Abstract

Electrochemical water splitting by high-performance catalyst materials unraveled by *operando* X-ray spectroscopy

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In the worldwide strive for reduction of CO_2 emissions, the sustainable production of synthetic fuels plays a key role. Their production requires the efficient oxidation of water, also called oxygen evolution reaction (OER), powered by renewable electricity or in artificial photosynthesis devices, directly by sunlight. Inspired by biology but aiming at knowledge-guided optimization of inorganic catalyst materials, we employ operando spectroscopy for following the reactions directly during operation of the catalyst material. The project aims at investigation of structural changes of OER selected high-performance catalyst materials equilibrated at various electrochemical potentials *and* in the time domain, from below one millisecond to tens of seconds. They are tracked with optical spectroscopy and X-ray absorption spectroscopy, the latter at the Berlin synchrotron radiation source (BESSY), targeting changes in atomic and electronic structure.

The project will focus on OER catalyst materials that excel by outstanding performance characteristics (exceptionally low overpotentials at technologically relevant current densities) in alkaline water oxidation. The project aims at understanding what distinguishes the performance champions from mediocre catalyst materials. The project will go beyond the state-of-the-art not only by advanced operando experiments, but also by investigating systematically the role of the operation temperature.

The prospective PhD student should be interested in (electro)chemical energy conversion and advanced physical experiments.