In situ study of anode reaction in intermediate temperature solid oxide fuel cells

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_theme_
Oxygen evolution reaction (OER) has been studied by in situ EELS at the anode side of the intermediate temperature solid oxide fuel cells (IT-SOFC). Gd_{0.2}Ce_{0.8}O_{2-α} electrolyte films were fabricated by PLD method at two different levels of crystallinity. TEM specimens of GDC-Ni anodes were prepared by the FIB micro-sampling technique.

_IT-SOFC Anodes’ Microstructure_
Low resolution images of modeled half cells. A uniform 86 nm SiO_{2} layer has been formed during the burning process of electrolyte, GDC_{b}.

_In situ EELS_
Ni-L edges changes in both studied anodes showed NiO formation at elevated temperatures. However, cerium cations remained at tetra-valent state and gadolinium cations were partially oxidized from tri-valent to tetra-valent cations. O-K edges at GDC-Ni interface showed the specific features of CeO_{2} at elevated temperatures. Also, O-K edges at SiO_{2}-GDC_{b} interface showed the overlapped spectra of SiO_{2} and CeO_{2}.

_GDC Electrolyte Characterization_
Both as deposited and burned electrolytes showed typical characteristics of fluorite cubic structure. However, higher crystallinity and grain growth in GDC_{b} are obvious in the XRD and nano electron diffraction patterns.

_Ex situ EDS_
STEM-EDS elemental maps of the operated anode in TEM showed no interdiffusion between electrolyte-electrode components during the OER.

_Conclusion_
OER was detected by EELS in IT-SOFC’ anodes at intermediate temperatures as low as 200°C. Nickel electrodes were oxidized as the oxygen anions migrate from the electrolyte to the electrode. The OER mechanism showed no difference between two GDC electrolytes. No interdiffusion was found between the cell components in the operated anodes.