



**Physikalisches Kolloquium**  
**Einladung**

**Physics Colloquium**  
**Invitation**

**Monday, 06 May 2019**

Lecture Hall N24/H13, 16:15

Coffee and cookies will be served in front of the lecture hall from 16:00

**In situ TEM and x-ray spectroscopy studies of  
perovskite oxide electrodes for electrochemical  
water oxidation**

**Prof. Christian Jooss**

Institute of Materials Physics (IMP),  
University of Göttingen



In-situ studies of electro-catalysts are of high interest since they offer the opportunity to study their atomic and electronic structure in the active state in operando. We present environmental Transmission Electron Microscopy (ETEM) and X-ray absorption spectroscopy (XAS) studies of O<sub>2</sub> evolution catalysis during H<sub>2</sub>O splitting in various doped manganite perovskite and Ruddlesden-Popper phases. These systems offer the opportunity for fundamental studies of factors controlling the active site, surface structure and surface defect chemical reactions during water splitting and oxygen evolution.

Aberration corrected ETEM allows to image highly dynamic motion of surface atoms, relevant for mechanistic understanding of the O-O bond formation process. These dynamic atoms are forming the active state of the electrodes. However, depending on the electronic band structure of the studied Pr<sub>1-x</sub>Ca<sub>x</sub>MnO<sub>3</sub> and La<sub>1-x</sub>Sr<sub>x</sub>MnO<sub>3</sub>, the involvement of metal centers or lattice oxygen during oxygen evolution is quite different. In addition to reversible surface dynamics of atoms irreversible surface defect reaction evolve, influencing the stability of the surface. Correlating trends in ETEM and in-situ x-ray absorption spectroscopy with electrochemical analysis via cyclovoltammetry allow for steps toward understanding atomic scale mechanisms of activity and stability of the electrodes. Our experimental studies are complemented by ab initio calculations.

The presentation will also provide an introduction into method aspects of in situ ETEM and XAS studies, in order to give support the significance of the in situ observations for real world electro-chemistry.