

Transmission X-ray Microscopy of Energy Materials: Progress, Challenges and Opportunities

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Fuel cells, reversible electrochemical cells, and ceramic separation membranes are energy materials that exhibit functional behavior in a manner that controls their collective performance as an energy material. There is a critical need to understand the role of an energy material's structure, morphology, and composition on device performance. This talk will present an approach to image and characterize energy materials using synchrotron-based transmission x-ray microscopes at NSLS, APS, and SSRL. Sample volumes are prepared, imaged, tomographically reconstructed, and digitally segmented to identify ionic, electronic, and/or gaseous 3-D transport channel structures at up to 17 nm spatial resolution. XANES nanotomography is then used to map out nanoscale poisoning scales and phases in 3-D. Preliminary results using *in situ* TXM for direct observation of the fuel cell material under operational conditions will be presented. The goal of this study is to establish quantitative links between material microstructure, elemental/chemical composition, material properties, and performance. *This work is supported by an Energy Frontier Research Center on Science Based Nano-Structure Design and Synthesis of Heterogeneous Functional Materials for Energy Systems (HeteroFoam Center) funded by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences (Award DE-SC000106).*

About the Speaker

Wilson K. S. Chiu joined the University of Connecticut in 1999 where he is now Professor in the Department of Mechanical Engineering. He earned his M.S. and Ph.D. degrees in Mechanical Engineering from Rutgers University in 1997 and 1999, respectively. His research is supported by the U.S. Department of Energy, National Science Foundation, Office of Naval Research, Army Research Office, and industry. He published 81 journal articles and 130 conference articles/abstracts. Among his honors, he was elected into the *Connecticut Academy of Science and Engineering* in 2013, received the *Rutgers University School of Engineering Medal of Excellence Award* in 2010, the *United Technologies Corporation Professorship in Engineering Innovation* in 2008, the *ASME Bergles-Rohsenow Young Investigator Award in Heat Transfer* in 2006, the *U.S. Army Research Office Young Investigator Award* in 2005, and the *National Science Foundation CAREER Award* and the *Office of Naval Research Young Investigator Award* in 2001. He serves on the executive committee of the *ASME Advanced Energy Systems Division*, chairman of the *ASME Advanced Energy Systems Division Technical Committee on Electrochemical Energy Conversion and Storage*, associate editor for the *ASME Journal of Heat Transfer*, and associate editor for the *International Journal of Thermal Sciences*. He has served as organizer, session chair/co-chair, or on the program committee for over 50 conferences and workshops, and has given over 70 keynote and invited lectures in the United States and abroad.