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Direct-methane solid oxide fuel cell (SOFC) with Ni-SDC anode-supported cell

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ABSTRACT

The performance of a Ni-SDC anode-supported cell operating with a dry CH_4 feed stream and the effectiveness of exposing the anode to H_2 as a method of removing carbon deposits are evaluated. This has involved the continuous monitoring of the outlet gas composition during CH_4 operation and H_2 exposure. A degradation rate in the cell voltage (~1.33 mV h^{-1}) is observed during 100 h operation with dry CH_4. Carbon is detected in the Ni-SDC anode after the stability test but only in the portion of the anode closest to the fuel channel. No carbon is detected at the electrolyte-anode interface, which is the likely reason that the cell performance remains relatively stable. The information obtained from SEM and gas outlet composition analyses can be explained by a process whereby most of the CH_4 that reacts decomposes into H_2 and C in the Ni-SDC anode near the fuel channel. H_2 then makes its way to the anode-electrolyte interface where it is electrochemically oxidized to H_2O which can also react with any C that may have formed, leaving behind C primarily at the fuel channel. When an aged cell is exposed to H_2, carbon-containing gases (CO, CH_4 and CO_2) are released, indicating that some carbon has been removed from the anode. Examination of the anode after the test shows that some carbon still remains after this treatment.