Systems for Solar Fuels Generation Utilizing PV and Electrolysis

Commercial photovoltaic (PV) and electrolyzer (EC) technologies have been available for decades, and their combination represents an attractive means of converting renewable electricity into storable "solar fuels" such as H_2. Though not as elegant as an integrated artificial photosynthesis device that simultaneously performs solar harvesting and electrolysis, the physically decoupled PV/EC system has great potential to be a low-cost technology for solar fuels production. The key positive attributes of a decoupled PV/EC system include

i.) flexibility in energy output (electricity vs. H_2),
ii.) the use of technology with proven durability and scalability, and
iii.) relatively simple "precursor-in/fuel-out" management.

Despite the promise of such a system, commercial PV modules and EC systems have been largely developed in isolation, and there remain great opportunities to improve performance and drive down costs of PV/EC plants through device- and systems-level optimization.

Invited speakers representing industrial, academic, and sponsoring agencies will provide the current status of research and development of renewable fuels and stimulate discussions on the merits and challenges of obtaining high production capacities using the proposed PV/EC approach. A critical workshop emphasis will be the conception of a research team to meet the identified challenges for large-scale fuel and chemical production. A paper highlighting system designs and R&D needs identified during the workshop is planned.

This workshop will focus on identifying the challenges in the design and development of low cost PV driven EC systems for large-scale production of H_2 and other fuels and useful chemicals from H_2O, CO_2 and other abundant starting materials. The workshop will evaluate the current state of PV/EC technology and identify challenges and opportunities in two critical areas:

1) Systems optimization: A systems-driven approach will identify design and scaling rules for optimizing the manufacture, assembly, and operation of large-scale PV/EC systems for solar fuels production. Topics will include techno-economic analysis, minimization of coupling losses, power conditioning, and design implications for PV and electrolyzer components in an optimized system.

2) PV & electrolyzer design: Current state-of-the-art PV and electrolyzer technologies have been designed independently, and as a result there is tremendous opportunity to improve system performance by redesigning both components for truly synergistic operation. Topics will include identification of low-cost/high-performance components, novel module and electrolyzer designs, membrane technologies, and catalyst development.