

CatLab Lecture Series hosted by FHI and HZB

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**Friday, November 10<sup>th</sup> 2023, 10:30-12:00**  
BESSY II, "Kino Saal", Magnusstraße 2, 12489 Berlin Adlershof

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## **Microwave absorption: Operando EPR and MCPT as tools to characterize heterogeneous gas phase catalysts**

It is well established that many heterogeneous catalysts encounter substantial changes of their properties if comparing the catalyst under turn-over conditions with those found ex-situ. These changes encompass not only structural but also electronic properties rendering a detailed characterization still challenging. A variety of characterization techniques have been developed in recent years to investigate catalytic systems under operando conditions. In this respect it is important to realize that none of these methods allows to obtain a complete picture which requires on the one hand the combination of different techniques and on the other hand knowledge about available techniques and their potential use and their limitations.

To this end, the presentation will focus on electron paramagnetic resonance (EPR) spectroscopy as well as the microwave cavity perturbation technique (MCPT), which are two methods out of the toolbox of operando methods. [1-3] These two methods allow to elucidate the presence and properties of paramagnetic species (EPR) and the dielectric properties of the catalyst (MCPT), respectively. Using catalytically important systems in gas phase catalysis we will discuss experimental aspects, the ability of these methods to provide important insights into the system under operando conditions as well as the limitations of the techniques and ways to mitigate these e.g. by combination with complementary techniques.

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[1] A. Brückner *Adv. Catal.* 51, 265–308 (2007).

[2] S. A. Bonke, T. Risse, A. Schnegg, A. Brückner *Nat. Rev. Methods Primers* 1, 33 (2021).

[3] M. Eichelbaum, R. Stößer, A. Karpov, C.-K. Dobner, F. Rosowski, A. Trunschke, R. Schlögl *Phys Chem Chem Phys* 14, 1302-1312 (2012).