamentals, the world's best-selling textbook on fuel cell science and technology (translated into multiple languages) and has published >200 peer-reviewed publications in the field, including papers in Science and Nature, as well as several patents and book chapters. He has received several young-investigator research and teaching honors including the 2009 Presidential Early Career Award in Science and Engineering (PECASE), the US's top honor for early-career scientists and engineers. Since 2022, he has served as University Distinguished Professor at the Colorado School of Mines

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