Accepted Manuscript

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PII: S0925-8388(18)31669-4

DOI: 10.1016/j.jallcom.2018.04.326

Reference: JALCOM 45964

To appear in: *Journal of Alloys and Compounds*

Received Date: 11 February 2018

Revised Date: 28 April 2018

Accepted Date: 30 April 2018

Please cite this article as: N. Xu, M. Chen, M. Han, Oxidation behavior of a Ni-Fe support in SOFC anode atmosphere, *Journal of Alloys and Compounds* (2018), doi: 10.1016/j.jallcom.2018.04.326.

Oxidation behavior of a Ni-Fe support in SOFC anode atmosphere

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Abstract: In this work, we investigated the long-term oxidation behavior of a Ni-Fe (1:1 weight ratio) support for solid oxide fuel cell (SOFC) applications. Ni-Fe supports were obtained through tape casting, high temperature sintering and pre-reducing in 97% H_2/N_2 (9/91)-3% H_2O at 750 and 1000 °C, respectively. Then the Ni-Fe supports were exposed in simulated anode atmospheres of 97% H_2/N_2 (9/91)-3% H_2O and 75% H_2/N_2 (9/91)-25% H_2O for periods of up to 1000 h at 750 °C. The samples were examined for mass change, phase and chemical composition, and microstructure evolution during the annealing process. The Ni-Fe supports exposed to H_2/N_2-3% H_2O showed negligible oxidation, while those exposed to H_2/N_2-25% H_2O showed a 4-6% mass increase, due to the fact that a Fe-rich oxide scale was found on the surface of the Ni-Fe alloy particles. Room-temperature conductivity measurements showed that the supports annealed in the two atmospheres maintained sufficiently high conductivity. The results from the current work demonstrate that the porous Ni-Fe support can be well employed in SOFCs, especially metal-supported SOFCs.

Keywords: Ni-Fe support; Oxidation resistance; Metal-supported solid oxide fuel cell; Electrical conductivity

Solid oxide fuel cell (SOFC) technology has made significant progress over the past decades owing to improvements in materials, production techniques and other related technologies [1-3]. However, cost is still one of the main obstacles hindering the commercialization of SOFC technology [4]. Research into SOFC-based auxiliary power plant (APU) systems shows that a large part of the overall cost is the material cost of the SOFCs, which accounts for ~30 - 40% of the total system cost across the analyzed production volume. In addition, the high operation temperature of SOFCs imposes rigid requirements on stack components, such as the requirement of high-temperature alloys for interconnects (ICs) and thermal insulation materials,