**Fakultät 1**
**Institut für Physik**

Brandenburgische
Technische Universität
Cottbus - Senftenberg

## Einladung
## zum
# Physikalischen Kolloquium

**Termin:** **Dienstag, 20. Juni 2023**
**Zeit:** **17.15 Uhr**
**Ort:** **Hauptgebäude (HG), Raum HG 0.18**

# *"Unraveling the Oxidative Behavior of Platinum-Tin Alloys"*

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*Abstract*

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In the last decades, platinum tin alloys have attracted increasing interest owing to their superior catalytic properties compared to pure platinum, which based on density functional theory (DFT) and kinetic modeling have been argued to originate from a combination of electronic ligand effects, ensemble, and strain effect [1]. In general, platinum-tin alloys are very well suited for several technological applications as, e.g., hydrocarbon conversion [2], electro-oxidation of methanol and ethanol in fuel cells [3], dehydrogenation [4] or preferential oxidation of CO in hydrogen [5]. The formation of tin oxides during the catalytic reaction, including separation into tin-rich and tin-deficient components, has been claimed to be responsible for this enhancement [6].

However, experimental evidence remains limited, and many questions about the exact role of tin in property enhancement, the influence of surface structure, and surface morphology have yet to be answered.

The oxidation processes on Pt3Sn(111)[7,8] and on alloyed PtSn/Pt(111) surfaces were characterized in-situ and with local probes by means of low energy electron microscopy (LEEM), micro spot low energy electron diffraction ( $\mu$-LEED), and X-ray photoemission electron microscopy (XPEEM) to determine the structure and chemistry of the different surface oxide phases forming in dependence of the oxidation temperature and oxygen chemical potential. We analyzed both molecular and atomic oxygen oxidation, with the latter achieved by exposure to a thermal cracker to reduce the pressure gap between idealized ultra-high vacuum (UHV) conditions and the pressure at which catalysts typically operate.

From these experiments, we report the first phase diagram of the system over a wide range of conditions. Specifically, depending on the oxidation temperature and the oxygen chemical potential we have observed three different ultra-thin tin oxide phases, i.e., a (4x4), a (2mx2n) with m ~ 4 and n ~ 4

or 6 depending on the oxidation temperature, and a (4x4)* phase. Furthermore, at high oxidation temperatures (550°C-780°C) and high oxygen chemical potential, we report the nucleation and growth of rutile $SnO_2$ micro-crystallites from the ultra-thin tin oxide wetting layer.

By determining the surface structure and the factors that lead to the formation of specific oxide phases, we will later be able to precisely identify the active sites. This will allow the design of catalysts to be optimized. For example, the catalyst could spontaneously adopt the optimal surface structure based on reaction conditions, or industrial operation conditions could be tailored to promote the preferential formation of one oxide phase over another.

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[4] R. D. Cortright et al., Catal. Today **55**, 213-223 (2000)
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***Alle Interessenten sind sehr herzlich eingeladen!***
*gez. Prof. Seibold*