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Coupling SOFCs to biomass gasification – The influence of phenol on cell degradation in simulated bio-syngas. Part II – Post-test analysis

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ABSTRACT

Anode-supported solid oxide fuel cells (SOFCs) with a state-of-the-art Ni/YSZ anode have been tested in simulated bio-syngas with controlled addition of phenol as a model molecule to study the influence of tars on the degradation of SOFCs operated with gasified biomass. The post-test analysis results of SOFCs are described after operation with different concentrations of phenol. The tests with pure syngas and up to 2 g/Nm^3 of phenol show a relatively stable performance in a short-term period of 500 h, but the test with 8 g/Nm^3 phenol shows drastic degradation. The microstructural changes of anode and support layers, phase changes, and carbon deposition were analyzed and discussed based on performance degradation and post-test analysis. No structural changes were found after tests with pure syngas. On the other hand, the addition of phenol causes macro- and micro-scale structural changes in the support, spreading from the fuel inlet. The support shows an erosion pattern and both Ni and YSZ were found as dust after the test. In these eroded areas, carbon fibers were observed by SEM and it was more pronounced with higher phenol content. There was no material phase transformation related to syngas or phenol, but surface carbon deposition was confirmed by Raman spectroscopy in the support and anode layers.

Introduction

Fossil fuel is not only limited in supply but also polluting the environment through the emission of greenhouse gases such as CO_2. Nuclear fission, which is considered as alternative energy source, faces issues of safety and radioactive waste. Therefore, the development of new types of power production systems is essential for a sustainable energy infrastructure. Biomass is a promising alternative energy source since it is

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