THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT
WINTER COLLOQUIUM SERIES PRESENTS:

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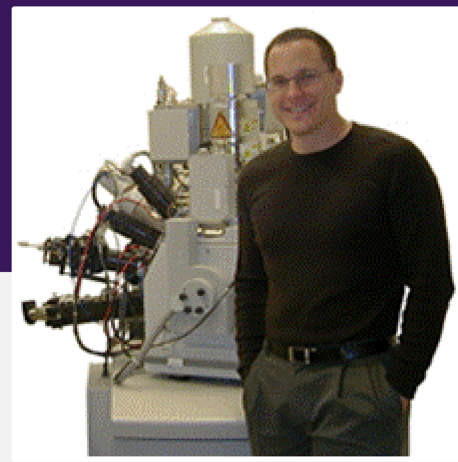

Interface and Oxygen-Vacancy-Polaron Engineered Solid Fuel Cell Materials

Solid Oxide Fuel Cells (SOFCs) are multi-layer, multi-component devices with some of the highest energy densities and highest demonstrated efficiencies of any chemical to electrical energy technology. In addition, they can be operated in reverse, as Solid Oxide Electrolysis Cells (SOECs), to store energy and/or produce chemicals. Unfortunately, despite being invented in the early 20th century, SOFCs remain a niche technology. In response, the SOFC community has sought to incorporate many different materials (often with engineered point defect concentrations), across multiple different length scales, to improve SOFC performance, durability, and cost. However, controlling the interfacial interactions between these various materials, and the point defects within them, has remained challenging. Hence, this talk will highlight some of our group's recent success in demonstrating 1) how Atomic Layer Deposited (ALD) thin films or pre-infiltrated secondary-phase particles improve SOFC cathode performance and durability through SOFC interface modification, 2) how secondary phases can boost the oxygen surface exchange coefficient (k) of SOFC cathode materials, 3) how new, in situ, contact-free techniques can be used to measure k without the use of potentially-performance-altering current collectors, 4) how porous and/or patterned nickel interlayers can be used to direct the wetting and spreading of molten silver on ceramic substrates for novel joining and/or current collector applications, and 5) how oxygen vacancy electron disproportionation controls the oxygen vacancy polaron shapes and sizes that, in turn, control the ionic conductivity and elastic dipoles of common SOFC materials.

Dr. Jason D. Nicholas is an Associate Professor in the Chemical Engineering and Materials Science Department at Michigan State University (MSU). His group develops new functional materials, processing routes, characterization techniques, and high-performance electrochemical devices to better understand and preserve the Earth. Presently, his group is focused on a) mechano-chemical coupling in electro-chemically active solids, b) high-temperature ceramic to metal seals, c) nano-composite Solid Oxide Fuel Cell electrodes, and d) strain-engineered thin films for Catalysis and Mineral Physics applications. He earned a B.S. in Geoscience, with Honors, from Franklin & Marshall College in 2000, a M.S. in Materials Science and Engineering from the University of Illinois Urbana-Champaign in 2003, and a Ph.D. in Materials Science and Engineering from the University of California Berkeley in 2007. After a PostDoc position at Northwestern University, he joined the faculty at MSU in 2010. His innovative teaching and research have earned him a MSU Withrow Teaching Award and a National Science Foundation (NSF) CAREER Award. Jason has also served as the lead organizer for a NSF-sponsored "Solid Oxide Fuel Cells- Promise, Progress, and Priorities" workshop, the inaugural organizer of an annual MSU Girl Scout STEM Demo Day, and a guest editor for a Journal of the Electrochemical Society Focus Issue on mechano-electro-chemical coupling. Updates on his work can be found at https://www.egr.msu.edu/nicholasgroup/

Tuesday, February 9 • 4 pm CT • Zoom

Registration is required. RSVP link.

Questions? Contact Kristina.lugo@northwestern.edu.

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