Fakultät 1
Institut für Physik

Brandenburgische
Technische Universität
Cottbus - Senftenberg

Einladung zum
Physikalischen Kolloquium

Termin: **Dienstag, 14. Februar 2023**
Zeit: **14.00 -.15.15 Uhr**
Ort: **Zentrales Hörsaalgebäude, Hörsaal C**

"Hydrogen production from renewables: thermal and photoexcited catalytic processes"

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Abstract

The talk is divided into two parts linked together by a common objective and it is to split water to molecular hydrogen and oxygen. As such it is a summary of a few years of work on different topics while addressing this objective at the fundamental and applied levels.

The first topic is related to the thermal hydrogen production from water on reducible oxides. In this field the bench mark oxide is CeO_2 as it is a textbook example of an oxide suitable for redox reactions. The main challenge is the cost of the removal of an oxygen atom (to reduce CeO_2). To this end many concepts have studied, one of them is what can be defined as “charge transfer reduction effect” in which doping of CeO_2 with U atoms results in making a solid solution $Ce_{1-x}U_xO_2$. Because U can have higher oxidation states than +4 (unlike Ce) more oxygen atoms at the vicinity can be removed. In this work this mixed oxide is studied for water splitting in steady state conditions while its structure was further characterized by core and valence level spectroscopy and TEM/EELS.

The second topic is related to using sunlight to directly split water. In this part, the focus is on transforming multijunction GaAs-based solar cells into a catalyst bypassing the need for an external electrolyzer. To do the work, that requires sun concentrations, cell protection is needed and this protection layer must act as the active catalyst for water splitting. A considerable amount of effort was put on and we have succeeded in protecting the back side of the solar cell with Ni (that becomes Ni hydroxide in the aqueous environment). Stability at 208 suns up to 9 years is extrapolated.

Some of this work may be found in

Oxgen vacancies role in thermally driven and photon driven catalytic reactions. H. Idriss, **Chem. Catalysis** (*perspective*) 2, 1549-1560 (2022).
A study of $Ce_xFe_{1-x}O_2$ as a reducible oxide for the thermal hydrogen production from water. S. Al-Taweel, M.A. Nadeem, H. Idriss*, **Energy Technol.** 2100491 (1-9) (2022)
Towards large scale hydrogen production from water, what have we learned and what are the main hurdles to cross for commercialization. H. Idriss **Energy Technol.,** (*Essay*) **9,** 2000843, 1-9 (2021).
Hydrogen production from water: past and present. H. Idriss, **Current Opinion Chem. Eng. 29**, 74-82 (2020)
The elusive photocatalytic water splitting reaction using sun light on suspended nanoparticles. Is there a way forward? H. Idriss, **Catal. Sci. & Technol.** (*perspective*) **10**, 304-310 (2020).
A Stable Integrated Photoelectrochemical Reactor for H_2 Production from Water Attains a Solar-to-Hydrogen Efficiency of 18% at 15 Suns and 13% at 207 Suns. M.A. Khan, I. Al-Shankiti, A. Ziani, N. Wehbe, H. Idriss, **Angewandte Chemie**, Int. Ed. 59, 14802–14808 (2020)

Alle Interessenten sind sehr herzlich eingeladen!
gez. Prof. Seibold

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