Title
Characterization of Metal-Supported Solid Oxide Electrolysis Cells Using FIB-SEM-TEM Techniques

Journal
ECS Meeting Abstracts, MA2026-01(42)

ISSN
2151-2043

Authors
Hu, Boxun
Ko, Jiwoo
Zhu, Zhikuan
et al.

Publication Date
2026-07-07

DOI
10.1149/ma2026-01422112mtgabs

Characterization of metal-supported solid oxide electrolysis cells using FIB-SEM-TEM techniques

Boxun Hu[1], Jiwoo Ko[2,3], Zhikuan Zhu[1], Mary Scott[2,3], Michael C. Tucker[1]

1: Lawrence Berkeley National Laboratory, Energy Storage and Distributed Resources Division, 1 Cyclotron Rd., MS 62-203, Berkeley, CA 94720, United States

2: University of California, Berkeley, Department of Materials Science and Engineering, 2607 Hearst Ave, Berkeley, CA 94720, United States

3. National Center for Electron Microscopy, Molecular Foundry, Lawrence Berkeley National Laboratory, 1 Cyclotron Rd., Berkeley, CA 94720. United States

This talk will present advanced characterization methods for pretest and posttest metal-supported solid oxide electrolysis cells (MS-SOEC). A unique symmetric cell architecture design, developed at Lawrence Berkeley National Laboratory (LBNL), has thin zirconia ceramic backbones and electrolyte sandwiched between porous metal supports, offers strong mechanical ruggedness, extremely fast start-up capability, and excellent tolerance to redox and dynamic operation for hydrogen production. Like conventional SOECs, MS-SOECs face component degradation that shorten lifetimes, making it critical to understand and mitigate component degradation and cell failure utilizing advanced characterization techniques.

The metal support at the air side introduces chromium migration. A thin protective layer ($CuMn_{1.8}O_x$) has been deposited on the metal support by electrophoretic deposition (EPD) to mitigate chromium evaporation and diffusion. Prior to EPD, the precursor particle size (5-10 μm) was reduced to the nano-size range (20-200 nm) by high energy ball-milling, as analyzed by Dynamic Light Scattering (DLS). MS-SOECs with/without EPD protective layers have been tested for 1 kh. Focused Ion Beam -Scanning Electron Microscopy- Transmission Electron Microscopy (FIB-SEM-TEM) has been utilized for preparing and analyzing samples at both microscale and nanoscale at select regions of interest. In-depth characterization provides critical information such as chemical compositions, morphologies, and structural state of cell components for cell optimization and development of EPD protocols. After 1kh steam electrolysis operation, FIB-TEM maps shows that chromium was confined under the EPD coating layer. The Cr/La ratio at LSCF electrode near electrolyte in the best EPD coated cell was significantly decreased by >20 times compared to that without EPD coating. Varied thickness (100 nm-5 μm) of EPD coatings and its impact on cell stability will allow us to determine optimal EPD coating thickness. Evaluating the interface layer near the electrolyte by FIB-SEM provides the nickel catalyst agglomeration and chromium deposition profiles. Overall, FIB-SEM-TEM techniques provide the ability to observe chemical and structure changes at micro/nano-meter scale and provide insight into cell component degradation mechanisms.