Modeling degradation in SOEC impedance spectra

Solid oxide cell (SOC) performance is limited by various processes. One way to investigate these processes is by electrochemical impedance spectroscopy. In order to quantify and characterize the processes, an equivalent circuit can be used to model the SOC impedance spectra (IS). Unfortunately, the optimal equivalent circuit is often unknown and to complicate matters further, several processes contribute to the SOC impedance - making detailed process characterization difficult. In this work we analyze and model a series of IS measured during steam electrolysis operation of an SOC. During testing, degradation is only observed in the Ni/YSZ electrode and not in the electrolyte or the LSM/YSZ electrode. A batch fit of the differences between the IS shows that a modified Gerischer element provides a better fit to the Ni/YSZ electrode impedance than the frequently used RQ element - albeit neither equivalent circuit provides a perfect fit. However, modeling with the Gerischer element indicates that the Ni/YSZ electrode performance decrease, relates to an electrochemical reaction resistance increase at the electrode triple phase boundaries. © 2013 The Electrochemical Society.