Parallel session: Materials & Catalysis

11:30 - 12:00
Keynote: Dipl.-Ing. Thomas Burgler (voestalpine Stahl)

12.00 – 12.20
Vera Smulders, MSc (UT)
The production of chlorate, a key chemical for paper pulp bleaching, is the third-largest of all electrochemical industries in terms of energy expenditure. It currently relies on highly carcinogenic chromium(VI) to achieve sufficient efficiency for economic viability. With the recent inclusion of Cr(VI) in REACH legislation, continued operation of this process in the EU is uncertain. Understanding the workings of Cr(VI) is crucial to pave the way to a non-toxic solution. We use an array of techniques to elucidate key behaviors that make Cr(VI) so suitable, and speculate on solutions to operate the chlorate process safely and efficiently.

12.20 – 12.40
Dr Shiju Raveendran (UvA)
A novel inexpensive catalyst for the efficient conversion of CO2 to CO.
We are working on a novel approach of using a co-ionic conducting Electrochemical Membrane Reactor to convert CO2 to value added chemicals at atmospheric pressure. The reactor consists of a dense co-ionic ceramic membrane and two porous electrodes. In the cathode, CO2 will be converted to CO catalytically. We have invented a new catalyst for this purpose. This bimetallic oxide system, which is inexpensive and easy to prepare, converts CO2 to syngas with unprecedented efficiencies at atmospheric pressure. The catalyst works without deactivation for several hours. In the lecture, I will discuss more about the catalyst and its performance.

12.40 – 13.00
Dr Ruud Kortlever (TUD)
Tuning the selectivity of electrochemical CO2 reduction on copper with organic additives
Increasing CO2 concentrations in the atmosphere are an issue of global concern. In this talk I will discuss the tuning of the selectivity of electrochemical CO2 reduction on polycrystalline copper electrodes with organic N-substituted heterocycles in the electrolyte.

15.00 – 15.20
Leon Jacobse, MSc (UL)
Visualizing Electrochemical Reactivity and Electrode Structure at the Nanoscale
Scanning probe techniques play a crucial role in understanding local electrochemistry. Here, I will discuss the nanoscale visualization of electrochemical reactivity (Scanning Electrochemical Cell Microscopy) and electrode surface structure (Electrochemical Scanning Tunneling Microscopy).

15.20 – 15.40
Dr Maarten van Biesheuvel (Wetsus)
Porous electrodes for energy storage, desalination and CO2 cycling
Electrochemical cells with porous electrodes have a high capacity for the storage of salt ions and their subsequent release in a cyclic process. Such systems can make use of intercalation electrodes or electrical double layer effects and store energy, desalinate water (selectively), and play in role in CO2 capture technologies.

15.40 – 16.00
Prof Joost Reek (UvA)

Supramolecular approaches in electrocatalytic water splitting

Electrocatalytic water splitting is crucial for the transformation of a fossil fuel based society to one that is based on sustainable energy. Both half reactions, water oxidation and proton reductions, are efficiently carried out in Nature by enzymes, for which the active site resides in a well-defined protein cage. Inspired by this, we have explored the effect of catalyst encapsulation in well-defined cages on their electrocatalytic performance, and we demonstrate that also for synthetic systems this can be a versatile strategy to increase their performance in electrocatalysis.

16.00 – 16.20
Dr Frans van Berkel (TNO)

Cost-efficient PEM-based electrolyzers: Shortening the time-to-market

One of the big challenges in the implementation of water electrolysis in the renewable energy system is the high capital cost and uncertainty regarding future cost and performance improvements. The current cost of electrolyzers is partly determined by achieving low performance degradation, requiring relatively expensive components. In order to shorten the time-to-market of more cost-efficient components an accelerated stress test procedure is required. This paper discusses the approach by ECN part of TNO and Hydron Energy towards an Accelerated Stress Test protocol(s) (AST) for complete cells and individual cell components for PEM-based electrolysis.

Parallel session: Innovative electrochemistry

11:30 - 12:00
Keynote: Prof. Dr. Annick Hubin (Vrije Universiteit Brussel)

12.00 – 12.20
Prof. Dr Emiel Hensen (TU/e)
Within the alliance between Eindhoven University of Technology and Utrecht University a new research program is initiated, focused at understanding electrochemical conversion processes at the fundamental level. Combining catalysis, electrochemistry, spectroscopy and reaction engineering, high-PT electrochemistry will be explored for the efficient reduction of CO2 and biogenic resources to chemicals and fuels. The scientific challenges and possible solution will be highlighted as well as the need to connect these lab-scale developments to scale-up efforts in test beds, which would benefit from intensive collaboration between academia, knowledge institutes and industry.

12.20 – 12.40
Dr Anja Bieberle-Hütter (DIFFER)
Electrochemical interfaces are the heart of many energy conversion and storage devices. However, the processes limiting the performance of these are often not well known because they cannot be measured directly. We will present a new approach where we combine experiments with modeling and simulations in order to identify limiting processes at electrochemical interfaces. We will discuss the general approach using the example of photoelectrochemical water splitting. We will compare electrochemical impedance spectra from our experimentally measured hematite photoanodes with those simulated from an electrochemical model using state-space modeling. Surface coverage plots from simulations which cannot straight forwardly be obtained by experiments, will be discussed.

12.40 – 13.00
Dr Thijs de Groot (Akzo)
Improvement potential in alkaline water electrolysis
Alkaline water electrolysis has been operational for over 100 years and is therefore considered to be a mature technology. However, there is still significant room for improvement of alkaline water electrolysis, eg. through increased current density, thinner separators and improved electrode coatings.

15.00 – 15.20
Dr Roman Latsuzbaia (TNO)
Electrosynthesis of lactic acid
Lactic acid is an important feedstock for sustainable production of bio-based polymers, fibers, and solvents. It can be produced from 2-propandiol derived from glycerol, the latter is an abundant and cheap feedstock, as it is a side product of production of biodiesel. 90% of lactic acid is produced through fermentation of carbohydrates, which is associated with issues such as high costs of the culture media, product purification, waste generation. The aim of our work is to develop a cheap electrochemical production method of lactic acid and demonstrate continuous electrochemical production, particularly, achieve high lactic acid conversion and yield at industrially relevant conditions, obtain design parameters for an electrochemical process.

15.20 – 15.40

Dr Waldo Bongers (DIFFER)

"Waldo Bongers, Henny Bouwmeester*, Zandrie Borneman**, Juehan Gao, Floran Peeters, Dirk van den Bekerom, Tom Butterworth, Adelbert Goede, Pieter Willem Groen, Teofil Minea, Qin Ong, Tim Righart, Gerard van Rooij, Michail Tsampas, Tiny Verreycken, Stefan Welzel, Bram Wolf and Richard van de Sanden

Electrically-driven conversion technologies of feedstock CO2, H2O, CH4 and N2 may convert surplus electricity from renewable sources like wind and solar energy into synthetic fuels and products. Plasmolysis and high-temperature electrolysis, using solid oxide cells (SOECs), are considered as most promising. Integration of plasmolysis and electrolysis may enhance both conversion and energy efficiencies. Current CO2 MW plasma reactor designs lead to core temperatures well above 1000 K, making integration of CO2 plasmolysis and electrolysis challenging. New reactor designs are investigated to minimize gas temperatures.

This work is supported by NWO, TTW (Toegepaste en Technische Wetenschappen), project 15325.

15.40 – 16.00

Dr Thomas Burdyny (TUD)

Enhancing electrocatalytic CO2 reduction using a system-integrated approach to catalyst discovery

Industrial-scale electrochemical CO2 conversion will be required to operate at high current densities in order offset capital cost expenditures and minimize the overall conversion footprint. However, as the reaction itself impacts the local reaction environment, the catalytic reaction substantially changes as currents are increased. In this talk we will show that operating at high current densities using a gas-diffusion layer not only improves CO2 reduction performance metrics, but provides further opportunities for catalyst discovery.

16.00 – 16.20

Dr Klaas Jan Schouten (Avantium)

CO2 electrocatalysis as key technology for the production of high value chemicals

Avantium is developing a technology-platform to electrocatalytically convert CO2 by bringing in it's technology and capabilities in catalyst research into the area of electrochemistry. In 2016, Avantium acquired Liquid Light, in which more than $35M was invested to develop a proprietary technology to make major chemicals from CO2. The acquisition combines the capabilities of both Liquid Light and Avantium to develop a leading electrocatalysis platform and brings Avantium in the top of the world's IP position in CO2 related electrolysis. Using this technology platform Avantium is developing an integrated process for the production of high-value C2 chemicals from CO2.

Parallel session: System integration, business & government

11:30 - 12:00
Keynote: Dr. Pieter Boot (PBL Netherlands Environmental Assessment Agency)

12.00 – 12.20
Rob Terwel, MSc (Kalavasta)
Affordable Carbon Neutral Synthetic Kerosene Enabled by Electrochemistry
Renewable synthetic kerosene seems to be the only solution to significantly reduce CO2-emissions in aviation on the medium term. The authors explore how system integration and advances in electrochemistry can enable affordable production of carbon-neutral jet fuel.

12.20 – 12.40
Ing. Rob van der Sluis (MTSA)
System integration of electrolysis
• Introduction MTSA
• Role Hydrogen in decentral electricity production.
• MTSA study - Power2Power System
MTSA has the vision that hydrogen will play a crucial role as energy carrier in the Energy Transition towards Sustainable Energy Sources. Decentral electricity production on semi industrial scale demands for flexible, decentral storage of hydrogen and a fast responding system to balance e-consumption and e-supply and stabilize the (local) grid in a reliable way. MTSA developed a concept P2P system consisting of: electrolyser, small battery, H2 compression, H2 storage, fuel cell and endeavors to reduce the cost price of such system to become economically viable.

12.40 – 13.00
Guy Verkoeyen, MBA (Hydrogenics)
Experiences with power-to-gas technologies in international projects
A view on Power to Gas (Electrolysis) from a market perspective.

15.00 – 15.20
Dr Andreas ten Cate (ISPT)
"The ISPT Cluster on System Integration focuses on the industry role in the future renewable-energy system. In this contribution an overview of the program is presented. Current activities are covering both strategic explorations as well as research that ranges from fundamental to pilot scale activities, addressing the following topics:
• Fundamental research on activation of small molecules (CO2 and N2)
• Strategic explorations on future hydrogen-based renewable energy supply chains, and on scale-up of electrolysis to industry scale capacity
• Program on closing the carbon cycle – re-use of carbon from steel to chemicals"

15.20 – 15.40

Drs. Toon van Harmelen (TNO)

Three electrification scenarios to decarbonise the Dutch production of basic materials and transportation fuels

The aim of the study was to quantitatively assess deep decarbonisation scenarios through electrification of the production of basic materials and transportation fuels in the Netherlands in 2050. This to explore the technical feasibility, required feedstock and energy potentials and pro's and con's of three distinct electrification pathways for the Dutch energy intensive industry, viz. A. All electric, B. Big on hydrogen en C. Competition. Each scenario has its own specific set of technologies and infrastructure. With the results in hand, better decisions can be made regarding Power-2-X development and its impact on business and policy.

15.40 – 16.00

Dr Frits van Hout (ASML)

"Energy conversion and storage are key in the energy transition. They offer ample opportunities for enhancing sustainability of industry, agriculture and transport, three important areas in Brabant. To support and promote breakthrough technologies in energy conversion and storage, cooperation between knowledge institutes, industry and governmental organization is essential. We use a new approach in facilitating cooperation around and impact of energy conversion and storage technologies without subsidizing stranded assets while at the same time offering opportunities for high tech industry."

16.00 – 16.20

Prof. Gert-Jan Kramer (UU)

Electrochemical Conversion, Energy Storage and Future Fuels – assessing the options

In this contribution to the ECCM conference I want to put the prospect that electrochemical conversion offers in the context of the wider challenge of the global energy transition. Electrochemical conversion offers great prospects if and when it can be commercialized and scaled up with unprecedented speed and determination. Is the community up for the challenge? And can the world afford to bet on it?