Brandenburgische Technische Universität Cottbus - Senftenberg

Fakultät 1
Institut für Physik

Invitation to Physics Colloquium

Lecturer:

Prof. M. Veronica Ganduglia-Pirovano
Institute of Catalysis and Petrochemistry Madrid

Topic:

"Metal-Oxide Interfaces and their Role in Methane Conversion to Fuels"

Methane dry reforming (MDR), which converts CH4 and CO2 into syngas (CO/H2), is gaining attention for its environmental benefits. Additionally, direct conversion of CH4 and hydrogenation of CO2 to CH3OH are highly sought goals in catalysis. Metal-ceria systems, particularly those involving Ni, Co, and Pt on CeO2, have emerged as promising catalysts for these processes. This presentation explores recent theoretical and experimental advances in understanding these catalysts, using DFT+U simulations alongside in situ/operando techniques (AP-XPS, XRD, XAFS) and catalytic testing.1-4 A key finding is that low metal loading, combined with ceria's ability to stabilize oxidized metal species by re-localizing electrons on f-states, is essential for CH4 activation at room temperature and efficient CH4 reforming at relatively low temperatures (700 K). Notably, the room-temperature activation of methane on low-loaded metal/CeO2 deviates from traditional linear scaling relationships, highlighting how this nanomaterial overcomes the "tyranny of linear scaling." This presents a promising strategy for developing active and stable catalysts for methane activation and conversion. Furthermore, we present evidence that low Ni loadings on CeO2 can catalyse methanol production at low temperatures (450 K) with high selectivity, using oxygen and water.5 Additionally, Pd-CeO2 catalysts modified with carbon (Pd-iC-CeO2) achieve 100% selectivity for methanol in the liquid phase at 350 K using hydrogen peroxide as the oxidant.6 The role of solvent interactions in enhancing selectivity is also discussed, highlighting the potential of these catalysts to drive cost-effective and selective methane conversion to valuable products. Finally, Cu/MgO is explored for selective hydrogenation to methanol, where the synergy between Cu+ species and water plays a crucial improving selectivity.

Date: Thursday, 22.05.2025
Time: 03:30 p.m.
Location: ZHG, room SR1

Im Auftrag von Prof. Flege - Stefanie Jannasch

FG Angewandte Physik und Halbleiterspektroskopie
Prof. Dr. rer. nat. habil. Jan Ingo Flege
Konrad-Zuse-Straße 1, 03046 Cottbus
Tel. 0355 69 5352 / E-Mail: flege@b-tu.de