

## COMPREHENSIVE UNDERSTANDING OF CATHODIC AND ANODIC POLARIZATION EFFECTS ON STABILITY OF NANOSCALE OXYGEN ELECTRODE FOR REVERSIBLE SOLID OXIDE CELLS

Jong-Ho Lee, Korea Institute of Science and Technology, South Korea  
jongho@kist.re.kr

Ho-Il Ji, Korea Institute of Science and Technology, South Korea  
Sung Min Choi, Korea Institute of Science and Technology, South Korea  
Junsung Ahn, Korea Institute of Science and Technology, South Korea  
Hyoungchul Kim, Korea Institute of Science and Technology, South Korea  
Kyung Joong Yoon, Korea Institute of Science and Technology, South Korea  
Ji-Won Son, Korea Institute of Science and Technology, South Korea  
Byung-Kook Kim, Korea Institute of Science and Technology, South Korea  
Hae-Weon Lee, Korea Institute of Science and Technology, South Korea

Key Words: Solid oxide cell, Oxygen electrode, Degradation, Polarization, LSCF

Whereas solid oxide cells (SOCs), which perform dual functions of power generation (fuel-cell mode) and energy storage (electrolysis mode) with high efficiency at high temperatures, are considered a potent candidate for future energy management systems, it is yet far from their practical use due to the fact that the stable long-term operations have not been achieved. Particularly, degradations of oxygen-electrode in the both electrolysis and fuel-cell operations are considered as the most imminent issues that should be overcome. Unfortunately, even the origins and mechanisms of degradation in the oxygen-electrode have not been clearly established due to the difficulties in precise assessments of microstructural/compositional changes of porous electrode, which is a typical form in actual solid oxide cells, and due to the diversities in operating conditions, electrode structure and material, fabrication history, and so on. We simultaneously investigated the degradation phenomena in electrolysis and fuel-cell operations for 540h using identical two half cells composed of a geometrically well-defined, nanoscale  $\text{La}_{0.6}\text{Sr}_{0.4}\text{Co}_{0.2}\text{Fe}_{0.8}\text{O}_{3-\delta}$  (LSCF) dense film with a thickness of  $\sim 70$  nm on  $\text{Ce}_{0.9}\text{Gd}_{0.1}\text{O}_{2-\delta}$  electrolyte. Owing to the benefit of well-defined geometry of LSCF thin film, the microstructural/compositional changes in LSCF films were successfully analyzed in nanoscale, and the correlation between the components of electrochemical impedance and the major origins resulting in degradations was clarified. Furthermore, we suggest the most probable degradation mechanisms, and importantly, it is newly suggested that kinetic demixing/decomposition of LSCF, which is not readily observable in the typical porous-structured electrode, are highly probable to affect the both fuel-cell and electrolysis long-term degradations.