NANOMATERIALS SPEAKER SERIES

FIRST BABY STEPS TOWARDS HYDROGEN- WHERE CAN I DO THIS RESEARCH FASTER?

February 3, 2017 at 12:30pm

CBB, Rm 106

I will report on our recent results on plasmonic nanoparticles for applications to solar fuel generation. Plasmonic nanoparticles act as efficient optical nanoantennae that interact with light with an effective cross section exceeding their geometric size. We have recently exploited this antenna effect to engineer photoelectrodes for solar water splitting, optimizing for different plasmonic decay mechanisms such as near-field energy transfer to the surrounding semiconductor [1], plasmon-induced hot carrier generation and utilization [2], and broadband extreme light absorption within monolayer MoS_2 [3]. However, often more than one plasmonic decay mechanism is at work, which makes it challenging to separate out the relative contributions and optimize them efficiently for solar water splitting. Novel characterization tools with high spatiotemporal resolution to study the heterogeneity of plasmonic photocatalysts both in terms of their morphology and optical near-field enhancements at relevant time scales in-situ are therefore of widespread interest. I will give an example of a novel optical microscope technique to resolve optical near-fields near plasmonic photocatalysts [4], and an example how ultrafast spectroscopy can serve as a novel tool to observe and optimize hot carrier generation and utilization with the potential application to drive chemical reactions in solution. These initial efforts are however completely insufficient to make quick progress towards research and development of hydrogen production by sunlight with the goal to make this an accessible technology worldwide. It is difficult to comprehend why every other technology and gadget has been "overfunded" but this technology, solar-hydrogen-production, that offers so many benefits to society including clean energy, clean water, clean food, carbon dioxide conversion to value-added products, and byproducts that also have high market values is underfunded and not consistently funded.

Isabell Thomann
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SPEAKER BIO

Isabell Thomann is Assistant Professor in the Department of Electrical and Computer Engineering, Assistant Professor of Materials Science and Nanoengineering, and Assistant Professor of Chemistry at Rice University, Houston, Texas, USA. She received her Vordiplom in physics at the Technische Universität Kaiserslautern (Germany), her Diploma in physics from the Swiss Federal Institute of Technology (ETH) Zürich (Switzerland), her PhD in physics from the University of Colorado at Boulder, Colorado (USA), and served as a postdoctoral fellow at Stanford University, Stanford, CA (USA) in Materials Science and Engineering, before she joined the faculty at Rice University. Her interests are centered around solar-chemical, solar-thermal, and solar-thermochemical fuels with a particular interest in solar hydrogen production. In May 2014, she received an NSF CAREER Award to develop methods for "Characterizing Electrochemical and Photocatalytic Reaction Pathways via Nanostructured Photoelectrodes". She is the chairwoman of the IEEE Photonics Society – Houston Chapter, and was the PI and event coordinator of the recent Army Research Office sponsored "Workshop on surface plasmons, metamaterials, and catalysis" at Rice University, October 21-23, 2013, and the symposium co-organizer, with her husband Volker Schweikhard, for "Applications of Photonics in Energy and the Life Sciences" at the Southwest Regional Meeting, American Chemical Society, Galveston, Nov 10-13, 2016.

Contact Professor Jiming Bao at jbao@uh.edu if you would like to arrange for a time to meet with Dr. Thomann.

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