

Journal of Photonics for Energy

PhotonicsforEnergy.SPIEDigitalLibrary.org

Solar fuels photocatalysis

Roland Marschall
Jeremy Pietron

SPIE.

Roland Marschall, Jeremy Pietron, "Solar fuels photocatalysis," *J. Photon. Energy* 7(1), 012001 (2017), doi: 10.1117/1.JPE.7.012001.

Solar fuels photocatalysis

Roland Marschall^{a,b} and Jeremy Pietron^{a,b}

^aJustus-Liebig-University Giessen, Institute of Physical Chemistry, Heinrich-Buff-Ring 17,
35392 Giessen, Germany

^bU.S. Naval Research Laboratory, Code 6170 Surface Chemistry Branch, 4555 Overlook
Avenue SW, Washington, DC 20375, United States

Solar energy conversion and storage is one of the most pressing research topics in the physical and chemical sciences, and its prospects for success have implications for the entire planet. Challenges such as a rapidly growing global population, the concomitant growth in greenhouse gas emissions, and the impact that growth has on climate change make finding low-carbon solutions to energy production and storage all the more critical. The sun provides far more clean energy than humans can actually utilize, but due to the fundamental problem of fluctuating availability of sunlight, solar energy has to be converted into storable forms of energy before it can be applied more broadly to meet a larger fraction of global energy needs.

This special section of the *Journal of Photonics for Energy* on solar fuels photocatalysis centers broadly on ways to convert solar energy to usable fuel—either by reducing CO₂ to carbon-based fuels, or by reducing protons to hydrogen.

More specifically, the special section covers several important long-standing and emerging areas in solar fuels photocatalysis. [Timothy Shelton et al.](#) describe some of the latest advances in the understanding of photocatalytic water oxidation with iron oxide nanoparticles under visible light; [Chao Liu et al.](#) describe the role of highly dispersed Cu sites on TiO₂ in the photocatalytic reduction of CO₂; [Toshihiro Takashima et al.](#) dive still more deeply into the electrocatalytic CO₂ reduction mechanism at Cu, elucidating the role of proton-donating compounds in proton-coupled electron-transfer (PCET)-mediated reduction of CO₂ at Cu electrodes; [Marcin Janczarek et al.](#) present detailed work on the interplay of TiO₂ crystal facets and surface plasmon resonance-driven photocatalytic H₂ generation at composites comprising TiO₂, Cu, and Ag, providing important materials-specific and mechanistic insights into a widely studied but still inadequately understood research area.

Also included are some timely reviews, including an up-to-date minireview of photoelectrochemical water splitting by [Piangjai Peerakiatkhajohn et al.](#), and reviews on emerging topics, including the incorporation of spinel ferrites into solar fuels photocatalysis by [Dereje Taffa et al.](#), and that of exploitation of photonic crystals for solar fuels photocatalysis by [Jeremy Pietron and Paul DeSario](#).

The articles in this special section provide a good overview of recent progress in solar fuels photocatalysis, giving insight into the ever-increasing variety of materials and techniques—already existing and emerging—in this exciting research field.

Roland Marschall obtained his PhD in physical chemistry from the Leibniz University Hannover in 2008. After a one-year postdoctoral research stay at The University of Queensland, he joined the Fraunhofer Institute for Silicate Research ISC in 2010 as project leader. In 2011, he joined the Industrial Chemistry Laboratory at Ruhr-University Bochum. Since 2013, he is Emmy-Noether Fellow at the Justus-Liebig-University Giessen. His current main research interest is heterogeneous photocatalysis, especially photocatalytic water splitting.

Jeremy Pietron received a PhD in analytical chemistry at the University of North Carolina at Chapel Hill in 1998. After completing a National Research Council Postdoctoral Fellowship at the Naval Research Laboratory (NRL) in Washington DC from 1999–2002, he joined the laboratory as a full-time staff scientist in 2003. His primary research interests are nanostructured materials, electrocatalysis, plasmonic nanomaterials, heterogeneous catalysis, and solar fuels photocatalysis.