Solar hydrogen production by water splitting in photo-electrochemical cells

Photovoltaics is a well-established and well known technology for solar energy conversion into electric energy which has made it into operation and into a huge energy market.

Related to this technology is the conversion of solar energy into solar fuels, the simplest of which would be hydrogen, which is formed when water is split into its components oxygen and hydrogen. Solar water splitting with hydrogen and oxygen gas formation can be achieved in controlled form in so called photo-electrochemical cells (PEC). The operation principle is based on semiconductor photo-electrochemistry, where a semiconducting material that is hit by visible light - practically of course from the sun - will generate pairs of electrons and electron holes which will reduce water at a photo-cathode and oxidize water at a photo anode, both of which are immersed in an aqueous electrolyte.

For the economic viability of this concept it is necessary to have functional and affordable materials and processes. I work on simple semiconductor metal oxides such as iron oxide and tungsten oxide. They are not necessarily the best alternatives for PEC applications in terms of functionality and efficiency, but they are definitely more affordable than the best alternatives. We are therefore researching in order to enhance the efficiency of the affordable materials.

Relevant links:

DoE PEC Working Group

Swiss Hydrogen Research Programme

International Energy Agency Hydrogen Implementation Agreement Annex 26

If you are interested in PEC and standard measurements:

Get this Review which was published in the Journal of Materials Research Focus Issue on Photocatalysis for Energy and Environmental Sustainability (edited by A. Braun et al.):

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