

EW-P008

Maximizing TPBs through Ni-self-exsolution on GDC based composite anode in solid oxide fuel cells

탄제완¹, 이대희¹, 김보경¹, 김주선², 문주호¹

¹연세대학교 신소재공학과, ²한국과학기술연구원 고온에너지재료연구센터

The performance of solid oxide fuel cells (SOFCs) is directly related to the electrocatalytic activity of composite electrodes in which triple phase boundaries (TPBs) of metallic catalyst, oxygen ion conducting support, and gas should be three-dimensionally maximized. The distribution morphology of catalytic nanoparticle dispersed on external surfaces is of key importance for maximized TPBs. Herein in situ grown nickel nanoparticle onto the surface of fluorite oxide is demonstrated employing gadolinium-nickel co-doped ceria ($\text{Gd}_{0.2-x}\text{Ni}_x\text{Ce}_{0.8}\text{O}_{2-\delta}$, GNDC) by reductive annealing. GNDC powders were synthesized via a Pechini-type sol-gel process while maximum doping ratio of Ni into the cerium oxide was defined by X-ray diffraction. Subsequently, NiO-GNDC composite were screen printed on the both sides of yttrium-stabilized zirconia (YSZ) pellet to fabricate the symmetrical half cells. Electrochemical impedance spectroscopy (EIS) showed that the polarization resistance was decreased when it was compared to conventional Ni-GDC anode and this effect became greater at lower temperature. Ex situ microstructural analysis using scanning electron microscopy after the reductive annealing exhibited the exsolution of Ni nanoparticles on the fluorite phases. The influence of Ni contents in GNDC on polarization characteristics of anodes were examined by EIS under $\text{H}_2/\text{H}_2\text{O}$ atmosphere. Finally, the addition of optimized GNDC into the anode functional layer (AFL) dramatically enhanced cell performance of anode-supported coin cells.

Keywords: in-situ exsolution, Ni catalyst, solid oxide fuel cells (SOFCs), GDC composite anode.

EW-P009

Simple fabrication route for vertically-aligned CZTS nanorod arrays for photoelectrochemical application based on AAO template

김지민¹, 양우석², 오윤정³, 문주호⁴

연세대학교 신소재공학과

In photoelectrochemical (PEC) water splitting, $\text{Cu}_2\text{ZnSnS}_4$ (CZTS) compound has attracted intense attention as a photocathode due to not only large optical absorption coefficient, but also earth-abundance of constituent elements and suitable band alignment. With rapid development of nanotechnology, one-dimensional nanostructures of CZTS have been investigated as a potential form to achieve high efficiency because the nanostructures are expected to be capable of capturing more light and enhancing charge separation and transport. Here, we report a well-controlled fabrication route for vertically-aligned CZTS nanorod arrays on anodic aluminium oxide (AAO) template via simple sol-gel process followed by deposition of ZnS or CdS buffer layers on the CZTS nanorod to enhance charge separation. The structure, morphology, composition, optical absorption, and PEC properties of the resulting CZTS nanorod samples were characterized using X-ray diffraction, Raman spectroscopy, transmission electron microscopy, energy dispersive X-ray spectrometry, scanning electron microscopy, and UV-vis spectroscopy.

Keywords: CZTS, AAO, water splitting, nanostructuring