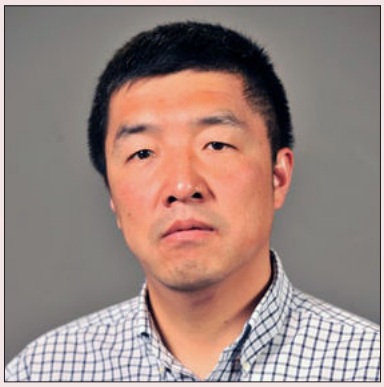
Nebraska Center for Materials and Nanoscience

2018 Fall Seminar Series

Co-sponsored with the Dept. of Mechanical & Materials Engineering

Xingbo Liu

Professor & Associate Chair of Research
West Virginia University



Roles of Oxygen Lattice Defects on the Oxygen Reduction Reaction Kinetics in Solid Oxide Fuel Cell Cathodes

We report our research on the roles of oxygen defects on oxygen reduction reaction (ORR) kinetics of solid oxide fuel cell (SOFC) cathode. For perovskites, we developed a multi-domain 1-D physical model incorporating multi-step charge transfer to examine the competitive behaviors between the paralleled 3PB and 2PB kinetic pathways. Analyses identified the limitation of surface oxygen ion diffusion as the mechanism for 3PB-to-2PB transition. The model also proved surface reactions are driven predominantly by electrochemical forces at the 3PB, while being controlled by oxygen vacancy concentration variation at regions away from 3PB. For Ruddlesden–Popper (R-P) phases, the governing factors of the ORR are identified as oxygen adsorption and incorporation. The incorporation rate is drastically dependent on the amount of interstitial oxygen. Since the unfilled interstitial sites serve to accommodate the adsorbed oxygen during incorporation, more oxygen interstitials would seem to suppress the kinetics of this process. We proposed a physical model to reconcile the discrepancy between the experimental results and intuitive reasoning. This model illustrates a possibility of how oxygen interstitials works to regulate the exchange rate, and how the contradiction between oxygen vacancies and oxygen interstitials is harmonized so that the latter in the R–P structure also positively promotes the incorporation rate in the ORR.

Dr. Xingbo Liu received his Ph.D. on Materials Science from University of Science and Technology Beijing in 1999, and he subsequently went to West Virginia University as a postdoc. Currently, he is the Statler Endowed Chair in Enginering & associate chair for research in Mechanical & Aerospace Engineering Department at West Virginia University. Dr, Liu's has developed an international recognized research program on materials for next generation energy conversion and storage, with the focus on solid oxide fuel cells, high temperature alloys, and batteries. Dr. Liu has been serving leading roles in TMS, ACerS, and ECS, and he has received numerous awards, including one R&D 100 Award (2011) for his development of SOFC interconnect coating, TMS Early Career Faculty Fellow Award (2010), State of West Virginia Innovator of the Year (2013), WVU CEMR Researcher of the Year (2015, 2011), Outstanding Researcher Awards (2015, 2011, 2009, 2008), and several others. Most recently, Dr. Liu was elected as the Fellow of ASM International (2015), and received TMS Brimacombe Medal (2016).

NCMN

November 27, 2018 | 3:30 pm
110 Jorgensen Hall

Host: Li Tan
Department of Mechanical & Materials Engineering