

**SPRING 2021
CHEMISTRY
SEMINAR SERIES**



DR. HEINZ FREI

*Lawrence Berkeley
National Laboratory
Berkeley, CA*

**HOST:
DR. GALOPPINI**

**ALL THOSE
INTERESTED ARE
WELCOME TO ATTEND**

**Inorganic Core-Shell Nanotube Array for CO₂
Photoreduction by H₂O**

March 26th, 2021 ~ 11:30AM

Seminar Via Zoom

Abstract: Inspired by the design of natural photosynthesis, the only existing system to make chemical compounds on the terawatt scale, we are developing an artificial photosystem in which the most demanding charge transfer and catalytic transformations are accomplished on the shortest possible length scale - nanometers - under membrane separation. Implemented as Co₃O₄-SiO₂ core-shell nanotubes arranged in the form of square inch-sized arrays, the design affords extension of the favorable properties of the nanotubes, each constituting a complete, independently operating photosynthetic unit, to the macroscale. An essential component of the nanotube is a 3 nm thick amorphous silica membrane with embedded molecular wires that chemically separates the incompatible CO₂ reduction and H₂O oxidation environments while providing efficient electronic and protonic communication between them. Emphasis of the talk will be on the quantitative evaluation and optimization of charge transfer, proton transport, and chemical separation properties of the ultrathin wall by photocurrent measurements, ultrafast optical, FT-IRRAS, and impedance spectroscopy. Recent progress in the understanding of how the transferred charges drive H₂O oxidation and CO₂ reduction catalysis based on transient FT-IR spectroscopy will be discussed as well.

Biographical sketch: A Senior Scientist at Lawrence Berkeley National Laboratory, Heinz Frei studied chemistry at the Swiss Federal Institute of Technology (ETH) Zurich (PhD in physical chemistry 1977). After a postdoctoral stay at the Chemistry Department of the University of California at Berkeley, he started a research group in solar photochemistry at LBNL with focus on chemistry with near infrared light, work for which he received the Werner Prize of the Swiss Chemical Society in 1990. Since then, Frei has established new methods for utilizing visible and near infrared light for the environmentally friendly synthesis of useful chemicals and for the chemical storage of solar photons, communicated in over 160 peer reviewed articles. Currently, his research effort focuses on the scientific challenges of the direct conversion of carbon dioxide and water to a liquid fuel by artificial photosynthesis. Frei served as a Deputy Director of LBNL's Physical Biosciences Division (1998-2007) and the Helios Solar Energy Research Center (2008-2011). He was one of the founding scientists of the Joint Center for Artificial Photosynthesis (JCAP, the U.S. Dept. of Energy Innovation Hub for Fuels from Sunlight), Leader of its Interface Project 2010-2015, and Acting Dept. Head of JCAP at LBNL in 2012. Frei has co-organized several symposia on solar photochemistry in the past few years and was Joint-Chair of the 2016 Gordon Research Conference on Solar Fuels and is Editor-in-Chief of the RSC Energy Environmental Series. He was elected Fellow of the American Association for the Advancement of Science in 2014.

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