Department of Materials Science and Engineering

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הפקולטה להנדסה ע"ש איבי ואלדר פליישמן אוניברסיטת תל אביב

המחלקה למדע והנדסה של חומרים

You are cordially invited to attend this seminar to be held on

Tuesday, November 7th, 15:00
Room 206, Wolfson Mechanical Engineering Building

Photoelectrochemical water splitting for solar energy conversion and storage

Prof. Avner Rothschild

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Abstract

Photoelectrochemical (PEC) water splitting is a promising route for solar energy conversion to hydrogen. It produces clean hydrogen that can be used for refueling fuel cell electric vehicles or serve as a feedstock for the production of drop-in liquid fuels by CO_2 hydrogenation or ammonia via the Haber–Bosch process. The greatest challenges towards PEC solar water splitting technology lay in the selection and optimization of stable photocatalytic materials for water photo-oxidation, and the design of scalable PEC devices that produce hydrogen at a competitive cost. Iron oxide (-Fe_2O_3, hematite) is one of few materials meeting the basic selection criteria for stable photoanodes, but its poor charge transport properties and fast recombination present challenges for efficient charge separation and collection. We explore innovative solutions to these challenges using ultrathin (20-30 nm) films on specular back reflectors. This optical design 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 epilayers whose properties can be tailored by material design at the atomic scale. Our recent efforts to uncover the design rules of these photoanodes will be presented. On the other end of the spectrum we explore innovative device architectures and operation schemes for scalable and competitive PEC solar water splitting technology. These include power and optical management schemes for optimizing the hydrogen and power outputs of PEC – PV tandem cells, and separating the hydrogen production from the oxygen production for safe operation and on-site hydrogen production.

With these examples I hope to show you the prospects of understanding and designing 3D assembly.

Avner Rothschild is an associate professor at the Department of Materials Science & Engineering of the Technion. He studied Physics and Materials Engineering at the Technion and had a postdoc at MIT. Since 2006 he is a faculty member at the Technion, where he is heading the Electrochemical Materials & Devices research group. His research focuses on materials and devices for hydrogen production and solar energy conversion and storage. He is one of the founding directors of the Israeli Center of Research Excellence on Solar Fuels, member of several European consortia and holds an ERC grant for research on ultrathin film solar cells.