AKE 3: AKE 3

Time: Wednesday 14:00–15:15 Location: AKE-H16

Invited Talk AKE 3.1 Wed 14:00 AKE-H16

The perspective of plasma conversion within the Power-to-X initiative — •Ursel Fantz[1], Ante Hecimovic[1], and David Rauner[2] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching — [2]AG Experimentelle Plasmaphysik, Universität Augsburg, Universitätsstr. 1, 86159 Augsburg

The Power-to-X initiative refers to various technologies for storing or using surplus electricity of variable renewable energies such as solar energy, wind energy and hydropower to convert the power into gas, heat or liquids. Using plasma technology for conversion of low energy molecules into value-added chemicals (following the Power-to-Gas route) is a promising approach: plasmas provide a fast response time and high throughput, are tolerant against impurities and operate different gases in a wide parameter range. Various plasma reactor concepts for formation of syngas, hydrogen, and ammonia are presently under investigation at the technology readiness level of about three to four. Within the plasma activities embedded in the Research Field "Energy" of the Helmholtz Association an atmospheric plasma torch is investigated. Its goal is to established the plasma route and develop a prototype reactor. A near future milestone is the performance comparison of plasma CO_2 conversion into CO including the gas separation process with low temperature and high temperature electrolysis. These facets of the plasma technology and its perspective to contribute to the PtX route will be highlighted in the presentation.

AKE 3.2 Wed 14:30 AKE-H16

Konzentrierende Solarsysteme mit IR-PV-Modul für solare Photobioreaktoren der nächsten Generation — •Markus Sauerborn und Joachim Göttsche — Solar-Institut Jülich, FH Aachen, D-52428 Jülich

Am Solar-Institut Jülich werden in Kooperation mit Instituten der Mikrobiologie solare Photobioreaktoranlagen der nächsten Generation entwickelt. Mit der aktuellen Entwicklung sollen kombinierten Versorgungssysteme für Mikroalgenkulturen für verschiedene Nutzungskonzepte ausgelegt und energetisch optimiert werden. Allgemein vielversprechend ist hier, dass aus Zivilisationsabwässern effektiv Nährstoffe gewonnen werden können, um so Nährstoffkreisläufe zu forcieren oder besondere Schadstoffbelastungen zu vermeiden. Für die in den Projekten vorliegenden Rahmenbedingungen wurden jeweils geeignete Bestrahlungssysteme konzipiert. Während im Projekt AlgNutrient eine Solaranlage für eine PBR-Tankanlage und mit Upscaling-Ziel zur Großanlage konstruiert wurde, stand in AlgaeSolarBoxes als Vorgabe eine containerbasierte mobile Kleinanlage im Fokus der Entwicklung. Abgeschlossenen solaren Bioreaktoren wirken mit ihrer optimierten Lichtaufnahme als Strahlfalle. So wird auch die von der Photosynthese nicht verwertbare IR-Strahlung verstärkt absorbiert und durch reduzierte Abstrahlung entsteht Stauwärme. Ein neuartiges IR-PV-Modul nutzt spektrale Aufspaltung des Solarstrahls und verwertet den selektierten IR-Anteile des Sonnenlichtes durch geeignete PV-Zellen. Das Gesamtsystem erhöht damit die Gesamtenergieeffizienz und wird energetisch autarker.

AKE 3.3 Wed 14:45 AKE-H16

Broadband dielectric spectroscopy on lithium-salt-based and choline-chloride-based DESs — •Arthur Schulz, Peter Lunkenheimer, and Alois Loidl — University Augsburg, Experimental Physics V, Augsburg, Bavaria

We have performed broadband dielectric spectroscopy (BDS) on three Lithium-salt-based deep eutectic solvents (DESs) - systems where the only cation is Li+ - covering a broad temperature and frequency range that extends from the low-viscosity liquid around room temperature down to the glassy state approaching the glass-transition temperature. We observe a relaxational process that can be ascribed to dipolar reorientational dynamics and exhibits the clear signatures of glassy freezing. We find that the temperature dependence of the ionic dc conductivity and its room-temperature value also are governed by the glassy dynamics of these systems, depending, e.g., on the glass-transition temperature and fragility. Compared to previously investigated systems, containing the same hydrogen-bond donors and choline chloride instead of a lithium salt, both the reorientational and ionic dynamics are significantly reduced due to variations of the glass-transition temperature and the higher ionic potential of the lithium ions. Additionally, we analyzed a range of deep eutectic systems composed of choline chloride and a carboxylic acid (e.g., maline, for which a relatively high room-temperature conductivity was reported) using BDS. The nature of the observed dynamic processes, as well as the evidence for and strength of their coupling are compared to previously investigated choline-chloride-based DESs.

AKE 3.4 Wed 15:00 AKE-H16

Multiphysical Simulation of a PEMFC — •Fabian Gumpert[1], Lara Kefer[1], Susanne Thiel[2], Maik Eichelbaum[2], and Jan Lohbreier[1] — [1]Technische Hochschule Nürnberg, Applied Mathematics, Physics and Humanities, Germany — [2]Technische Hochschule Nürnberg, Applied Chemistry, Germany

Proton Exchange Membrane Fuel Cells (PEMFC) excel through their high power density and dynamic behavior making them promising candidates for future mobile sources of energy. In a fuel cell hydrogen and oxygen combine in a redox reaction to water thereby releasing electrical energy. But many parameters which determine the performance and lifetime of the PEMFC are experimentally difficult to access. Finite-element-method (FEM) simulations are utilized to solve coupled differential equations to numerically study these parameters.

First of all, voltage-current curves which are commonly used to describe the properties of power sources are modelled. The numerical results show good qualitative agreement with experimental data. This is also true for the computed temperature distribution in the PEMFC, which was compared with data from a laboratory-sized setup. For the performance of the fuel cell it is critical that the relative humidity of the membrane stays in a specific range. Only when the water content is sufficient the polymer membrane is permeable for hydrogen ions. As indicated above, this parameter is hardly measurable; it can only be investigated with the use of multiphysical simulations. We combine exterior experimental data and numerical models of the interior to draw conclusions about the water content within the fuel cell.