AKE 9: Energy Storage II

Time: Tuesday 14:00–15:15 Location: A 151

Invited Talk AKE 9.1 Tue 14:00 A 151

Power to Gas - an economic approach ? — •Manfred Waidhas — Siemens AG, PD LD HY, 91058 Erlangen, Germany

The reduction of CO2 emissions is clearly linked with the extension of renewable energies (RE). However, due to the volatile character of its power generation there will be an increasing mismatch between generation and demand. The storage of excess production will become essential in the future in order to prevent increasing curtailment of wind and PV installations and to enable an economic viable scenario with renewables.

It is very clear that grid extension and demand side management will come prior to energy storage. But the estimated storage demand in a 85 % RE scenario - as targeted for Germany in 2035 - will be in the TWh range.

There are many concepts and technologies to store electric energy. Among the three options for large- scale storage * pumped hydro, compressed air and hydrogen - hydrogen is the only viable option to address capacities >10 GWh. Enabling component is the electrolyzer technology, converting electrical energy into hydrogen, a multifunctional chemical energy carrier.

This concept - power to gas - has raised big resonance on one side, but contradictory discussions on the other hand. This presentation addresses all the disputed arguments. It will illustrate the technology, its pros and cons and its limitations. Stress will also be laid on the economic viability in the current and future power generation market.

AKE 9.2 Tue 14:30 A 151

CO_2 Methanation with different gas mixtures — •Fabian Rachow, Johannes Israel, Carola Schwiertz, Evgenia Charlafti, Klaus Müller, and Dieter Schmeisser — Brandenburg University of Technology, Applied Physics and Sensors, Konrad-Wachsmann-Allee 17, 03046 Cottbus, Germany

A key issue in the Energiewende in Germany is the storage of excess energy, as it enables energy management systems to react to fluctuating sources and enhances the flexibility of an energy mix. Power to Gas may be the most reasonable approach to store the energy in the form of hydrogen or synthetic natural gas.

We study the direct conversion of CO_2 by the Sabatier reaction to gain a methane based mixture which can replace natural gas in CHP plants and gas motors and can help to partially reduce the CO_2 emission. In laboratory scale we investigated the performance (with IR and QMS) of Ni-based catalyst for different sources of CO_2 like clean CO_2, CO_2 emitted as flue gas from an Oxyfuel power plant or a synthetic mixture with O_2, N_2 and SO_2 in concentration typical for conventional power plants. Measurements from an up-scaled system are also presented, showing data important for a technical application. Here, we are able to convert more than 200kg CO_2/day with conversion rates up to 90%.

AKE 9.3 Tue 14:45 A 151

Ionic Conductivity of Sodium based Electrolytes — •Kaustubh Bhat, Stefan Blügel, and Hans Lustfeld — Peter Grünberg Institut (PGI-1) and Institute for Advanced Simulation (IAS-1), Forschungszentrum Jülich GmbH, D-52425 Jülich, Germany

Sodium ionic conductors (SICs) are currently receiving renewed attention in the search for electrolytes that possess better ionic conductivity than the materials presently in use. Owing to their lower cost and abundant availability, SICs offer significant advantages over lithium ion batteries for application in large scale energy storage systems. The class of sodium phosphates and thiophosphates (Na_3PO_4, Na_3PS_4) and the class of NASICON materials are known from experiments to contain electronic insulators with good ionic conductivities [1]. To get an insight into the mechanism of ionic transport we determine in particular the energy barriers of ionic hopping for the following situations: i) several pathways, ii) several pressures [2], and iii) replacement of sodium ions by potassium ions. The aim is to detect from these results materials that have smaller energy barriers, and thus better ionic conductivity.

[1] M. Guin and F. Tietz, J. Power Sources **273**, 1056 (2015).
[2] J. A. Hirschfeld and H. Lustfeld, Phys. Rev. B **84**, 224308 (2011).

AKE 9.4 Tue 15:00 A 151

Self restriction oft the Sabatier reaction in large scale — •Johannes Israel, Fabian Rachow, Carola Schwiertz, Evgenia Charlafti, Klaus Müller, and Dieter Schmeisser — Brandenburg University of Technology, Applied Physics and Sensors, Konrad-Wachsmann-Allee, 03046 Cottbus, Germany

A main goal for a sustainable energy supply is a long term energy storage system. One opportunity in this research field is the power to gas concept, where the produced gas can be fed in the existing network of natural gas. Here we show in a technical scale how the direct CO_2 conversion to methane according the Sabatier reaction, $CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$, is self organized. At a certain limit of gas flow, a steady state equilibrium of exothermic heat production and thermal flow is reached and the reaction needs no further external annealing. We find for the maximum volume rate at the steady state equilibirum a shift of around 250 °C above the optimized temperature of the catalytic supported chemical equilibrium. It is shown that also with this setup the used catalyst works with a stable conversion higher than 80 % under the reached temperature and given pressure conditions.