Tuesday Morning, November 5, 2024

Vacuum Technology
Room 121 - Session VT2-TuM

Sustainable Energy Production

Moderators: Sol Omolayo, Lawrence Berkeley National Laboratory, **Jacob Ricker**, NIST

8:45am **VT2-TuM-4 Photochemistry and Photocatalysis of Alcohols – Vacuum Technology for Sustainable Chemistry**, ***Moritz Eder,*** TU Wien, Austria; *P. Petzoldt, C. Aletsee, M. Tschurl,* Technical University of Munich, Germany; *J. Pavelec, G. Parkinson,* TU Wien, Austria; *U. Heiz,* Technical University of Munich, Germany **INVITED**

In photocatalysis, light is harvested by semiconductors to utilize its energy for chemical reactions. Despite being highly promising for sustainable chemistry driven by (sun)-light, large-scale applications are still nonexistent due to the low efficiency of these photocatalysts. Screening for more efficient photocatalysts by mixing different powder materials has so far not led to the desired breakthrough.

With a more recent approach based on vacuum technology, photocatalysts can be optimized by observing the chemical and physical processes at the atomic level. To this end, single-crystalline semiconductors with atomically defined surfaces are investigated with different analytical techniques in ultra-high vacuum (UHV) during illumination with light. Since this is a comparably young topic in vacuum technology as well as physical chemistry, I will show the different approaches to the problem as well as the technological requirements and developments which go along with them.

While the investigation of a broad range of semiconductor materials for the bigger picture is still lacking, titania (TiO_2) has been investigated thoroughly as a photocatalyst in the last years. Among other substrates, alcohols have often been used as reactants with very unexpected results. While structurally more complex than common model substrates such as CO or water, alcohols provide a very versatile chemistry. Furthermore, molecular hydrogen can be produced selectively and efficiently by alcohol photocatalysis.

Using alcohols on the TiO_2(110) surface as an example, I will present the tools which have been developed and utilized in UHV to elucidate the photocatalytic processes. I will show the learning process of how photocatalysis on titania works at the atomic level over the last decade. Finally, I will discuss the most recent developments, which aim at designing devices for (near) ambient pressure photocatalysis. The goal is to close the so-called pressure gap between model systems and applied catalysts. This way, one can utilize vacuum technology for the rational design of photocatalytic materials and pave the way for sustainable, light-driven chemistry.

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