Abstract
Presented are baseline experiments for SOFC cell “poisoning,” caused by the deposition of chromium from metallic interconnects into the cathode via the vapor phase. Cell performance was assessed using I-V measurements and corroborated utilizing SEM and EDAX. The analyses demonstrated a decrease in performance due to exposure to chromium vapor species. Two strategies, chemical and electrochemical cleaning, are proposed to remove the Cr deposits, thus reversing the effects of poisoning and increasing cell lifetime.

Introduction

Cr-containing deposits will volatilize, and the poisoning will be mitigated.

Chemical Cleaning (Fig. 2)
During chemical cleaning, cells will be placed under open circuit conditions, the temperature will be raised to 850-900°C, and 5-15% water vapor will be added to the air supply. Under these conditions, Cr deposits in the cathode will volatilize, and the poisoning will be mitigated.

Electrochemical Cleaning (Fig. 3)
During electrochemical cleaning, 0-15% water vapor will be added to the air and 5-20% to the fuel. A small anodic and cathodic bias will be applied on the air and fuel electrodes, respectively. Under such an electrolytic bias, the Cr deposits in the cathode will volatilize as:

1.5CrO3(s, air side) + 2H2(g, air side) + 3H2O(g, fuel side)
= 2CrO2(OH)(g, air side) + 3H2(g, fuel side)
1.5CrO3(s, air side) + 1.5H2O(g, air side) + 3H2O(g, fuel side)
= 3CrO2(OH)(g, air side) + 3H2(g, fuel side)
Cr2O3(s, air side) + 3H2O(g, fuel side) = 2CrO2(g, air side) + 3H2(g, fuel side)

Poisoning Experiment: Setup & Procedure (Fig. 4)
• Cells are activated for 48 hour at 800°C with 0.5 A/cm² using 3% humidified H2, and dry air.
• Poisoning experiments are carried out at 800°C with pre-oxidized Crofer 22 APU strips.
• Cells were poisoned for 70 hours with 0.5 A/cm², 3% humidified H2, and 5% humidified air.

Preliminary Poisoning Results
• I-V demonstrates a ~16% decrease in maximum power density due to poisoning over 70 hours (Fig. 5).

Future Work
• Perform cleaning methods on poisoned cells.
• Optimize the experimental conditions for cleaning processes, including temperature, water vapor content, and electrolytic bias.

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