

The effect of reduction atmosphere on the LaGaO₃-based solid oxide fuel cell

Jae Yeon Yi and Gyeong Man Choi

Department of Materials Science and Engineering, Pohang University of Science and Technology, San 31, Hyoja-dong, Pohang, 790-784, South Korea

The electrolyte for solid oxide fuel cells (SOFCs) is required not only to have high oxygen-ion conductivity but also to have a high stability under severe operating conditions, such as high temperature and large oxygen-partial pressure (P_{O_2}) gradient for a long time. LaGaO₃-based electrolytes may easily decompose in reducing atmosphere.

Examination of P_{O_2} dependence of overpotential is one method to determine the reduction mechanism of the electrolyte. As P_{O_2} decreases, the cathodic overpotential of electrolyte normally increases. High cathodic overpotential develops even at low current density and tends to reduce the electrolyte. However, the effect of high potential on the cathode and electrolyte is not yet clear for LaGaO₃ – based electrolyte. In this study, the change in cathode performance and electrolyte properties under high overpotential condition were examined.

The ohmic- and the over-potential values were measured by using a current interruption device (Doosung Induction, model DSI-10, Korea), a current source (Solartron, SI 1287, UK) and a digitizing oscilloscope (Tektronix, TDS 3032, USA). The electrochemical measurement was performed between 800 and 900 °C in P_{O_2} between 1 and 0.003. Microstructure was observed by a field-emission scanning electron microscope. X-ray diffraction measurement was used to determine the phases of cell before and after electrochemical measurement.

Chemical stability of La_{0.9}Sr_{0.1}Ga_{0.8}Mg_{0.2}O₃ (LSGM) as an electrolyte for SOFCs was investigated during the electrochemical measurement. At low oxygen-partial pressure (~0.003 atm), the LSGM electrolyte partly decomposed due to the development of high overpotential even at low current density, i.e., due to the induced reduction atmosphere near the cathode. The morphology of LSGM grain near cathode changed due to the formation of new phases. The main decomposition phases were La₂O₃, La(OH)₃, and LaSrGaO₄. The polarization conductance increased due to the microstructural change in LSM and thus the increase in the specific surface area of the LSM electrode.