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PREC
Professorship of Renewable Energy Carriers

Energy Science Center

Institute of Energy Technology – Professorship of Renewable Energy Carriers

Invitation to a Seminar

Date: Wednesday, September 3, 2015

Time: 16:00- 17:30

Place: Maschinenlaboratorium ETH Zürich, ML-J25/26

Speaker: Prof. Avner Rothschild
Department of Materials Science and Engineering
Technion – Israel Institute of Technology
Haifa, Israel

Title:

Reflections on rust:
Iron oxide photoelectrodes for solar energy conversion and storage

Abstract – Reliable utilization of solar power on a large scale requires affordable energy storage technology, much cheaper than batteries, in order to synchronize the variable power production with the changing demand. Likewise, there is a need for renewable fuels to replace fossil fuels. These challenges can be achieved, potentially, by splitting water into hydrogen and oxygen, $H_2O \rightarrow H_2 + ½O_2$, using solar power to drive this endergonic reaction uphill. The hydrogen can be stored and converted to electricity and heat on demand. Alternatively, it may serve as feedstock for the production of liquid fuels for transportation by reaction with CO_2, paving the road towards carbon-neutral synthetic fuels, so-called solar fuels. The first and foremost challenge toward this ambitious goal is the development of chemically stable, efficient and affordable photoelectrodes for water splitting.
Photoelectrodes for solar-powered water splitting must employ a semiconductor material with exceptional stability against corrosion, as well as visible-light absorption. On top of that, it should also be abundant, inexpensive and non-toxic. Iron oxide (α-Fe_2O_3, hematite) is one of few materials meeting these criteria, but its poor transport properties and ultrafast charge carrier recombination present a challenge for efficient charge carrier generation, separation and collection. We explore an innovative solution to this challenge using ultrathin (20-30 nm) quarter-wave films on back reflector substrates. This simple optical cavity design effectively traps the light in otherwise nearly translucent ultrathin films, amplifying the intensity close to the surface wherein photogenerated charge carriers can reach the surface and split water before recombination takes place. This is the enabling key towards the development of high efficiency photoelectrodes that could potentially lead to affordable solar energy storage and solar fuel production.

Brief Biography – Avner Rothschild is an associate professor at the Department of Materials Science and Engineering of the Technion – Israel Institute of Technology in Haifa, Israel. He graduated from the Technion (BSc in Physics and in Materials Engineering, 1997, PhD in 2003) and spent 3 years as a postdoc at MIT. Since 2006 he is a faculty member of the Technion. The Rothschild group has ~20 researchers working on photoelectrochemical water splitting for solar hydrogen production. The group is currently involved in two EU projects: ETASECS - Extremely Thin Absorbers for Solar Energy Conversion and Storage (ERC) and PECDEMO – PhotoElectroChemical DEMOnstration devices. Prof. Rothschild is one of the founding directors of the Israeli Center of Research Excellence on Solar Fuels.

Host: Prof. A. Steinfeld, www.prec.ethz.ch