Light Harvesting
Special Interest Group

Sunlight to Chemical Conversion – Devices and Applications, 4th May 2022

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Discussion Points
• Direct solar to chemical synthesis; how important is it?
• Solar-driven chemical production is an exciting area of research, often inspired by natural photosynthesis.
• Chemicals and materials can be made from solar energy and CO2.
• Green H2 production and storage could serve as an alternative to large-scale battery storage.
• Solar energy is abundant and free. Photovoltaics (PVs) coupled to electrolysis already allow for green H2 generation, as well as synthesis of alcohols.
• Powering our future has large renewable energy requirements. Solar power and wind power are key options.
• Dark hydrogenation of CO2 can be done using solar-derived H2 from water, as well as by direct solar CO2 utilisation. Gas phase hydrogenation of CO2 (e.g. methanol transformation) requires high pressure and temperature.
• In solar to H2, transport of H2 is a challenge that needs to be addressed.
• A further challenge to address is improving the oxygen evolution reaction and investigating alternative scalable oxidation reactions.
• Chemicals other than H2 are also important, where clean production and value creation needs to be taken into account. E.g., microorganisms can produce isopropanol, which is now important due to COVID-19 and can also be used as a fuel.
• Chemical industries mostly rely on fossil fuels to make cheap commodity chemicals from CO2 and H2. For e.g., ethylene is an important building block that can make other important products. Cascade reactions is an attractive catalysis approach to generate high-value products.
• The market value of different products should be taken into consideration to help estimate profits.
• Integrating technology with existing local infrastructure will require support by government and policy makers.
• Decentralisation can strengthen solar fuels research.
• Microorganisms can be used to produce chemicals locally.
• Chemical safety must be taken into account locally for local solar fuel production.

Opportunities
• PV-electrolyser are being developed for commercial use.
• Early-stage technology is ripe for stronger interaction with industry to take to next stages.
• Extensive research is ongoing to develop robust and scalable solar to chemical conversion devices.
• Fast progress in developing catalysts to make clean fuels.
• Work with government and industry to bring solar fuels to the market.

Challenges
• Stability. PVs as light absorbers in water.
• Scalability. Chemical production and collection on large surface areas.
• Efficient and clean solar to chemical conversion.
• Intermittency. Seasonal availability of sunlight.
• Replacing fossil fuels in chemical industries.
• Product separation. Separation of liquid products from solution requires energy.
• Storage and transportation of gaseous products (e.g., green H2).

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