

Generalized Electrochemical Impedance Spectroscopy (GEIS) in Solid State Ionics

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Electrochemical Impedance Spectroscopy (EIS) is a widely applied tool in solid state ionics. It is used to analyze transport and adsorption processes as well as interfacial reactions for a large variety of electrochemical systems. Yet, there are elusive processes and intermediate reaction steps that cannot be identified just by analyzing the impedance of the system, defined as the transfer function between voltage and current.

I will show how additional quantities can be probed in order to gain more information about processes and characteristics of the electrochemical system. Replacing voltage or current, i. e. excitation or response signal, in an EIS measurement by another physical quantity such as illumination or temperature leads to so-called generalized electrochemical impedance spectroscopy (GEIS) measurements, opening up a whole new field of measurement techniques. Just recently, such techniques have received great interest in the materials community, especially as optics and electrochemistry are being linked for applications like photoanodes for solar water splitting, solar cells and smart windows. GEIS measurements can be applied *in situ* and provide a general transfer function capable of being analyzed with the tools readily available for evaluating EIS data.

In this talk, I will give an overview of some of the special GEIS techniques and demonstrate in which way the results can be useful for analyzing the oxygen reduction reaction in solid oxide fuel cell model cathodes and the nature of the photoconductivity in strontium titanate as examples. Also, I will give experimental insights into the techniques and discuss advantages and disadvantages as compared to other, more established techniques.