C-7

Development of Cobalt-free $La_xSr_{4-x}Fe_6O_{13}$ ($0 \leq x \leq 2$) Intergrowth Cathode Material for Solid Oxide Fuel Cells

이승준, 용석민, 김동석, 김도경†

KAIST
(dkkim@kaist.ac.kr†)

Cobalt-free $La_xSr_{4-x}Fe_6O_{13}$ ($0 \leq x \leq 2$) oxide have been synthesized and investigated as a potential cathode material for solid oxide fuel cells (SOFCs). $Sr_4Fe_6O_{13}$ consists of alternating perovskite layers ($Sr_4Fe_2O_8$) containing iron cations in octahedral oxygen coordination and Fe_4O_5 layers where iron cations have 5-fold coordination of two types-square pyramids and trigonal bipyramids. Our preliminary electrochemical testes of pristine $Sr_4Fe_6O_{13}$ show a rather high area specific resistance ($0.47\Omega cm^2$ at 700°C) for ~20 μm thick layers with CGO electrolyte. The electrochemical performances are improved by La addition up to x=1 ($La_1Sr_3Fe_6O_{13}$, $0.06\Omega cm^2$ at 700°C). In addition, thermal expansion coefficient (TEC) values of $La_1Sr_3Fe_6O_{13}$ specimen demonstrated 15.1×10^{-6} $^oC^{-1}$ in the range of 25-900°C, which provides good thermal expansion compatibility with the CGO electrolyte. An electrolyte supported (300-μm-thick) single-cell configuration of $La_1Sr_3Fe_6O_{13}$/CGO/Ni-CGO delivered a maximum power density of 584 $mWcm^{-2}$ at 700°C. In addition, an anode supported single cell by YSZ electrolyte (10-μm-thick) with a porous CGO interlayer between the cathode and the electrolyte to avoid undesired interfacial reactions exhibited 1,517 $mWcm^{-2}$ at 800°C. The unique composition of $La_1Sr_3Fe_6O_{13}$ with low thermal expansion coefficient and higher electrochemical properties could be a good cathode candidate for intermediate temperature SOFCs with CGO and YSZ electrolyte.

Keywords: Solid oxide fuel cells, Cathode, Electrochenical properties

C-8

Pt/MOF-5 Hybrid Composite Encapsulated with Microporous Carbon Black to Improve Hydrogen Storage Capacity and Hydrostability

여신영, 곽승엽†

서울대학교 재료공학부
(sykwak@snu.ac.kr†)

Metal organic frameworks (MOF) have generated considerable interests as a potential candidate for hydrogen storage owing to their extremely high surface-to-volume ratio and low density. In this study, Pt nanoparticles of about 3 nm in size were introduced outside MOF-5 [Zn_4O(1,4-benzenedicarbocylate)3], which was then encapsulated with hydrophobic microporous carbon black (denoted CB@Pt/MOF-5) in order to enhance hydrogen uptake capacity without decreasing the specific surface area and hydrostability. To study the chemical composition, morphology, crystal information, and properties of the synthesized material, a variety of techniques is employed, including WXRD, XPS, ICP-AES, FE-SEM, HR-TEM, and N2 adsorption-desorption, confirming the formation of novel hybrid composite designated CB@Pt/MOF-5 with highly crystalline structure, large specific surface area and pore volume. In addition, H_2 storage capacity for resulting material was measured using magnetic suspension microbalance at 77 and 298 K under high-pressure condition, and the hydrostability was also tested by exposing the sample to 33% relative humidity at 23°C and measuring XRD as a function of time.

Keywords: MOF-5, Pt nanoparticle, Carbon black, Spillover, Hydrogen uptake, Hydrostability