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Making Solar Fuels

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In one approach to solar energy conversion, the separate half reactions for water oxidation or reduction, or the reduction of CO2 to carbon fuels, occur at the separate half reactions in Dye Sensitized Photo electrolysis Cells (DSPEC) cells. Significant progress has been made for both electrodes and in their integration for water oxidation splitting and CO2 reduction in nanoparticle oxide films. For water oxidation based on TiO2 modified films, significant advances have come from the use of core-shell structures and surface stabilization of external molecular structures by Atomic Layer Deposition (ALD). Significant advances have also occurred in the design of external molecular structures that both absorb light, and following excitation, activate external catalysts for water oxidation. The new designs include examples of integrated electrodes with core/shell over layer oxide structures on Si with co-excitation of the Si resulting in H2 production, an integrated DSSC-DSC design with the second electrode a dye-sensitized solar cell for low energy visible light absorption, and an external Ag plasmon structure for enhanced light absorption. For coupled photocathode structures, significant advances have been made with new structural motifs on NiO electrodes based on surface modification and external molecular structures that avoid back electron transfer with the NiO surface.

Biography:

Thomas J. Meyer designed the first molecular water oxidation catalyst and first described proton coupled electron transfer. He was an early pioneer in the field of artificial photosynthesis and solar fuels. He is a member of the US National Academy of Sciences and the American Academy of Arts and Sciences and has received many awards including the Samson Prize for energy research in 2014. He is currently Arey Professor of Chemistry at UNC Chapel Hill, Director of the UNC Energy Frontier Research Center, and past Vice Chancellor for Graduate Studies and Research at UNC and Associate Laboratory Director at LANL.