A Comparative Study of Durability of Solid Oxide Electrolysis Cells Tested for Co-Electrolysis under Galvanostatic and Potentiostatic Conditions

State-of-the-art SOECs consisting of a nickel-yttria stabilized zirconia (Ni-YSZ) fuel electrode, YSZ electrolyte and lanthanum strontium cobaltite ferrite-gadolinium doped ceria (LSCF-GDC) composite oxygen electrode were tested under co-electrolysis (H2O+CO2) conditions. The aim in this study was to compare the SOEC durability under co-electrolysis conditions between galvanostatic and potentiostatic modes. Specifically, the cells were operated at 0.75 A/cm² (galvanostatic) and at 1.2V (potentiostatic) at 750 degrees C for over 1000 hours. In both modes, a larger degradation was observed initially for the first 200 hours of testing, followed by a more stable performance over longer operating times. Interestingly, there was a difference in trends of serial and polarization resistances’ evolution. In galvanostatic mode of operation, both increased while for potentiostatic mode only the polarization resistance increased over time. The difference of the degradation was attributed to the overpotentials being experienced by the cells in the respective modes. Trends of the area specific resistance (ASR) and detailed electrochemical analysis of the performance of the cell under durability conditions for both modes indicated that the degradation was due to both the fuel electrode and the oxygen electrode, with an additional contribution from fuel electrode in galvanostatic testing. Microstructural analysis also confirmed the degradation of the active fuel electrode. (C) The Author(s) 2018. Published by ECS.