FROM RENEWABLE ENERGY TO HYDROGEN AND SYNFUELS

Prof. Dr. Andreas ZÜTTEL

LMER, ISIC, SB, École polytechnique fédérale de Lausanne (EPFL) Valais/Wallis, Energypolis, Rue de l'Industrie 17, CP 440, CH-1951 Sion, Switzerland

The increasing contribution of renewable energy to our energy demand requires energy storage for mobile application and seasonal storage. Hydrogen can be produced from electricity or heat and water. The storage of hydrogen with a high gravimetric and volumetric energy density is a challenge. However. if CO2 from the atmosphere is reduced with hydrogen to synthesize hydrocarbons with C > 8 (synthetic fuels), the storage and applications are based on established technology.

Energy storage for mobility and seasonal storage are the two major challenges, because of the high energy density required and the large amount of stored energy. The technical solution is to produce hydrogen from renewable electricity. Hydrogen production by electrolysis is an established technology also currently we are facing a lack of large scale electrolysers available. The storage of hydrogen under high pressure, in liquid form or in hydrides is a material challenge and limited to 50% of the energy density of liquid hydrocarbons. The hydrogen can be used to reduce CO_2 from the atmosphere in order to synthesize liquid hydrocarbons. Based on known reactions the efficiency from solar energy to hydrocarbons could reach 18%. This requires large scale electrolyzers, hydrogen storage, adsorption of CO_2 and finally a well controlled reaction of H_2 and CO_2 to a specific product, e.g. octane. The storage of liquid hydrocarbons is a well established technology in mobility as well as large tanks. The challenges and the solutions for the realization of the technical process will be discussed and an example of the realization of the whole energy conversion chain will be presented.

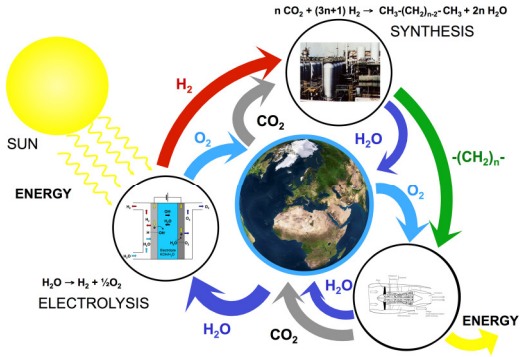

Fig. Schematic representation of the closed materials cycle, where hydrogen is produced from renewable energy and used together with CO_2 from the atmosphere to synthesize hydrocarbons as CO_2 neutral energy carriers.

Biography

Born 22. 8. **1963** in Bern, Switzerland. **1985** Engineering Degree in Chemistry, Burgdorf, Switzerland. **1990** Diploma in Physics from the Unversity of Fribourg (UniFR), Switzerland. **1993** Dr. rer. nat. from the science faculty UniFR. **1994** Post Doc with AT&T Bell Labs in Murray Hill, New Jersey, USA. **1997** Lecturer at the Physics Department UniFR. **2003** External professor at the Vrije Universiteit Amsterdam, Netherlands. **2004** Habilitation in experimental physics at the science faculty UniFR. President of the Swiss Hydrogen Association „HYDROPOLE“. **2006** Head of the section “Hydrogen & Energy” at EMPA and Prof. tit. in the Physics department UniFR. **2009** Guest Professor at IMR, Tohoku University in Sendai, Japan. **2012** Visiting Professor at Delft Technical University, The Netherlands, **2014** Full Professor for Physical Chemsitry, Institut des Sciences et Ingénierie Chimiques, Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland