Nanoscale Electrodes for Solid Oxide Cells: Fabrication, Microstructure and Stability

Aligül Büyükaksoy
Gebze Technbical University

Solid oxide cells (SOCs) are high-temperature (600-800 °C) electrochemical devices that can both convert electricity and water to hydrogen and oxygen hydrogen and vice versa – a trait that can address the intermittency problem of renewables. The combination of these two technologies can address the carbon emission issues we are facing today. SOCs are associated with challenges, including insufficient electrochemical performance and degradation of microstructures and materials chemistries upon long-term exposure to operating conditions. For example, SOC electrodes fabricated by conventional powder-based methods are short of electrochemically active electrocatalyst-ionic conductor-gas triple phase boundaries (TPBs), their electrocatalysts undergo agglomeration and diminish TPBs, and Sr segregates to the surfaces of (La, Sr)(Co/Fe/Mn)O 3 -type perovskite oxygen electrocatalysts to finally deactivate them. Changing the electrode fabrication approach from a powder sintering-based route into a liquid precursor-based one generates several opportunities to address these challenges. First, it enables the fabrication of nanoscale composites from a single precursor, to form electrocatalyst and ionic conductor phases via self-assembly, which yields extremely long TPBs. Second, the layer-by layer nature of this approach enables the application of multiple interlayers, which can be tailored to mechanically constrain electrocatalyst agglomeration, reverse the concentration gradients to avoid cation segregation or generate desired interfaces for synergistic other synergistic effects, thereby addressing many challenges SOCs are facing. In this talk, microstructure – electrochemical performance relationships in nanoscalecomposite SOC electrodes will be elaborated. Impact of the introduction of multiplenanolayers on the structural and chemical stability of electrodes is discussed.

Aligul Buyukaksoy Aligül Büyükaksoy obtained his BS and MSc degrees in Materials Science and Engineering from Gebze Technical University (then, Gebze Institute of Technology) in 2007 and 2009, respectively. He completed his PhD work in 2013, at Missouri University of Science and Technology in the same field. Through Eyes High and Calgary Innovates – Technology Futures fellowships, he then worked under the supervision of Prof. Viola Birss at the University of Calgary for two years. In 2016, he joined the Materials Science and Engineering department, at Gebze Technical University as an assistant professor and got promoted to associate professor position in 2021. His research interests include solid oxide cells, defect chemistry, solid state electrochemistry, electroceramics and ceramic fabrication techniques.