

Title: SOFC temperature sensing during anode reductions and cell operations

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Abstract:

Temperature driven performance degradations is one of the major problems that impedes the successful commercialisation of Solid Oxide Fuel Cell (SOFC) technology. To mitigate such degradations as well as to further enhance stack's performance, it is very important to understand the temperature distribution of a SOFC stack while in operation. Researches for experimental measurement of the temperature distribution are very limited in literature. The available efforts are also confined for measuring temperature in both (air/ fuel) channels and they mostly do not measure the temperature from a SOFC electrodes, which is more desirable than gas temperature measurement for investigating cells' behaviour and the correlation to the stack's performance. Hence, the in-situ cell temperature monitoring is topical research area where a technical challenge is necessary. Authors fabricated a thin-film K-type thermocouple network on an electrode of a commercial SOFC test cell ($\phi 52\text{mm}$, Kerafol Ltd) for in-situ temperature sensing. Thin film thermocouple network was sputter deposited on a cathode. Using the thermocouple network, authors measured the cathode temperature during an anode reduction process and then measured the same during normal cell operation under different air/ fuel ratios. In addition, Open Circuit Voltage (OCV) was also measured during the operations. To validate the measurements, a commercial K-type thermocouple was placed close to the cathode measuring air temperature during the experiments. The measurements showed that the sensors on cathode were very sensitive to even a trivial temperature change whilst the commercial thermocouple adjacent to the cell was almost non-responsive to most of subtle temperature changes that had occurred on the cell. During the monitoring, dramatic temperature fluctuation and uneven temperature distribution were detected during an anode reduction process. A correlation between the OCV and the cell temperature was also investigated.