

TUESDAY, AUGUST 23, 2005, A.M.

SESSION 11B: INTERNATIONAL SYMPOSIUM ON FUEL CELL AND HYDROGEN TECHNOLOGIES

SOFC ANODE

Sponsor(s): Materials Science and Engineering Section, The Metallurgical Society of CIM

Room: Imperial Ballroom 5

Chairmen: V.I. BIRSS, University of Calgary, Canada

E. TANG, Versa-Power Systems, Canada

PAPER 11B.1 — 10:20 (KEYNOTE)

IMPROVING THE PERFORMANCE AND DURABILITY OF SOFC ELECTROCATALYSTS.

V.I. BIRSS, University of Calgary, Canada

Planar solid oxide fuel cells (SOFCs) offer great promise as stationary power generation devices, primarily due to their flexibility in terms of fuels, high energy conversion efficiency (when both electricity and heat are captured), and their relatively low fabrication costs. However, the anode performance can be compromised by such factors as exposure to certain sulfur-containing fuels and the deposition of coke when using hydrocarbon fuels. In terms of the cathode, its performance is limited primarily by the slow kinetics of the oxygen reduction reaction, while its lifetime can be negatively affected by factors related to the corrosion of currently used stainless steel interconnect materials. This talk will present an overview of these challenges and some possible solutions to these problems. The presentation will also focus on how electrochemical methods can be used to evaluate and improve the performance of SOFC anodes, cathodes, and interconnect materials. In addition, recent promising research efforts directed towards performance enhancement of SOFCs through the use of nanoscale electrocatalysts will be discussed.

PAPER 11B.2 — 10:40

APPLICATION OF CONDUCTING ATOMIC FORCE MICROSCOPY TO THE STUDY OF Ni-YSZ SOFC ELECTRODE MATERIALS.

T. SMITH and V.I. BIRSS, University of Calgary, Canada

Commercial SOFC systems will likely utilize hydrocarbons or hydrogen produced from hydrocarbon fuels and therefore will likely be exposed to sulfur impurities. Conducting-Atomic Force Microscopy (C-AFM) is a scanning probe microscopy technique which maps both sample topography and conductivity with tens of nanometers resolution. In Ni-YSZ, C-AFM measures the resistance of the metallic network at scanned locations, with the ability to differentiate between interconnected and isolated metallic particles. We have applied C-AFM, as well as high resolution TEM and TGA/DSC methods, to the study of Ni-YSZ SOFC anode materials, with the goal of monitoring changes in the conductivity of the Ni anode network resulting from SOFC degradation processes, such as H₂S poisoning.

PAPER 11B.3 — 11:00

ANODE MATERIALS FOR H₂S-POWERED SOLID OXIDE FUEL CELL.

V. VORONTSOV, W. AN, J.L. LUO, K.T. CHUANG and A. SANGER, University of Alberta, Canada

Anode catalysts have been prepared by heating together MoS₂ and NiS (CoS) in different weight proportions. Catalyst formulations prepared by admixed these composite sulfides with 5% wt of each of Ag and YSZ have high activity and are stable in H₂S-powered SOFC at temperatures up to 850°C. Catalysts prepared from 1:1 (by wt.) NiS:MoS₂ have the highest performance, with power density up to 300 mW/cm² in pure H₂S at 850°C. Anode material of different NiS:MoS₂ ratios have been characterized by means of X-ray diffraction, TG/DSC analysis and atomic absorption spectroscopy (AAS). There is a direct relationship between formation of a new phase in the anode composition and fuel cell performance.

PAPER 11B.4 — 11:20

THE POISONING EFFECT OF H₂S FUEL IMPURITIES ON SOFC ANODES.

D. WALDBILLIG, A. WOOD and D. IVEY, University of Alberta, Canada

A baseline of the poisoning effect of hydrogen sulphide (H₂S) fuel impurities on solid oxide fuel cell (SOFC) anodes was developed using polarization testing. After the baseline behaviour was characterized, tests to study the effect of varying the H₂S concentration and applied current on the rate and amount of cell voltage degradation and recovery were performed. Attempts were made to improve the rate and amount of recovery by various methods. Testing was very reproducible, but significant electrochemical performance degradation was seen after all H₂S poisoning tests. Degradation is initially quite rapid, but after a period of time the rate of degradation levels off. After

poisoning was complete, the H₂S flow was stopped and the cell was allowed to recover. Some recovery was seen after poisoning, but cell performance was never fully recovered.