A HIGHLY ACTIVE AND REDOX STABLE NOVEL CERAMIC ANODE WITH IN-SITU EXSOLUTION OF NANOCATALYSTS

Kang Taek Lee, DGIST(Daegu Gyeongbuk Institute of Science and Technology), KOREA
ktlee@dgist.ac.kr
Kyeong Joon Kim, DGIST(Daegu Gyeongbuk Institute of Science and Technology), KOREA
Manasa K. Rath, DGIST(Daegu Gyeongbuk Institute of Science and Technology), KOREA
Hunho H. Kwak, DGIST(Daegu Gyeongbuk Institute of Science and Technology), KOREA
Hyung Jun Kim, University of Seoul, KOREA
Jeong Woo Han, POSTECH(Pohang University of Science and Technology), KOREA
Seung-Tae Hong, DGIST(Daegu Gyeongbuk Institute of Science and Technology), KOREA

Key Words: Solid oxide fuel cell, Ceramic anode, Layered perovskite, Redox stability, Exsolution,

Layered perovskite novel ceramic anode (referred to as SGNM) phases were evaluated for use in solid oxide fuel cells (SOFCs). Hydrogen temperature programmed reduction (H_2-TPR) analysis of the SGNM materials revealed that significant exsolution of Ni nanoparticles occurred. Consistently, the SGNM on the LSGM electrolyte showed low electrode polarization resistance in H_2 at 800 °C. Moreover, after 10 redox cycles at 750 °C, the electrode area specific resistance of the SGNM anode in H_2 slightly increased during cycle, indicating excellent redox stability in both reducing and oxidizing atmospheres. An LSGM-electrolyte supported SOFC employing an SGNM-based anode yielded a high power density of ~1 W cm^{-2} at 800 °C, which is the best performance among the any SOFCs with Ruddlesden-Popper based ceramic anodes to date. After performance measurement, we observed that metallic Ni nanoparticles (~ 25 nm) were grown in situ and homogeneously distributed on the SGNM anode surface. These exsolved nanocatalysts are believed to significantly enhance the hydrogen oxidation activity of the SGNM material. These results demonstrate that the novel SGNM material is promising as a high catalytically active and redox-stable anode for SOFCs.

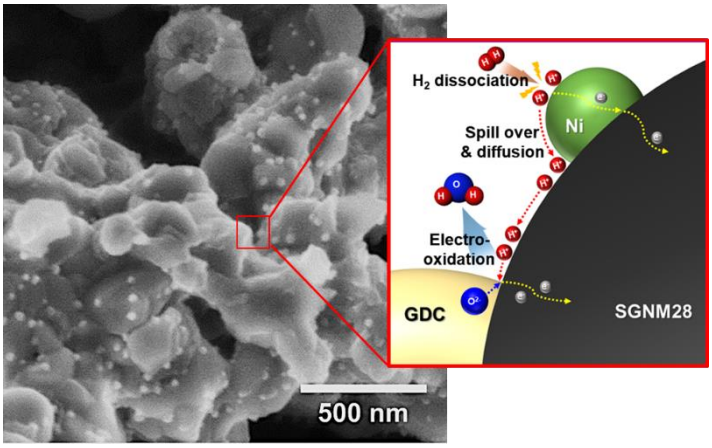

Figure 1 – SEM image and Schematic diagram of HOR mechanism for SGNM with Ni-nanocatalyst.