WestVirginiaUniversity.
BENJAMIN M. STATLER COLLEGE OF ENGINEERING AND MINERAL RESOURCES

MATERIALS SCIENCE AND ENGINEERING (MS&E) SEMINAR SERIES
Friday August 30, 2019 at 3:00 PM in room 251 ESB

High-Efficiency Electrical Energy Storage Using Reversible Solid Oxide Cells

Scott Barnett
Department of Materials Science and Engineering
Northwestern University

Abstract: Electrical energy storage is a key technology needed for enabling increased utilization of renewable wind and solar energy resources, as needed for mitigation of CO_2 emissions. While many technologies are being considered, the grid "load shifting" application – storing excess electricity for several hours until there is demand – remains challenging. This presentation will discuss the use of reversible solid oxide cells for such grid-scale energy storage. One approach is to electrolytically produce a fuel that can subsequently be used for, *e.g.*, transportation. Another approach is similar to a flow battery – a fuel is first produced by using the solid oxide cell in electrolysis mode, stored, and then on demand converted back to electricity using the solid oxide cell in fuel cell mode. These approaches can provide large energy storage capacities when couple with large-capacity storage of the product gases. Usually this involves steam electrolysis and storing the energy as hydrogen. Another method that can yield improved efficiency > 70% is also described, utilizing a storage chemistry where the fuel cycles between H_2O-CO_2-rich and CH_4-rich gases. For electrolysis and reversible application, however, improved solid oxide cells are needed that can provide useful current densities at relatively low overpotentials. In order to be economically viable, they should operate for long times and many thousands of storage cycles, and hence it is important to avoid degradation mechanisms often observed during solid oxide electrolysis. The second half of this talk describes recent work done on developing improved solid oxide cells and studying their long-term stability in electrolysis mode and under reversing-current cycling.

Biography: Scott A Barnett is a professor in the Department of Materials Science and Engineering at Northwestern University. His research utilizes physical vapor and colloidal deposition methods for producing ceramic materials with energy applications, including Li-ion battery electrodes and solid oxide fuel cells. Focus areas include three-dimensional tomography of electrode microstructure for understanding electrochemical processes and degradation phenomena, SOFC operation with hydrocarbon fuels, reversible solid oxide cells for energy storage, and development of new fuel cell anode and cathode materials.

MS&E Seminar Series is sponsored by the Department of Chemical Engineering, Lane Department of Computer Science and Electrical Engineering, and Department of Mechanical and Aerospace Engineering