Probing and Mapping Electrode Reactions in SOFCs Using In-Situ Characterization Techniques

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Abstract

We have designed and constructed a state-of-the-art system capable of simultaneously performing *in-situ* FTIR/Raman spectroscopy (to probe electro-active species at electrode surfaces or interfaces) and electrochemical measurements on a solid oxide fuel cell (SOFC) under practical operating conditions (up to 750°C) while the gas phase compositions are monitored in real time by mass spectrometry. *In-situ* potential-dependent FTIR emission spectroscopy has been successfully used to investigate into oxygen reduction mechanisms on the cathode in an SOFC under actual operating conditions.[1,2] The addition of a Raman spectro-microscope offers capabilities for not only characterizing electrode surface structures and surface bonding but also mapping where a specific reaction of interest is occurring. When applied to an SOFC with patterned electrodes, this mapping capability becomes very powerful in investigating into active reaction sites of various electrode materials, especially mixed-conducting electrodes. The combination of these techniques has made it possible to map and probe surface electrochemical reactions, *in-situ*, in a functional SOFC perturbed by various electrical, chemical, and optical stimulus. These *in-situ* characterization techniques allow direct correlation between the phenomenological behavior of a patterned electrode (as determined by impedance spectroscopy or other electrochemical measurements), its surface molecular structures (as probed/mapped by FTIR/Raman), and its precisely controlled geometry as produced by micro-fabrication, providing invaluable insight into reaction mechanisms that has never before been accessible.

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Reference

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