Using equivalent circuit models in understanding the performance change of metal supported SOFCs in static and dynamic conditions

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In this work the measured electrochemical impedance spectra (EIS) of metal supported SOFCs were simulated by fitting to an equivalent circuit displayed in Fig.1.

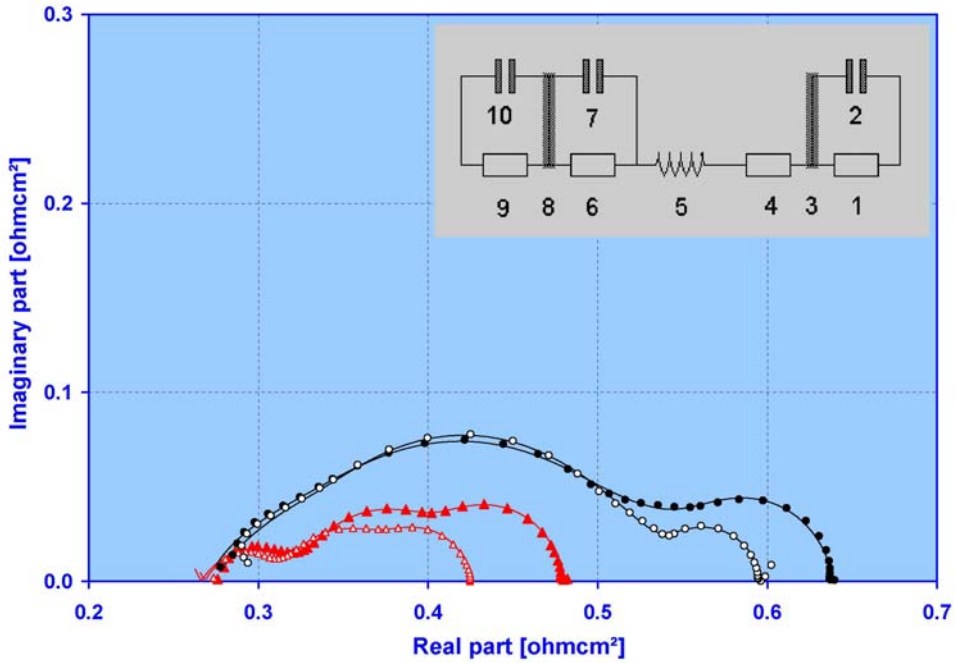

Figure 1: Measured and fitted EIS data at open cell voltage LSM (●) and LSCF (▲) and at 200 mAcm-2 LSM (o) and LSCF(Δ) cathodes

Electrochemical impedance spectroscopy is one of the most commonly used methods in evaluation of the performance which allows us to characterize the electrode processes and complex interfaces in addition to standard polarization curve recordings. Besides this method can be used as a diagnostic tool in understanding the reactivity and structure of the interface and also the mass transport limitations which actually effect the displayed performance of the system in the end. Two approaches were opted:

1. Replacing LSM (La0.8Sr0.2MnO3) cathode with LSCF (La0.6Sr0.4Co0.4Fe0.6O3)

2. Redox cycling of cells provoking degradation in anodes and overall performance of the cells.

Conclusion

- The performance of the metal supported fully plasma sprayed SOFCs improved by 35 % at 800 °C by changing the perovskite-type cathode material from LSM to LSCF.

- Using an equivalent circuit and fitting the measured electrochemical impedance spectra to an equivalent circuit made possible to split the discrete contributions of the functional layers (Fig.2).
- The contribution of the improvement in the cathode layer was found to be around 60 % decrease of its polarization resistance which in turn resulted in the increase of the performance.
- Reasonable cell performance was observed even after 20 Redox cycles

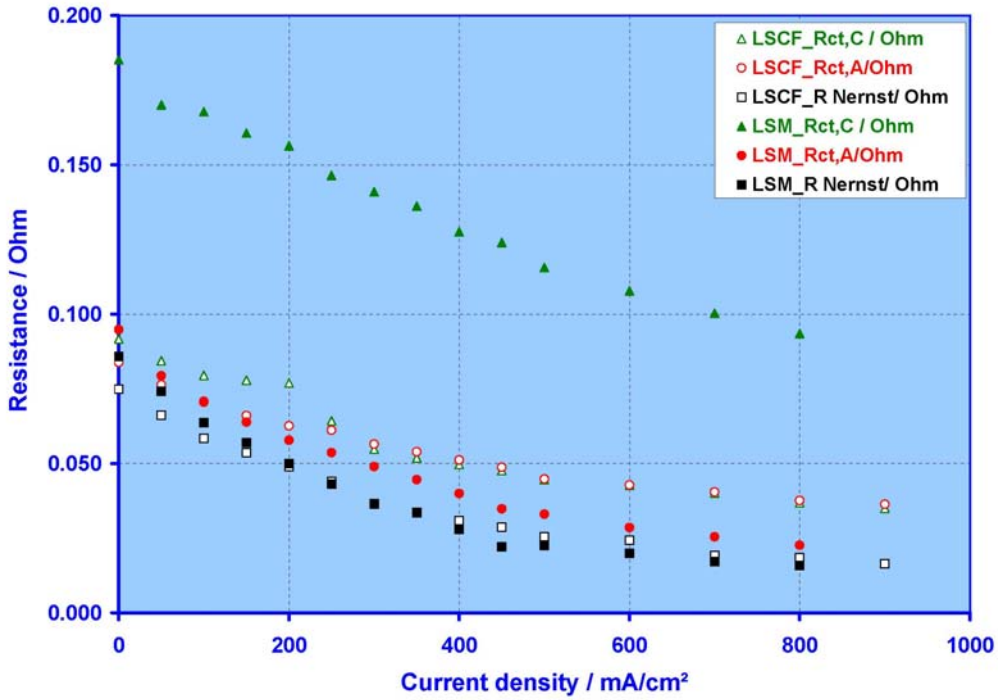

Figure 2: Measured impedance splitted into anode, cathode and Nernst resistances along the current density