

DPG Tagung Münster 2017 : Abstracts der AKE

UrQuelle: <http://www.dpg-verhandlungen.de/year/2017/conference/muenster/parts?lang=de>

Abstracts des AKE: <http://www.dpg-verhandlungen.de/year/2017/conference/muenster/part/ake>

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AKE: Arbeitskreis Energie

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⊕	Di, 16:45–17:15	S 8	AKE 9: Alternative Fuels for Air Traffic
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⊕	Mi, 16:45–18:15	S Aula	AKE 11: Nuclear Energy and Security (Joint Session AKE-AGA)

AKE 1: Electrochemical Storage: Batteries and Fuel Cells

<http://www.dpg-verhandlungen.de/year/2017/conference/muenster/part/ake/session/1>

Montag, 27. März 2017, 09:00–10:30, S Aula

- ⊖ 09:00 AKE 1.1 Hauptvortrag: [Energy Density, Lifetime and Safety - Not Only an Issue of Lithium Ion Batteries](#) — •MARTIN WINTER, FALKO SCHAPPACHER, MARKUS BÖRNER, and ALEX FRIESEN

Energy Density, Lifetime and Safety - Not Only an Issue of Lithium Ion Batteries — •MARTIN WINTER^{1,2}, FALKO SCHAPPACHER¹, MARKUS BÖRNER¹, and ALEX FRIESEN¹ — ¹MEET Battery Research Center, Westfälische Wilhelms-Universität Münster, Corrensstraße 46, 48149 Münster, Germany — ²Helmholtz Institute Münster (HI MS), IEK-12, Forschungszentrum Jülich GmbH, Corrensstraße 46, 48149 Münster, Germany

Lithium ion batteries (LIBs) became the most important rechargeable electrochemical energy-storage system for portable consumer electronics devices and are presently advancing to a key technology for enabling the broad commercial launch of electric vehicles (EV). For a broad acceptance of this technology and a market breakthrough of EVs several issues have to be addressed to overcome customers' objections against this technology. The cruising range and hence the energy density (Wh/L) and specific energy (Wh/kg), respectively, is a most crucial parameter. Different cell chemistries are discussed as alternative for LIB to increase the energy density, but the advantages and disadvantages (e.g. energy density, lifetime and safety) of these so-called Post-LIB systems and other alternatives with respect to LIBs and advanced LIBs have to be compared carefully.

In this presentation, we will highlight the most recent findings in view of practically realizable specific energies and energy densities of various battery chemistries as well as the safety and aging characteristics of LIBs and will compare it with state of the art technologies.

- ⊖ 09:30 AKE 1.2 Hauptvortrag: [Next Generation Batteries: Hopes and Problems](#) — •ARNULF LATZ and TIMO DANNER

Next Generation Batteries: Hopes and Problems — •ARNULF LATZ^{1,2,3} and TIMO DANNER^{1,2} — ¹Helmholtz Institute Ulm for Electrochemical Energy Storage, Ulm, Germany — ²German Aerospace Center, Stuttgart, Germany — ³University of Ulm, Institute for Electrochemistry, Ulm, Germany

The demand for batteries with higher energy densities and higher power densities is continuously rising. Although lithium ion technology made huge progress in recent years, it is to be expected that new chemistries and new battery designs are necessary to meet the expectations of society and politics for the performance of batteries e.g. in electromobility applications or as stationary storage devices. The list of possible candidates for the next generation battery is large and still growing every year. Based on simple theoretical calculations there are huge hopes that dramatically improved battery designs should be possible. But since batteries are intrinsic unstable nonequilibrium systems, each new material combination and each new battery design has to overcome its specific scientific challenges before a stable and safe battery with a sufficiently long lifetime is created. In the presentation, first an overview over some of the most promising and most interesting candidates for next generation batteries is given. Then we show at the example of sulfur based batteries how some of the scientific challenges of next generation batteries can be investigated with the help of theory based modeling and simulation techniques.

- ⊖ 10:00 AKE 1.3 Hauptvortrag: [Fuel Cells - A complement and an Alternative to Batteries on the Path to Application](#) — •K. ANDREAS FRIEDRICH

Fuel Cells - A complement and an Alternative to Batteries on the Path to Application — •K. ANDREAS FRIEDRICH — German Aerospace Center (DLR), Institute of

Engineering Thermodynamics, Pfaffenwaldring 38-40, Stuttgart 70569, Germany

Fuel cells are acknowledged as essential parts of the necessary transition of the energy system as required by the commitments to climate protection in the frame of COP21 and COP22. Fuel cell development has reached an advanced maturity stage as demonstrated by the first series cars from Asian manufacturers, the approaching commercialization of stationary systems in Europe as well as the successful market penetration of residential fuel cell systems in Japan. With the advancement of fuel cell application in cars a concurrent built-up of a hydrogen refueling infrastructure is needed. The first hydrogen infrastructure areas are located in California, Germany and Japan. In order to achieve a global reach, however, much more efforts worldwide are needed. In this presentation an overview over the state-of-art of fuel cells, with a focus on polymer electrolyte membrane (PEMFC) and solid oxide fuel cells (SOFC) is given accompanied by a critical assessment of achievements and challenges. The advantages and disadvantages in comparison to other technologies, in particular batteries, is discussed. The system design of a hybrid fuel cell with a battery exhibits many beneficial properties that will be described. Finally, some applications are highlighted, e.g. propulsion of aircraft, in which fuel cells are a necessity to achieve the requirements.

AKE 2: Renewable Energy: Photovoltaics

<http://www.dpg-verhandlungen.de/year/2017/conference/muenster/part/ake/session/2>

Montag, 27. März 2017, 11:00–12:15, S Aula

- ⊖ 11:00 AKE 2.1 [Hauptvortrag: Roadmap and roadblocks for multi-junction device technology based on metal halide perovskites](#) — •EVA UNGER

Roadmap and roadblocks for multi-junction device technology based on metal halide perovskites — •EVA UNGER — Department of Chemistry, Lund University, Lund, Sweden — Helmholtz Center Berlin for Materials and Energy, Berlin, Germany

Solar cells based on metal-halide perovskite semiconductors inspire high hopes for efficient low-cost solar cell technology. These materials are promising to realize efficient tandem solar cell technology compatible with conventional solar cell technology based on silicon. Multi-junction solar cell devices with efficiencies exceeding 30% could be achieved by boosting silicon solar panels with a device based on absorber materials with optical band gaps of about 1.7 eV. In this respect, the ease of tuning the optical properties of metal halide perovskite materials and the possibility to achieve highly efficient devices entirely by solution-based deposition methods make this class of evolving semiconductors an ideal case to develop low-cost and scalable multi-junction device technology. This talk will give an overview over the state of the art and current performance metrics of metal-halide perovskite device technology. Close to the ideal band gap for absorbers for tandem solar cell stacks of 1.7 eV, the onset of photo-induced halide migration becomes limiting to the open circuit voltage indicating an intriguing but potentially hampering intrinsic properties of metal halide perovskites to their application in solar energy conversion devices.

- ⊖ 11:30 AKE 2.2 [Highly Stable and Efficient Perovskite Solar Cells Via Multication Engineering](#) — •MICHAEL SALIBA, ANDERS HAGELDT, and MICHAEL GRAETZEL

Highly Stable and Efficient Perovskite Solar Cells Via Multication Engineering — •MICHAEL SALIBA, ANDERS HAGELDT, and MICHAEL GRAETZEL — EPFL, Lausanne, Switzerland

Perovskites have emerged as low-cost, high efficiency photovoltaics with certified efficiencies of 22.1%. The perovskites used for solar cells have an ABX₃ structure where the cation A is methylammonium (MA), formamidinium (FA), or Cs; the metal B is Pb; and the halide X is Br or I. Unfortunately, single-cation perovskites often suffer from phase, temperature or humidity instabilities. This is particularly noteworthy for CsPbX₃ and FAPbX₃ showing a photoinactive yellow phase at room temperature instead of the more desired photoactive black phase.

Here, we investigate triple cation (with Cs, MA, FA) perovskites resulting in significantly improved reproducibility and stability. We then use multiple cation engineering as a strategy to integrate the seemingly too small Rb (that never shows a black phase as a single-cation perovskite) to study novel multication perovskites.

One composition containing Rb, Cs, MA and FA resulted in a stabilized efficiency of 21.6%. The open-circuit voltage of 1.24 volts at a band gap of 1.63 eV leads to a very small loss-in-potential of 0.39 V, versus 0.4 V for commercial silicon cells. Polymer-coated cells maintained 95% of their initial performance at 85°C for 500 hours under full solar illumination and maximum power point tracking.(1)

(1) Saliba et al., Incorporation of rubidium cations into perovskite solar cells improves photovoltaic performance. Science (2016).

- ⊖ 11:45 AKE 2.3 [Growth-control of the ordered double-perovskite structure in \(Pr_{0.5}Ba_{0.5}\)CoO_{3-δ} thin films](#) — •GUNKEL FELIX, HAUSNER CLEMENS, DAVID N. MÜLLER, DANIEL BICK, LEI JIN, CHUNLIN JIA, THEO SCHNELLER, ILIA VALOV, and DITTMANN REGINA

Growth-control of the ordered double-perovskite structure in (Pr_{0.5}Ba_{0.5})CoO_{3-δ} thin films — •GUNKEL FELIX¹, HAUSNER CLEMENS², DAVID N. MÜLLER², DANIEL BICK¹, LEI JIN³, CHUNLIN JIA³, THEO SCHNELLER¹, ILIA VALOV², and DITTMANN REGINA² — ¹Institute of Electronic Materials (IWE2), RWTH Aachen University — ²Peter Grünberg Institut, Forschungszentrum Jülich GmbH — ³Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons, Jülich

The complex oxide compound (Pr_{0.5}Ba_{0.5})CoO_{3-δ} (PBCO) is considered an efficient catalytic oxide for oxygen evolution half-reaction (OER) taking place during water splitting operation. We discuss structural and electrical properties of epitaxial PBCO thin films serving a model systems for exploring the atomistic processes during OER. PBCO thin films are synthesized in a disordered and in an ordered double-perovskite crystal structure by controlling the growth temperature during pulsed laser deposition. The thin films are fabricated with defined surface morphologies and crystal orientation. During the growth process, the transition from disordered to ordered phase can be monitored directly by means of electron diffraction (RHEED). The epitaxial thin films show catalytic activity comparable to their porous counter parts fabricated by chemical routes, making them ideal model templates for systematic studies. The ability to control the ordered double-perovskite phase of PBCO bears the potential to force the formation of structural oxygen vacancies within the lattice with atomic precision and to tailor active sites for OER on the nanoscale.

- ⊖ 12:00 AKE 2.4 [Influence of the pH value of the dye on the electrical properties of dye sensitized solar cells prepared with anthocyanins](#) — •IRÉN JUHÁSZ JUNGER, SARAH VANESSA HOMBURG, HUBERT MEISSNER, THOMAS GRETHE, ANNE SCHWARZ-PFEIFFER, JOHANNES FIEDLER, ANDREAS HERMANN, TOMASZ BLACHOWICZ, and ANDREA EHRMANN

Influence of the pH value of the dye on the electrical properties of dye sensitized solar cells prepared with anthocyanins — •IRÉN JUHÁSZ JUNGER¹, SARAH VANESSA HOMBURG¹, HUBERT MEISSNER¹, THOMAS GRETHE², ANNE SCHWARZ-PFEIFFER², JOHANNES FIEDLER¹, ANDREAS HERMANN¹, TOMASZ BLACHOWICZ³, and ANDREA EHRMANN¹ — ¹Bielefeld University of Applied Sciences, Faculty of Engineering and Mathematics, Bielefeld (Germany) — ²Niederrhein University of Applied Sciences, Research Institute for Textile and Clothing (FTB), Mönchengladbach (Germany) — ³Silesian University of Technology,

Institute of Physics - Center for Science and Education, Gliwice (Poland)

In recent years the harvesting of renewable energies became of great importance. This led to a rapid development of dye-sensitized solar cells which can be produced from cheap, low-purity materials. The best electrical properties are provided by cells prepared using synthetic, ruthenium based dyes. Unfortunately, most of them are toxic and expensive. The anthocyanins extracted for example from hibiscus flowers yield a cheap and eco-friendly alternative to the toxic dyes, however, with a loss of solar cell efficiency. Our aim is to improve the conversion efficiency and the stability of solar cells prepared with anthocyanins by changing the pH value of the dye. In order to find the optimal pH value, its influence on the solar cell properties is investigated.

AKE 3: Economics of Energy Supply and Use

<http://www.dpg-verhandlungen.de/year/2017/conference/muenster/part/ake/session/3>

Montag, 27. März 2017, 16:45–17:15, S Aula

⊖ 16:45 AKE 3.1 Hauptvortrag: [Die Defizite der Energiewende](#) — •MANUEL FRONDEL

Die Defizite der Energiewende — •MANUEL FRONDEL — RWI Essen

Der Anteil der erneuerbaren Energietechnologien am deutschen Strommix lag Ende 2015 bei rund 30%. Das bedeutet gegenüber dem Anteil von weniger als 7% im Jahr 2000, in dem das Erneuerbaren-Energien-Gesetz (EEG) zur Förderung der Erneuerbaren eingeführt wurde, mehr als eine Vervielfachung. In keinem anderen Land der Welt wurde der Anteil der Erneuerbaren derart vorangetrieben. Doch was weltweit große Beachtung findet, hat einen sehr hohen Preis: Die Kosten für den Ausbau der erneuerbaren Energien in Deutschland nehmen stetig zu und liegen mittlerweile bei deutlich über 20 Mrd. Euro jährlich. Während viele armutsgefährdete Haushalte unter diesen Lasten zu leiden haben, wird immer mehr überschüssiger grüner Strom produziert, der wegen fehlenden Stromnetzen keine Abnehmer mehr findet. Um dies zu vermeiden und den künftigen Kostenanstieg für die Verbraucher zu dämpfen, sollte der weitere Ausbau der Erneuerbaren gedrosselt und mit dem Tempo des Netzausbaus in Deutschland synchronisiert werden.

AKE 4: Future Perspectives: Fusion Energy Research

<http://www.dpg-verhandlungen.de/year/2017/conference/muenster/part/ake/session/4>

Montag, 27. März 2017, 17:15–17:45, S Aula

⊖ 17:15 AKE 4.1 Hauptvortrag: [Fusion Research - recent progress and perspectives](#) — •ANTONIUS DONNÉ

Fusion Research - recent progress and perspectives — •ANTONIUS DONNÉ — EUROfusion, Garching, Germany

The European roadmap to the realisation of fusion electricity to the grid breaks the quest into eight missions. For each mission, it reviews the current status of research, identifies open issues, and proposes a research and development programme.

A long-term perspective on fusion is mandatory since Europe has a leading position in this field and major expectations have grown in other ITER parties on fusion as a sustainable and secure energy source. China, for example, is launching an aggressive programme aimed at fusion electricity production well before 2050. Europe can keep the pace only if it focuses its effort and pursues a pragmatic approach to fusion energy.

With this objective, the present roadmap has been elaborated.

ITER is the key facility of the roadmap as it is expected to achieve most of the important milestones on the path to fusion power. The Fusion Roadmap is tightly connected to the ITER schedule and the vast majority of resources in Horizon 2020 are dedicated to ITER and its accompanying experiments. Parallel to the ITER exploitation in the 2030s, the construction of the demonstration power plant DEMO needs to be prepared. DEMO will for the first time supply fusion electricity to the grid. The design, construction and operation of DEMO require full involvement of industry to ensure that, after a successful DEMO operation, industry can take responsibility for commercial fusion power.

AKE 5: Nuclear Decommissioning and Storage

<http://www.dpg-verhandlungen.de/year/2017/conference/muenster/part/ake/session/5>

Dienstag, 28. März 2017, 08:30–09:00, S Aula

⊖ 08:30 AKE 5.1 Hauptvortrag: [Research for the safe management of nuclear waste](#) — •DIRK BOSBACH

Research for the safe management of nuclear waste — •DIRK BOSBACH —
Forschungszentrum Jülich, Germany

The safe management of radioactive waste arising from electricity production is one of the great challenges of our times. Technologies for the decommissioning of nuclear facilities and for the safe management of the associated waste have been developed in recent decades. Current R&D activities are focusing on optimization regarding e.g. radiation exposure of personal, economic aspects, etc. Some special waste streams arising from the decommissioning of nuclear installations have not been in the focus of R&D activities in the past, e.g. radioactively contaminated toxic metals such as beryllium, cadmium or mercury, spent ion-exchange resins, radioactively contaminated NAPL and decontamination fluids, wastes containing asbestos, PCB, etc. and mixed wastes with elevated concentrations of chemotoxic/hazardous constituents. Although the expected volumes of various of these special waste streams will be comparatively small, there are specific challenges linked to their safe management, for example, due to their associated chemotoxicity, potential releases of radionuclides, their incompatibility to established conventional treatment and conditioning techniques, analytical challenges regarding the adequate determination of radioactive and chemotoxic inventories, etc. The presentation will provide an overview of current R&D activities at Forschungszentrum Jülich on waste treatment and waste form development regarding some special wastes.

AKE 6: Renewable Energy (RE) : Wind Energy

<http://www.dpg-verhandlungen.de/year/2017/conference/muenster/part/ake/session/6>
Dienstag, 28. März 2017, 09:00–10:00, S Aula

⊖ 09:00 AKE 6.1 Hauptvortrag: [Smarte Rotoren für kosteneffiziente Windenergieanlagen](#) — •JAN TESSMER

Smarte Rotoren für kosteneffiziente Windenergieanlagen — •JAN TESSMER — DLR
- Deutsches Zentrum für Luft- und Raumfahrt

Weltweit waren Ende 2015 Windenergieanlagen mit ca. 430 GW Gesamtleistung installiert, davon über 43 GW in Deutschland mit einem Anteil von rund 14 % an der Bruttostromerzeugung. Wesentlichen Vorteile von Windenergie sind niedrige Stromerzeugungskosten, globale Einsetzbarkeit und gute Regelbarkeit (Systemdienstleistungen).

Eines der wichtigsten Ziele der Forschung und Entwicklung ist eine weitere Kostenreduktion. Hierfür sind weitere Entwicklungen in der Anlagentechnik notwendig. Gewichtsreduktion und längere Lebensdauer durch neue Bauweisen und Werkstoffe unter Berücksichtigung genauerer Kenntnisse der Systemparameter bezüglich Elastizität und Strukturmechanik sind wesentliche Treiber bei der Kostenreduktion. Der Beitrag beleuchtet daher vertieft die Erforschung innovativer Rotorblatttechnologien im Rahmen aktueller Forschungsvorhaben.

Neue Methoden vom Designprozess bis zur automatisierten Produktion, das Verhalten neuer Komponenten im System der Gesamtwindenergieanlage und die Auswirkungen auf Akzeptanzkriterien (z.B. Lärm)müssen verifiziert und validiert werden bevor sie im industriellen Betrieb eingesetzt werden können. Der vom BMWi und dem Land Niedersachsen geförderte Aufbau einer Forschungsplattform (DFWind) wird in den kommenden Jahren eine Infrastruktur bereitstellen, die neben der phänomenologischen Untersuchung zwei hintereinander stehender Windturbinen sowie ihres Umfeldes auch die Erprobung und Qualifikation neuer Technologien und Methoden erlauben wird.

⊖ 09:30 AKE 6.2 Hauptvortrag: [Beiträge der Windphysik zum Ausbau der Windenergienutzung](#) — •MARTIN KÜHN

Beiträge der Windphysik zum Ausbau der Windenergienutzung — •MARTIN KÜHN
— ForWind - CvO Universität Oldenburg

In der Weiterentwicklung der Windenergie stellen sich eine Vielzahl spezifischer Fragen auch an die Physik. Diese reichen von den räumlichen und zeitlichen Eigenschaften des Kraftstoffs »Wind«, über die Energiewandlung im Konverter bis zu energiemeteorologischen und systemdynamischen Aspekten der Netzintegration.

Kürzlich wurde vor diesem Hintergrund das »Forschungslabor für Turbulenz und Windenergiesysteme« (WindLab) der Universität Oldenburg eröffnet. Es dient der Erforschung turbulenter atmosphärischer Strömungen und deren Zusammenspiel mit Windenergiesystemen, d.h. Windparks, Windenergieanlagen und deren Komponenten. ForscherInnen aus Physik, Meteorologie und Ingenieurwesen untersuchen grundlagenorientiert und angewandt die bisher nur lückenhaft verstandenen Turbulenzeigenschaften und -interaktionen auf unterschiedlichsten räumlichen Skalen vom Rotorblatt über einzelne Windenergieanlagen bis zu großen Windparkverbänden.

Die Forschungsprogrammatik gliedert sich in drei Schwerpunkte, in denen methodisch neuartige Lösungsansätze erarbeitet werden: Beschreibung und Modellierung der Windturbulenz, Simulationen und Experimente zur Interaktionen von Turbulenz und Windenergiesystemen und turbulenzkompensierende Regelungsverfahren.

Resultierend sind wesentliche Beiträge zur Reduktion der durch Windturbulenz verursachten Kosten für Nutzung und Netzintegration von Windenergie zu erwarten.

AKE 7: RE: Aspects of Intermittent Generation

<http://www.dpg-verhandlungen.de/year/2017/conference/muenster/part/ake/session/7>
Dienstag, 28. März 2017, 10:00–10:30, S Aula

10:00 AKE 7.1 Der Beitrag wurde abgesagt.

⊖ 10:00 AKE 7.2 Hauptvortrag: [Surplus electricity and storage under conditions of intermittent supply](#) — •FRIEDRICH WAGNER

Surplus electricity and storage under conditions of intermittent supply —
•FRIEDRICH WAGNER — Max Planck Institut für Plasmaphysik, Greifswald, Germany

Data from the German electricity system for the years 2010, 2012, 2013, and 2015 are used and scaled up to a 100% supply by intermittent renewable energy sources (iRES). In the average, 330 GW wind and PV power are required to meet a 100% target. A back-up system is necessary with the power of 89% of peak load. Surplus electricity accrues at high power levels. Curtailing surplus power to a large extent is found to be uneconomic. Demand-side-management will suffer from the strong day-to-day variation of available surplus energy. A day storage is ineffective because of the day-night correlation of surplus power during winter. A seasonal storage loses its character when transformation losses are considered because it can contribute only after periods with excessive surplus production. The capacities to be installed stress the difficulty to base heat supply and mobility also on iRES generated electricity in the future. As the German energy transition replaces one CO₂-free electricity supply system by another one no major reduction in CO₂ emission can be expected till the last nuclear reactor will be switched off. The German GHG emission targets for 2020 and beyond may be in jeopardy.

AKE 8: Sector Coupling, Chemical Conversion and Storage of RE

<http://www.dpg-verhandlungen.de/year/2017/conference/muenster/part/ake/session/8>

Dienstag, 28. März 2017, 11:00–13:00, S Aula

- ⊖ 11:00 AKE 8.1 Hauptvortrag: [Power to Gas Konzepte für die Energiewende](#) —
•FRANK GRAF

Power to Gas Konzepte für die Energiewende — •FRANK GRAF — DVGW-Forschungsstelle am Engler-Bunte-Institut des Karlsruher Instituts für Technologie (KIT), Engler-Bunte-Ring 1 - 7, 76131 Karlsruhe

Ein zukünftig auf Windkraft und Solarenergie basierendes Energiesystem kommt ohne verschiedene Speichermöglichkeiten nicht aus. Power to Gas kann deshalb mittel- und langfristig einen wichtigen Beitrag zum Gelingen der Energiewende leisten. Die Speicher- und Verteilstruktur für Erdgas ist in Deutschland hervorragend ausgebaut und sehr gut als Speicherinfrastruktur für elektrische Energie geeignet. Die derzeit betriebenen Poren- und Kavernenspeicher für Erdgas in Deutschland haben ein Arbeitsgasvolumen von 24,1 Mrd. m³, was etwa einer chemischen Speicherleistung von 265 TWh entspricht. Neben Transport und Speicherung von großen Mengen an elektrischer Energie mit Hilfe der bestehenden Erdgasinfrastruktur kann über PtG-Prozesse auch regenerativer Kraftstoff erzeugt werden. Außerdem kann der Wärmemarkt mit einem Gas aus erneuerbaren Quellen versorgen werden. In den letzten Jahren wurden umfangreiche Forschungs- und Entwicklungsarbeiten durchgeführt und erste Praxiserfahrungen an mehreren Demonstrationsanlagen gesammelt. Im Beitrag werden die verschiedenen Aspekte erörtert.

- ⊖ 11:30 AKE 8.2 Hauptvortrag: [Sektorenkopplung als Teil der Energieversorgung von morgen](#) — •RENÉ SCHOOF

Sektorenkopplung als Teil der Energieversorgung von morgen — •RENÉ SCHOOF — Energy Storage Technology, Uniper Energy Storage GmbH, Ruhrallee 80, 45136 Essen

In einer künftigen Energieversorgung, die zunehmend auf erneuerbaren Energien aus Wind und Sonne basiert, wird es immer wichtiger, diese planbar bereitzustellen und zu transportieren. Neben Netzausbau und Speichertechnologien kann die Kopplung verschiedenster Sektoren wie Wärme, Gas, Mobilität, Industrie usw. einen wesentlichen Beitrag zum Gelingen dieser Systemtransformation beitragen. Darüber hinaus ist die Sektorenkopplung der Garant für das Erreichen einer CO₂-neutralen Energienutzung zur Einhaltung der Klimaziele im Sinne von COP21.

- ⊖ 12:00 AKE 8.3 Eingeladener Vortrag: [Was kann Sektorenkopplung leisten? Eine modellgestützte Analyse von Technologien und ihrer Potenziale](#) — •HANS CHRISTIAN GILS

Was kann Sektorenkopplung leisten? Eine modellgestützte Analyse von Technologien und ihrer Potenziale — •HANS CHRISTIAN GILS — Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Technische Thermodynamik, Stuttgart

Eine stärkere Verknüpfung von Strom-, Wärme-, Verkehrs- und Gassektor kann einen wesentlichen Beitrag zum Gelingen der Energiewende leisten. So können beispielsweise durch ein gesteuertes Laden von Elektrofahrzeugen, sowie einen optimierten Betrieb von Wärmepumpen und Kraft-Wärme-Kopplungs-Anlagen der Bedarf nach regelbaren Kraftwerken gesenkt, und Erzeugungsspitzen aus Windkraft- und Photovoltaikanlagen in höherem Maße genutzt werden. Im Zentrum des Vortrags steht die Analyse des wirtschaftlichen Potenzials verschiedener Sektorenkopplungstechnologien in einem überwiegend auf fluktuierenden Quellen basierenden Energieversorgungssystem in Deutschland. Die Untersuchungen stützen sich auf die Anwendung des DLR-Energiesystemmodells REMix, und behandeln auch die Frage, wie die Sektorenkopplung mit anderen Technologieoptionen, z.B. einem erweiterten

Stromnetzausbau und dem Import regelbaren erneuerbaren Stroms, wechselwirkt.



12:30 AKE 8.4 [Direct CO₂-Methanation of flue gas emitted by conventional power plants](#) — •JOHANNES ISRAEL¹, FABIAN RACHOW, CAROLA SCHWIERTZ, EVGENIA CHARLAFTI, KLAUS MUELLER, and DIETER SCHMEIBER

Direct CO₂-Methanation of flue gas emitted by conventional power plants — •JOHANNES ISRAEL¹, FABIAN RACHOW¹, CAROLA SCHWIERTZ¹, EVGENIA CHARLAFTI², KLAUS MUELLER¹, and DIETER SCHMEIBER¹ — ¹BTU Cottbus - Senftenberg, Konrad-Wachsmann-Allee 17, 03046 Cottbus — ²TU Berlin, Ackerstraße 76, 13355 Berlin

The catalytic conversion of CO₂ with H₂ into CH₄ is possible by the Sabatier reaction $CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$. Using excess energy from renewable electricity generation, this approach offers an opportunity for recycling of CO₂ as synthetic natural gas.

In a new concept, we investigate the performance of the Sabatier reaction as direct methanation of flue gas, emitted by conventional power plants. We investigate the Sabatier process in an upscaled system, with a maximum input flow rate of 45 Nm³/h Gas. The performance is investigated in a simulated composition of flue gas and under real conditions at a lignite power plant in Schwarze Pumpe, Brandenburg, Germany.

We can achieve a CO₂-conversion of up to 90%, with approx. 100% selectivity towards CH₄. Under flue gas conditions and at a certain limit of gas flow the system is operated at an autothermal running modus, a steady state equilibrium of exothermic heat production and thermal flow that needs neither external annealing nor cooling.



12:45 AKE 8.5 [Synthesis of Methanol from CO₂ for Power-to-Liquid applications](#) — •FABIAN RACHOW, MORITZ HAGENDORF, KLAUS MÜLLER, and DIETER SCHMEIBER

Synthesis of Methanol from CO₂ for Power-to-Liquid applications — •FABIAN RACHOW, MORITZ HAGENDORF, KLAUS MÜLLER, and DIETER SCHMEIBER — Brandenburgische Technische Universität Cottbus - Senftenberg, Angewandte Physik-Sensorik, Konrad-Wachsmann-Allee 17, 03046 Cottbus, Germany

The direct synthesis of methanol [$CO_2 + 3H_2 \rightleftharpoons CH_3OH + H_2O$] represent a possibility to reduce the global CO₂-emission by recycling the CO₂ and also to store excess energy from renewable energy sources into a common fuel or chemical feedstock (Power-to-Liquid). For an acceptable conversion rate of CO₂ a catalyst is needed, together with high temperatures (>200°C) and high pressure (50-200bar). Methanol is normally produced from synthesis gas, a mixture of CO and H₂. By directly using CO₂ for the exothermic reaction, we avoid the conversion of CO₂ to CO by the reversed water gas shift reaction. We also present new concepts for the conversion from CO₂-rich flue gases, eliminating the need for a separation of the CO₂. The concept is backed up by measurements in laboratory scale. Here we use a Cu-ZnO catalyst on a ZrO₂ substrate prepared by impregnation and compare the results with commercially available catalysts. We achieved a conversion of around 7% and a selectivity of 60% at a temperature of 240°C and 45bar. The reaction is thermodynamically limited with a maximum conversion rate of 15% at 250°C and 50bar. The conversion and the selectivity towards methanol is highly influenced by the catalyst used, the temperature, the pressure as well as the flow rate of the reactants.

AKE 9: Alternative Fuels for Air Traffic

<http://www.dpg-verhandlungen.de/year/2017/conference/muenster/part/ake/session/9>

Dienstag, 28. März 2017, 16:45–17:15, S 8

⊖ 16:45 AKE 9.1 Hauptvortrag: [Verändern alternative Treibstoffe die Emissionen des Luftverkehrs und seine Klimawirkung?](#) — •CHRISTIANE VOIGT

Verändern alternative Treibstoffe die Emissionen des Luftverkehrs und seine Klimawirkung? — •CHRISTIANE VOIGT — Deutsches Zentrum für Luft- und Raumfahrt (DLR), Oberpfaffenhofen, Deutschland — Johannes Gutenberg-Universität, Mainz, Deutschland

Hohe Wachstumsraten im Luftverkehr erfordern eine umfassende Kenntnis der Wirkung des Luftverkehrs auf die Atmosphäre und das Klima. Aktuelle Prognosen erwarten eine Verdopplung der CO₂ Emissionen des Luftverkehrs bis 2050, daher setzen internationale Luftverkehrsorganisationen (IATA, ACARE) ambitionierte Ziele, die Emissionen des Luftverkehrs deutlich zu reduzieren. Nationale Luftfahrtbehörden streben z.B. mit dem "Biofuel Flightpath" eine Erhöhung des Anteils an alternativen Treibstoffen im Luftverkehr an. Alternative Treibstoffe besitzen einen niedrigeren Aromatengehalt, welcher die Verbrennungsprozesse im Triebwerk modifiziert und somit einen Effekt auf die Emissionen haben kann. Die Emissionen alternativer Treibstoffe im Luftverkehr und ihre Wirkung auf Atmosphäre und Klima sind bislang jedoch wenig untersucht und daher das Ziel aktueller Forschung. Der Vortrag zeigt neue Ergebnisse von Flugzeugmessungen im Abgasstrahl von Jets, die mit Bio- oder synthetischen Treibstoffen betankt wurden. Die Partikel und Spurengas-Emissionen alternativer Treibstoffe wurden im Abstand von 100 m hinter voranfliegenden Test-Flugzeugen gemessen und quantifiziert. Ihre Wirkung auf die Bildung und Lebensdauer von Kondensstreifen wird untersucht und das Klima-Potenzial alternativer Treibstoffe wird diskutiert.

AKE 10: Future Perspectives: CO₂-Storage

<http://www.dpg-verhandlungen.de/year/2017/conference/muenster/part/ake/session/10>

Dienstag, 28. März 2017, 17:15–17:45, S 8

⊖ 17:15 AKE 10.1 Hauptvortrag: [Geological CO₂ storage - concepts and state of knowledge](#) — •AXEL LIEBSCHER

Geological CO₂ storage - concepts and state of knowledge — •AXEL LIEBSCHER — Deutsches GeoForschungsZentrum, Potsdam, Germany

The German national climate targets aim at 80-95% reduction of greenhouse gas emissions by 2050. To reach these targets, additional and intensified measures for greenhouse gas reduction are necessary, which have to cover all emission sources and sectors. To limit global warming to significantly <2°C by end of the century in all likelihood, negative emissions are necessary in the second half of the century in all likelihood. Long-term geological storage of CO₂, captured at emission sources, is an essential measure within the portfolio of emission reduction technologies. In combination with biomass it is the only currently available technique that allows for negative emissions in climate relevant quantities. Currently, 15 industrial scale projects store 30 Mt of CO₂ per year worldwide. The longest operating CO₂ storage project is "Sleipner" offshore Norway, which stores 1 Mt of CO₂ per year since 1996. In Germany, experiences on geological CO₂ storage has been gained at the pilot site Ketzin, where ~ 67 kt of CO₂ have been stored between 2008 and 2013. Storage reservoirs are typically porous rocks (either depleted hydrocarbon reservoirs or saline aquifers) at > 1000 m depth that are overlain by impermeable cap rocks. Crucial to any storage project is a site-specific monitoring concept, based on geochemical and geophysical methods. With such a system, surveillance of the storage system, detection of even small amounts of CO₂ and sound prediction of long-term behaviour is possible.

AKE 11: Nuclear Energy and Security (Joint Session AKE-AGA)

<http://www.dpg-verhandlungen.de/year/2017/conference/muenster/part/ake/session/11>

Mittwoch, 29. März 2017, 16:45–18:15, S Aula

- ⊖ 16:45 AKE 11.1 Hauptvortrag: [Nuclear Power and Nuclear Safety Post Fukushima](#) — •CHRISTOPH PISTNER and MATTHIAS ENGLERT

Nuclear Power and Nuclear Safety Post Fukushima — •CHRISTOPH PISTNER and MATTHIAS ENGLERT — Öko-Institut e.V., Rheinstraße 95, 64295 Darmstadt

On March 11, 2011, the second "major accident" in a civilian nuclear power plant after Chernobyl took place in Fukushima Dai-ichi. A major earthquake and resulting tsunami lead to a core melt in three reactors and the following relocation of more than 100.000 residents. But still, worldwide there are 450 nuclear reactors operational today. Safety checks like the EU-Stresstest took place after Fukushima and possibilities for optimization have been identified basically everywhere. Fukushima emphasized the importance of taking natural events more thoroughly into account and led to the implementation of additional safety equipment. But still, events from internal and external causes continue to happen frequently. In addition to these "conventional" safety problems, also other threats gain in importance. Besides the danger of terrorist attacks on nuclear facilities, also the deterioration of the institutional environment due to a military or economic crisis has to be taken into account. Thus, nuclear power remains to be a technology with the inherent potential for catastrophic accidents.

- ⊖ 17:15 AKE 11.2 Hauptvortrag: [Safeguards and Non-Proliferation experience from an IAEA perspective](#) — •TARIQ RAUF

Safeguards and Non-Proliferation experience from an IAEA perspective — •TARIQ RAUF — formerly IAEA, Head Verification and Security Policy, Vienna

The International Atomic Energy Agency (IAEA) has been implementing nuclear safeguards for more than half a century covering peaceful nuclear activities. IAEA safeguards are implemented in States pursuant to legal authority from the IAEA Statute and bilateral, regional and international nuclear non-proliferation treaties and agreements; and are set of technical measures that allow the IAEA to independently verify a State's legal commitment not to divert nuclear material from peaceful nuclear activities to nuclear weapons or other nuclear explosive devices. In 1991, the IAEA safeguards system suffered a massive shock when it was discovered that Iraq was running an heretofore undetected parallel undeclared nuclear (weapon acquisition) programme. As a result, the IAEA safeguards system was strengthened based on a combination of expanded information and technical measures through the Additional Protocol (to safeguards agreements). Further challenges to the IAEA safeguards system came during 1992 through 2015, from the DPRK, Iran, Libya, South Korea and Syria. This presentation describes the structure and technical elements of safeguards, including implementation in high-priority cases.

- ⊖ 17:45 AKE 11.3 Hauptvortrag: [Civil Nuclear Power - The Cyber Security Perspective](#) — •GUIDO GLUSCHKE

Civil Nuclear Power - The Cyber Security Perspective — •GUIDO GLUSCHKE — Institute for Security and Safety at the Brandenburg University of Applied Sciences, Potsdam, Germany

The talk will discuss the situation at nuclear facilities in the digital age. It will elaborate on the cyber-related challenges of the safety and security domains. Furthermore, the talk will introduce the concept of design basis threat which represents the IAEA methodology for risk treatment in terms of physical protection and will have a look how cyber fits into this model. Finally, some international initiatives on cyber security will be presented.

<http://www.dpg-physik.de/presse/pressemit/2017/dpg-pm-2017-10.html>

<http://muenster17.dpg-tagungen.de/programm/abendvortraege.html>

- **Öffentlicher Abendvortrag**

Früher war alles besser – aber nicht die Batterien
Donnerstag, 30. März 2017, 20 Uhr, Hörsaal H 1, Schlossplatz 46
Prof. Dr. Martin Winter, Westfälische Wilhelms-Universität Münster

- **Öffentlicher Abendvortrag**

- Donnerstag, 30. März 2017, 20:00 – 21:00 Uhr, H 1
Prof. Dr. Martin Winter, Helmholtz Institut Münster
spricht über

- **“Früher war alles besser – aber nicht die Batterien”**

- Abstract:

- Ohne Lithium-Ionen-Batterien ist unsere „moderne“ Welt nicht mehr vorstellbar. Ob Mobiltelefon, Notebook-, Tablet-Computer, Digitalkamera, oder Handheld-Konsole, all das ist für viele zu unverzichtbaren täglichen Begleitern geworden. Nur der hohe Energieinhalt, die große Zuverlässigkeit und die lange Lebensdauer der Lithium-Ionen-Batterie (LIB) machen es überhaupt möglich, dass wir diese portablen Geräte so nutzen können, wie wir es gewohnt sind. Nicht nur im Bereich der Consumer-Elektronik werden Batterien eingesetzt, sondern seit langem wird daran gearbeitet, die Lithium-Ionen-Technik für die Elektromobilität und in stationären Batterien für die Speicherung von regenerativer Energie einzusetzen, mit sichtbaren Erfolgen in den letzten Jahren und mit noch größeren Erwartungen für die Zukunft.

Die Lithium-Ionen-Technologie hat ihr Potential noch lange nicht ausgereizt und ist gerade erst mal 25 Jahre alt, also ein „Youngster“ im Vergleich zum 150 Jahre alten Bleiakku. Dennoch: Die begrenzten Energieinhalte der verfügbaren Lithium-Ionen-Technologien, welche gerade auch im Zusammenhang mit der Elektromobilität immer wieder schmerzhaft aktuell spürbar sind, **treiben die Forschung nach neuen Hochenergiematerialien an**. Wie realistisch diese Optionen sind und ob und wann die „**Super-Batterie**“ kommen wird, wird in diesem Vortrag in (hoffentlich) allgemein verständlicher Form diskutiert.