

## 第714回 化学・物質工学セミナー 開催のお知らせ

この化学・物質工学セミナーは、「国際的な活躍が期待できる研究者の育成事業」第12回特別講演、第15回重点研究課題講演会およびグリーンシステム創成科学専攻令和元年度第5回国際セミナーと共催します。万障お繰り合わせの上、ご参加下さい。

# Generalized Electrochemical Impedance Spectroscopy in Electroceramics

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場所：総合教育研究棟2階 多目的ホール

アメリカ合衆国のマサチューセッツ工科大学のDino Klotz博士は、現在、九州大学のカーボンニュートラル・エネルギー国際研究所に滞在され、燃料電池の電極材料、ガスセンサ、酸素貯蔵材料に利用可能なエレクトロセラミックスの新しいキャラクター化手法の開発研究を精力的に進めておられます。今回の講演では、最近の研究成果についてご講演いただきます。

### Abstract

Electrochemical Impedance Spectroscopy (EIS) is a widely applied tool in electroceramics. 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. These open up a whole new field of measurement techniques just recently receiving interest in the materials community. Such 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, and with the benefits of superior signal to noise ratio.

Light illumination can be used in two ways for GEIS measurements: (1) to activate photoelectrochemical processes and (2) to probe characteristics of the materials by analyzing the dynamic transmission and absorption of electroceramic materials. In this talk I give an overview of GEIS measurements such as: intensity modulated photocurrent/voltage spectroscopy (IMPS/IMVS), and optical impedance spectroscopy (OIS). Practical examples will be provided that demonstrate the new insights that can be gained with the aid of GEIS. An overview of experimental setups will also be provided.

The model systems in this talk are fluorite and perovskite type mixed conductors, PCO ( $\text{Pr}_x\text{Ce}_{1-x}\text{O}_{2-d}$ ) and STF ( $\text{Sr}(\text{Ti}_{1-x}\text{Fe}_x)\text{O}_{3-d}$ ). These materials are promising candidates for use as electrodes in SOFC, gas sensors, and oxygen storage materials involving an oxygen exchange reaction. However, the individual rate limiting reaction steps are not fully identified.

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