Conference Programme

Netherlands conference on Electrochemical Conversion & Materials (ECCM)

Friday 21 Juni 2019, The Hague – NH Hotel

www.c02neutraalin2050.nl

TOPSECTOR ENERGIE
Empowering the new economy

Holland High Tech
High-tech Solutions for Global Challenges

Holland Chemistry
Global Challenges, Breakthrough Solutions

Conference programme

Date: Friday 21 June 2019
Location: NH Hotel The Hague

Time	Activity
9:00	Reception and registration
9:30	Opening conference: **Prof. Dr Richard vd Sanden** (chair of the Dutch committee for Electrochemical Conversion & Materials)

- **Drs. Focco Vijselaar**, Director-General of Enterprise & Innovation, Ministry of Economic Affairs and Climate Policy
- **Drs. Manon Janssen**, Chair Industry table Dutch Climate Agreement, chair top sector Energy, on behalf of the top sectors Energy, High Tech Systems & Materials and Chemistry, CEO Ecorys
- **Prof. Niek Lopes Cardozo**, member of the Excecutive Board of NWO, chair for the NWO Domain Science Board, Professor in Science and Technology of Nuclear Fusion
- **Ms Nienke Homan** (GroenLinks), provincial executive of the province of Groningen
- **Drs. Ton de Jong**, TNO, Managing Director of the Unit ECN part of TNO

Time	Activity
10:15	Keynote: **Dr. Noé van Hulst**, Hydrogen Envoy, Ministry of Economic Affairs & Climate, Netherlands
10:45	Keynote: **Prof. Yang Shao-Horn**, materials for electrochemical and photoelectrochemical energy storage and conversion, Massachusetts Institute of Technology, United States
11:15	Coffee break and change rooms for parallel tracks
11:30	Parallel tracks part 1 (1x 30 min + 3x20 min)

	Room: Rotterdam 2 (2nd floor)	Room: Rotterdam 3 (2nd floor)	Room: Eindhoven 1-3 (2nd floor)
	Materials & Catalysis	**Innovative electrochemistry**	**System integration, business & governance**
11:30 - 12:00 (30 min)	**Keynote: Dr Philipp Dietrich, CEO at H2 Energy AG, Switzerland**	**Keynote: Prof. Christian Breyer, Solar Economy, Lappeenranta University of Technology (LUT), Finland**	**Keynote: Dr. Heleen de Coninck, Environmental Science, Radboud University, The Netherlands**
12:00 - 12:20 (20 min)	Dr. Antoni Forner-Cuenca (TUe)	Dr. Okan Akin (RUG)	Dr. Andreas ten Cate (ISPT)
12:20- 12:40 (20 min)	Dr. Paola Granados Mendoza (Nouryon)	Ilona Dickschas, MBA (Siemens AG)	Dr. Edgar Harzfeld (Stralsund University)
12:40- 13:00 (20 min)	Dr. Willem Haverkort (TUD)	Dr. Amanda Garcia (TNO)	Dr. Kas Hemmes (TUD)

Time	Activity
13:00	Lunch
13:45	Keynote: **Prof. Ted Sargent**, Electrical and Computer Engineering, University of Toronto, Canada
14:15	Keynote: **Dr. Yu Morimoto**, Principal Researcher at Toyota Central R&D Labs. Inc., Japan
14:45	Coffee break and change rooms for parallel tracks
15:00	Parallel tracks part 2 (4x 20 min)

	Room: Rotterdam 2 (2nd floor)	Room: Rotterdam 3 (2nd floor)	Room: Eindhoven 1-3 (2nd floor)
	Materials & Catalysis	**Innovative electrochemistry**	**System integration, business & governance**
15:00 - 15:20 (20 min)	Prof. Mark Huijben (UT)	Dr. Thijs de Groot (Nouryon)	Robert de Kler, MSc (ECN part of TNO)
15:20 - 15:40 (20 min)	Prof. Gadi Rothenberg (UvA)	Dr. Elena Perez Gallent (TNO)	Prof. Andrea Ramirez (TUD)
15:40 - 16:00 (20 min)	Charlotte Vogt, MSc (UU)	Dr. Foteini Sapountzi (Syngaschem BV)	Ing. Rob van der Sluis (MTSA Technopower BV)
16:00 - 16:20 (20 min)	Jan Vos, MSc (Leiden University)	Dr. Michail Tsampas (DIFFER)	Bernhard Weninger, MSc (TUD)

Time	Activity
16:20	Change room for closing lecture
16:30	Keynote : **Prof. Mercedes Maroto-Valer**, Director of the Research Centre for Carbon Solutions, Heriot Watt University, United Kingdom
17:00	Keynote: closing lecture: **Dr. Reinhold Achatz**, CTO – Head of Corporate Function Technology, Innovation & Sustainability, thyssenkrupp AG, Germany
17:30	Drinks
18:00	End of programme

Scope of the conference

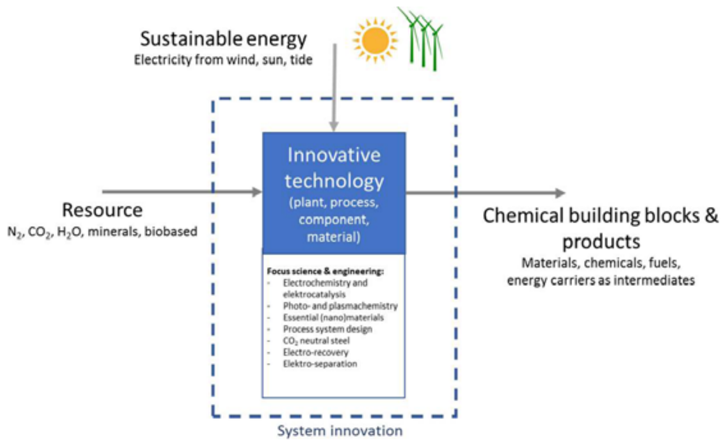
It is clear that in our future energy system renewable electricity will play a main role in the transition to a low carbon energy supply. This transition is facilitated by CO_2 targets of national governments and requires extensive electrification. In the future, however, there will still be a need for fuels (for aviation, shipping and heavy road transport) and for chemical products and materials. These activities and associated production processes are now responsible for more than 35% of global CO_2 emissions. There is a big challenge to produce these fuels and chemical products through the use of renewable electricity, at the basis of biomass and/or CO_2.

In addition, solutions are needed for the problem of the imbalance between production and consumption of electricity. These solutions lie in connecting networks and production capacity (interconnection), organizing an optimal balance of supply and demand, and in direct storage of electrical energy. Storage of electricity in batteries or similar systems is an option; electrochemical production of chemicals as an energy carrier is another option. Electrochemical conversion is a promising option for long-term storage as this technology is easy scalable to the amount of energy.

During the conference the state-of-the-art in science and technology will be shared by international key notes from academia and industry. Dutch scientist and industry representatives will contribute to an appealing parallel programme related to the theme of the conference. During the conference national R&D initiatives related to the ECCM theme will be announced.

Setup

- Date & time: Friday 21 June 2018, 9:30 – 18:00 h
- Venue: Netherlands, NH Hotel, The Hague (Pr. Margrietplantsoen 100)
- Participation: free, including lunch.
  Registration via www.CO_2neutraalin2050.nl
- Not yet on the ECCM mailing list?
  Please subscribe via www.CO_2neutraal2050.nl
- Setup: one day conference with plenary keynote lectures from academia, industry and NGO's. To the parallel sessions Dutch representatives from industry, scientists (group leaders), applied research organisations, government and NGO's will contribute to an appealing programme
- During the conference several ECCM initiatives will be kicked off.
- Language: English



Key note speakers
eccm conference 21 june 2019

Prof. Ted Sargent, Electrical and Computer Engineering, University of Toronto, Canada

Ted Sargent received the B.Sc.Eng. (Engineering Physics) from Queen's University in 1995 and the Ph.D. in Electrical and Computer Engineering (Photonics) from the University of Toronto in 1998. He has held the following visiting professorships: MIT: Visiting Professor, Nanotechnology and Photonics, in the Microphotonics Center, MIT, 2004-5, UCLA: Fulbright Visiting Professor at UCLA 2013 and Berkeley: Somorjai Visiting Miller Professorship at Berkeley Fall 2017.

He holds the rank of University Professor in the Edward S. Rogers Sr. Department of Electrical and Computer Engineering at the University of Toronto. He holds the Canada Research Chair in Nanotechnology and also serves as Vice President - International for the University of Toronto.

His book The Dance of Molecules: How Nanotechnology is Changing Our Lives (Penguin) was published in Canada and the United States in 2005 and has been translated into French, Spanish, Italian, Korean, and Arabic.
He is founder and CTO of InVisage Technologies and a co-founder of Xagenic.
He is a Fellow of the Royal Society of Canada; a Fellow of the AAAS "...for distinguished contributions to the development of solar cells and light sensors based on solution-processed semiconductors;" and a Fellow of the IEEE "... for contributions to colloidal quantum dot optoelectronic devices." He is Fellow of the Canadian Academy of Engineering for "... ground-breaking research in nanotechnology, applying novel quantum-tuned materials to the realization of full-spectrum solar cells and ultra sensitive light detectors. The impact of his work has been felt in industry through his formation of two start-up companies." His publications have been cited over 30,000 times [Scopus].

Prof. Mercedes Maroto-Valer, Assistant Deputy Principal (Research & Innovation) and Director of the Research Centre for Carbon Solutions (RCCS), Heriot Watt University, United Kingdom

Prof Mercedes Maroto-Valer (FRSE, FIChemE, FRSC, FRSA) is Assistant Deputy Principal (Research & Innovation) and Director of the Research Centre for Carbon Solutions (RCCS) at Heriot-Wat University. She has held appointments at the University of Kentucky (1997-1998), Pennsylvania State University (1998-2004) and University of Nottingham (2005-2012). She joined Heriot-Watt University in 2012 as the first Robert Buchan Chair in Sustainable Engineering and has been Director of the cross-university Energy Academy and Head of the Institute of Mechanical, Process and Energy Engineering. She is Director of the Research Centre for Carbon Solutions (RCCS) comprising over 50 researchers and an active research portfolio of >£17m. RCCS is a world leading engineering centre delivering innovation for the wider deployment of low-carbon energy systems required for meeting carbon targets. She has over 450 publications, including editor of 4 books and 32% of her publications are in top 10% most cited worldwide. She holds leading positions in professional societies, including President Environment, Sustainability and Energy Division - Royal Society Chemistry (RSC); Editor-in-Chief Greenhouse Gases: Science and Technology; Member of the British Geological Survey (BGS) Advisory Committee; Board Member of the Energy Technologies Partnership (ETP); and Royal Academy of Engineering (RAEng) Frontiers of Engineering Steering Group. She has received numerous international prizes and awards, including 2019 Honorary Doctorate by TU Delft; 2018 Merit Award by Society of Spanish Researchers in the UK (SRUK/CERU); 2013 Hong-Kong University Mong Distinguished Fellowship; 2011 RSC Environment, Sustainability and Energy Division Early Career Award; 2009 Philip Leverhulme Prize; 2005 US Department of Energy Award for Innovative Development; 1997 Ritchie Prize; 1996 Glenn Award- Fuel Chemistry Division of the American Chemical Society and the 1993 ICI Chemical & Polymers Group Andersonian Centenary Prize. Her research portfolio has included as PI/CI projects worth ~ £35m, and has been awarded a prestigious European Research Council (ERC) Advanced Award.

In her role as Assistant Deputy Principal (Research and Innovation), her key strategic responsibilities include leading the development of university wide initiatives (UK, Dubai and Malaysia) to support global research activities.

Prof. Yang Shao-Horn, materials for electrochemical and photoelectrochemical energy storage and conversion, Massachusetts Institute of Technology, United States

Professor Shao-Horn is W.M. Keck Professor of Energy at the Massachusetts Institute of Technology (M.I.T.). Her research is centered on exploiting chemical/materials physics at interface and in bulk to understand and design materials/processes for energy storage and making of chemicals. Professor Shao-Horn is a member of National Academy of Engineering and is among the World's Most Influential Scientific Minds and Highly Cited Researchers.

Dr Philipp Dietrich, CEO at H2 Energy AG, Switzerland

Dr. Philipp Dietrich is CEO at H2 Energy AG. He was Head of the Technology Management of Axpo. Before he was the Managing Director of the Competence Center Energy and Mobility (CCEM) at the Paul Scherrer Institute in Villigen, Switzerland. Prior to joining the PSI and the CCEM, Mr. Dietrich held leading position within ABB in Baden (instrumentation and control systems for CCPP) and worked in the research departments of BMW in Munich (hydrogen-engine).

Dr Noé van Hulst, Hydrogen Envoy, Ministry of Economic Affairs & Climate, Netherlands

Dr Noé van Hulst is Hydrogen Envoy at the Ministry of Economic Affairs & Climate. From 2013 till 2018 he was Permanent Representative of The Netherlands to the OECD. He was chairman of the IEA Governing Board (2017-2018). He holds a Master's Degree and a Ph.D. in Economics from VU Amsterdam. Van Hulst started his career in 1980 as a Researcher/Lecturer in the Department of Micro-economics at VU Amsterdam. In 1985, he was appointed Senior Economist and Deputy Head of the Macroeconomic Policy Department of the Social and Economic Council (SER) in the Netherlands. Mr. van Hulst then held several positions at the Ministry of Economic Affairs: Head of the Longer-Term Studies Group within the Directorate for Technology Policy, Deputy Director for Technology Policy, Director for Fair Trading and Deputy Director-General of Economic Structure, Director-General for Energy, Director-General for Competition and Energy. In 2003, Mr. van Hulst joined the International Energy Agency (IEA) in Paris as Director for Long-Term Co-operation and Policy Analysis (LTO). From 2008, he held the position of Secretary-General of the International Energy Forum (IEF) in Riyadh, Saudi Arabia. From 2012 until his nomination with OECD, Van Hulst was Director of Energy Academy Europe.

Dr Yu Morimoto, Principal Researcher at Toyota Central R&D Labs. Inc., Japan

Yu Morimoto is Principal Researcher at Toyota Central R&D Labs, Nagoya, Japan. He started his professional career at Toyota Central R&D labs. Inc, (TCRDL) in 1982 in R&D on secondary batteries for SLI (Starting, lighting ignition) and EV. In 1989 he initiated research activities on Polymer Electrolyte Fuel Cells (PEFC) from scratch. Since 1995 he leads the PEFC R&D at Toyota focusing on electrocatalysis and MEAs by in-house research but also collaboration with material suppliers, universities, and national labs from all over the world.

Mr. Morimoto obtained his PhD in 1994 at Case Western Reserve University with Professor E. B. Yeager on Electrochemical oxidation of methanol on platinum and platinum based electrodes. Mr. Morimoto's key expertises are in electrocatalysis and MEA development, evaluation, characterization, degradation analysis and macroscopic modeling and simulation.

Dr. Reinhold Achatz, Global R&D thyssenkrupp AG, Germany

Dr. Reinhold Achatz is Chief Technology Officer (CTO) and Head of the Corporate Function Technology, Innovation and Sustainability at thyssenkrupp AG in Essen, Germany. In this position he is globally responsible to initiate and implement future oriented projects, to identify and leverage synergies between thyssenkrupp's businesses and to define, implement and improve processes. The future oriented projects include projects addressing the challenges of climate change (e.g. Carbon2Chem) and implementing the digital transformation of thyssenkrupp. Before joining thyssenkrupp in 2012 he worked for Siemens in a number of management positions in Germany and the United States of America.

He holds a degree in Electrical Engineering (Dipl. Ing.) from the Friedrich-Alexander University in Erlangen-Nuremberg (1979), a Ph.D. in Information Technology in Mechanical Engineering (Dr. Ing.), from the Technical University of Munich (2009) and was awarded an honorary advisory professorship from the Tsinghua University in Beijing, China (2010).

Reinhold Achatz is a member of board of trustees of a number of institutes of the Fraunhofer Society and the Max-Planck-Society and a member of the board of the working group Research, Innovation and Technology of the Federation of German Industry (BDI). Since 2016 he serves as chairman of the Board of the International Data Space Association (IDS).

For four years he was consulting the Science Commissioner of the European Union as member of the European Research Area Board (ERAB) and for six years he was consulting the German Government as member of the German Council for Science and Humanities (WR).

Prof. Christian Breyer, Solar Economy, Lappeenranta University of Technology (LUT), Finland

Christian Breyer has started the Solar Economy professorship at Lappeenranta University of Technology (LUT), Finland, in March 2014. His major expertise is the integrated research of technological and economic characteristics of renewable energy systems specialising in energy system modeling, 100% renewable energy scenarios and hybrid energy solutions, on a local but also global scale. Mr Breyer has been managing director of the Reiner Lemoine Institute, Berlin, focused on renewable energy research and worked previously several years for Q-Cells (now: Hanwha Q Cells) a world market leader in the photovoltaic (PV) industry in the R&D and market development department. Mr Breyer received his PhD in the field of the economics of hybrid PV power plants from University of Kassel. He is member of international working groups like European Technology and Innovation Platform Photovoltaics (ETIP PV), IEA-PVPS Task 1, member of the scientific committee of the EU Photovoltaic Solar Energy Conference (PVSEC) and the International Renewable Energy Storage Conference (IRES), chairman for renewable energy at the Energy Watch Group, expert for the 100% renewables initiative and founding member of DESERTEC Foundation. Mr Breyer had been member of the executive team of the Neo-Carbon Energy project in Finland focused on power-to-X solutions. He authored and co-authored about 250 scientific publications.

Dr. Heleen de Coninck, Environmental Science, Radboud University, The Netherlands

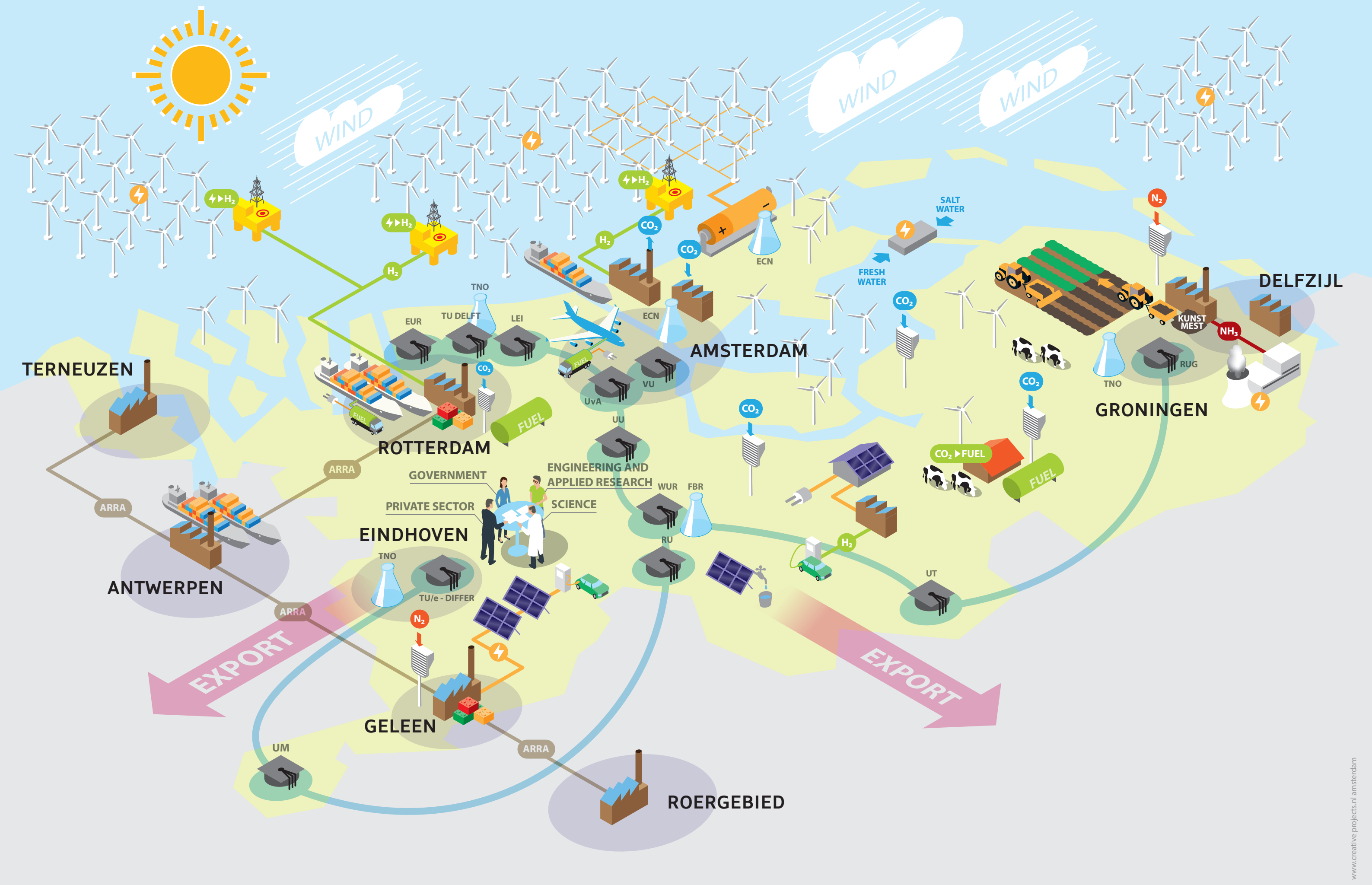
Heleen de Coninck is associate professor in innovation studies at the Environmental Science department at Radboud University's Faculty of Science. Before joining Radboud University in 2012, she worked for over ten years at the unit Policy Studies of the Energy research Centre of the Netherlands (ECN). Her main field of work is climate change mitigation, innovation and policy analysis, in particular at the international level.

Heleen has conducted research and consultancy for among others the European Commission, UNFCCC, UNIDO, UNEP, the World Bank and various governments and private sector actors. From 2008 to 2012, while at ECN Policy Studies, she managed a group of researchers focussing on international climate policy, energy and development, and technology transfer, and acted as programme manager for ECN Policy Studies. Heleen is a board member of Climate Strategies, a climate policy research network that aims to improve the linkage between climate policy research and the negotiations at the European and UN level. She was a Coordinating Lead Author of the chapter on implementing and strengthening the global response of the IPCC Special Report on limiting warming to 1.5C, which was released in October 2018.

Heleen graduated in Chemistry and in Environmental Science, specialisation climate change and atmospheric chemistry, from Radboud University. After her studies, she worked as atmospheric chemistry researcher at the Max Planck Institute for Chemistry. In 2009, she finished a PhD on the role of technology in the international climate regime at the VU in Amsterdam in collaboration with Princeton University in the United States and ECN.

Advisory committee for Electrochemical Conversion & Materials

Prof. dr. Richard van de Sanden (chair, Dutch Institute for Fundemental Energy Research, DIFFER), director DIFFER, Plasma physics & chemistry
Prof. dr. Bernard Dam (Delft University of Technology), Materials for Energy Conversion & Storage
Dr. Earl Goetheer (TNO), Principle scientist Sustainable Process & Energy Systems
Prof. dr. Gert-Jan Gruter (Avantium), Chief Technology Officer
Prof. dr. Petra de Jongh (Utrecht University), Inorganic Chemistry & Catalysis
Prof. dr. Marc Koper (Leiden University), Electrochemistry
Ir. Geert Laagland (Vattenfall), head of engineering
Prof. dr. Guido Mul (Twente University), Photocatalytic synthesis
Dr. Alexander van der Made (Shell), Principal Scientist Future Energy Technologies
Ir. Ton Peijnenburg (VDL Enabling Technologies Group), Systems Engineering
Dr. John van der Schaaf (TU/e), Chemical reactor engineering
Drs. Marco Waas (Nouryon), Director RD&I and Technology Industrial Chemicals
Dr. Hans van der Weijde (Tata Steel), Electrochemistry and CO_2 reduction
Dr. Ellart de Wit (HyGear), Chief Technology Officer



TOPSECTOR ENERGIE
Empowering the new economy

Holland High Tech
High-tech Solutions for Global Challenges

Holland Chemistry
Global Challenges, Breakthrough Solutions

Powered by the Netherlands Ministry of Economic Affairs and Climate Policy

Ministry of Economic Affairs and Climate Policy

Parallel session: Materials & Catalysis

11.30 – 12.00

Keynote: Dr. Philipp Dietrich, CEO at H2 Energy AG, Switzerland

12.00 – 12.20

Dr. Antoni Forner-Cuenca (TUE)

Towards optimal chemistry-specific electrodes for next-generation redox flow batteries

Widespread commercialization of redox flow batteries (RFBs), currently hindered by elevated costs, necessitates the development of a new generation of materials with increased performance. Porous electrodes, which are repurposed gas diffusion layers featuring suboptimal properties, are key components as they must distribute liquid electrolytes, provide surfaces for electrochemical reactions, and conduct electrons. Elucidating fundamental structure-performance relationships is required to guide the design of novel electrode architectures. First, we employ model diagnostic platforms, spectroscopic methods, and structure-informed simulations to elucidate the role of electrode microstructure and surface chemistry. Then, we leverage these learnings to rationally synthetize chemistry-specific electrodes for high-performance RFBs.

12.20 – 12.40

Dr. Paola Granados Mendoza (Nouryon)

Material challenges related to intensified alkaline electrolysis

To reach a competitive price for the green hydrogen produced from alkaline water electrolysis it is necessary to decrease the capital costs of the electrolyzers and to enable operation at increased current densities with low energy consumption. To achieve this, it is necessary to develop improved electrodes, membranes and cell designs. Moreover, the manufacture of cells and components should move towards a continuous mass production while economizing material usage. In this presentation, we examine the typical components and materials of alkaline electrolyzers to understand their limitations at intensified operating conditions and explore the improvements needed regarding materials and manufacturing processes.

12.40 – 13.00

Dr. Willem Haverkort (TUD)

The optimal electrode thickness

Most commercial electrochemical systems, from batteries to electrolysers, use porous electrodes. A hitherto largely unanswered but important question is how thick such electrodes should ideally be. Thin electrodes will miss out on surface area, while thick electrodes give a high ohmic resistance and will be used ineffectively. Borrowing from the chemical engineering field, an “electrode effectiveness factor” is defined that can be used to find the optimal electrode thickness. With this highly useful concept, approximate analytical solutions for the polarization curve and the optimal thickness and porosity of porous electrodes are obtained. See also: https://doi.org/10.1016/j.electacta.2018.10.065

15.00 – 15.20

Prof. Mark Huijben (UT)

Advanced thin film technology for enhanced materials interfaces

Essential for all high performance energy applications are processes that happen at the interfaces between the different components. Key problems include slow electrode process kinetics with high polarization and low ionic diffusion or electronic conductivity, particularly at the electrode-electrolyte interfaces. Epitaxial engineering is used to control the crystal orientation of electrode thin films, which enables a unique insight into the relation between electrochemistry and crystal directionality of such chemically complex inorganic interfaces, not obtainable in single crystals or polycrystalline samples. Crystalline thin films of electrode materials are studied to obtain more insight into the ideal interfacial atomic ordering.

15.20 – 15.40

Prof. Gadi Rothenberg (UvA)

Platinum-free fuel cell electrodes for economically viable clean energy

Proton-exchange membrane fuel cells (PEMFCs) are highly efficient engines. Their theoretical energy efficiency is 82%, much higher than the 37% of internal combustion engines. PEMFCs running on hydrogen or methanol could reduce mankind’s CO2 emissions substantially. But there's a catch: today’s fuel cells require platinum-coated electrodes, and at over $30,000/kg, platinum is too expensive.

We have now developed platinum-free fuel cell cathode materials that reduce oxygen with over 700 mW/cm2 efficiency and cost less than $30 per kilo. In the lecture, I will present these materials and discuss how they can be integrated into clean energy cycles.

15.40 – 16.00

Charlotte Vogt, MSc (UU)

Effect of Metal Nanostructuring in Electrocatalytic CO2 Reduction

The development of advanced electrocatalysts with enhanced performance requires 1) introducing more active sites; e.g. by nanostructuring electrocatalytically active metals, or 2) by increasing specific site activity. Via a novel electrode preparation method, we were able to combine these two principles yielding useful insights in structure-activity relationships of the electrocatalytic reduction of CO2 over Cu, Ni and Cu-Ni electrodes. Furthermore, via in-situ spectroscopy (Raman and infrared) during electrocatalytic operation, the mechanism of enhanced catalytic activity is revealed. By combining a novel synthesis technique with state-of-the-art spectroscopic evidence for mechanistic principles, new insights in CO2 electroreduction could be obtained.

16.00 – 16.20

Jan Vos, MSc (Leiden University)

Promotion of Oxygen Evolution Selectivity in Acidic Chloride Solutions Using IrOx Buried Interfaces

Competition between evolution of oxygen and chlorine plays a central role in large-scale electricity-to-chemical conversion. Particularly, an oxygen-selective anode would allow the direct splitting of saline water without the costly need of removing chloride from the system, making direct seawater electrolysis possible. Unfortunately, unwanted chlorine formation scales with oxygen evolution catalytically and has inherently faster kinetics.
In this work, we explore enhancement of OER selectivity by depositing porous, inert layers of material onto an IrOx electrocatalyst. The resulting 'buried interface' may prevent chloride from reaching catalytically active sites, and represents a promising approach towards enhancing OER selectivity.

Parallel session: Innovative electrochemistry

11.30 – 12.00

Keynote: Prof. Christian Breyer, Solar Economy, Lappeenranta University of Technology (LUT), Finland

12.00 – 12.20

Dr. Okan Akin

Kolbe Electrolysis of Levulinic Acid to Higher Energy Density Chemicals

Electrochemical upgrading of Levulinic acid (LA) to higher energy density chemicals is of the interest of this research. In this purpose, electrochemical oxidation of LA (Kolbe electrolysis) has been investigated in a three-neck bottle cell with Platinum anode and glassy carbon cathode in methanol medium. Cyclic voltammetry characterization showed that LA hinders the oxidation of methanol and oxidizes to Kolbe (2,7-ocatendione) and non-Kolbe (2-butanone) products. Preliminary results showed that LA selectively oxidizes to 2,7-octandione (50%) and 2-butanone (25%) with the conversion of 90%. Current target is to investigate effect of different type of anode materials and electrolytes on product distribution.

12.20 – 12.40

Ilona Dickschas, MBA (Siemens AG)

Large Scale PEM Electrolysis for Industrial Applications

Polymer electrolyte membrane (PEM) based water electrolysis for hydrogen production is widely considered as a key technology to decarbonize our fossil-based energy system. Due to its highly dynamic behavior PEM electrolyzer systems accomplish the requirements to be operated with renewable energy-based electricity such as wind or PV power. The production of chemical energy carrier such as hydrogen enables the integration of renewable energy into industrial processes and mobility.

Siemens Hydrogen Solution has already installed the first P2X projects in Germany and released its next generation of PEM electrolyzer system called Silyzer 300 for large scale industrial use.

12.40 – 13.00

Dr. Amanda Garcia (TNO)

Challenges and advances in organic electrosynthesis: combining building blocks in electrochemical reactions

The energy transition from fossil fuels to renewable materials offers new opportunities for many industrial sectors and will help to make the chemical industry more sustainable. The implementation of large-scale faces various challenges related to the development of new electrochemical technologies, scaling-up issues and fundamental challenges related to limited efficiency of some chemical transformations. Here, I will talk about the challenges in organic electrosynthesis, more specifically in combining building blocks in electrochemical condensation reaction, that is CO2, CO or NH3 with biobased building blocks in electrocarboxylation, electro-hydroformylation and electrochemical amination, and the advances in redox reactions of biomass-related organic compounds.

15.00 – 15.20

Dr. Thijs de Groot (Nouryon)

Making alkaline electrolyzers flexible

In the Alkaliflex project Nouryon and Eindhoven University of Technology are jointly investigating how to make alkaline water electrolyzers more flexible. Aim is to make alkaline electrolyzers suitable for flexible operation in the future dutch electricity system. The results show that there are a number of flexibility limiting constraints, including overall heat management, dense bubbly flow behavior, power conversion and gas purity. Most of these constraints can be tackled relatively easily, whereas especially the dense bubbly flow behavior requires a better fundamental understanding of bubble formation and coalescence in strong electrolytes.

15.20 – 15.40

Dr. Elena Perez Gallent (TNO)

Electroreduction of CO2 to CO paired with 1,2-propanediol oxidation to lactic acid. Towards an economically feasible system

Industrial electrochemical processes must be efficient and selective and produce valuable chemicals while minimizing the energy input. However, an economically feasible process for CO2 reduction has not yet been developed. Typically, the electrochemical reduction of CO2 is paired to water oxidation, but an alternative strategy would be coupling the CO2 reduction to an oxidation in which a higher-value product is co-produced.

In this study, we performed the electroreduction of CO_2, paired with the electrooxidation of 1,2-propanediol. Combining these reactions decreases energy consumption by 35%, increases of product value, and results in combined faradaic efficiencies of ca. 160%.

15.40 – 16.00

Dr. Foteini Sapountzi (Syngaschem)

Zero-gap water electrolysers for storing electricity: Current status and perspectives

In zero-gap configurations the diaphragm and aqueous electrolytes of water electrolysers are replaced with ion-conducting polymer membranes on which electrodes are attached. This configuration can be ideally coupled with renewable energy sources, offering high efficiency, responsiveness to variable power input, and high purity hydrogen production. The transported ionic agent can be either OH^- or H^+, but several barriers limit the widespread introduction of these technologies. With novel promising electrocatalysts available, application in suitably engineered membrane-electrode assemblies is the next step for assessing the viability of these technologies.

16.00 – 16.20

Dr. Michail Tsampas (DIFFER)

Making hydrogen from thin air

Solar hydrogen is a promising sustainable energy vector for mobility and power generation. Steady progress has been made towards the development of photoelectrochemical water splitting devices. However, these devices typically require a purified liquid water supply, contain strong acid or base (causing safety concerns) and are ideally operated in areas with high solar irradiance (where frequently water supply is limited). We are examining an alternative approach where the humidity in the ambient air is used instead of liquid water. This potentially enables the construction of liquid-free, independent devices producing hydrogen without any inputs beyond sunlight and air.

Parallel session: System integration, business & governance

11.30 – 12.00

Keynote: Dr. Heleen de Coninck, Environmental Science, Radboud University, The Netherlands

12.00 – 12.20

Dr. Andreas ten Cate (ISPT)

MW – GW – TW: Building the value chain for electrolysis-based large-scale production of sustainable hydrogen

The ISPT program for renewable hydrogen develops the key knowledge for large-scale production of hydrogen from renewable electricity. The program is built on three pillars:

MW - The Megawatt testcenter aims to remove limitations in stack operation and reduce the Capex below 100 €/kW.

GW - The Gigawatt electrolyser project develops a conceptual design at the GW scale to understand the cost structure and drive innovation to reach plant cost below 350 €/kW.

TW – The HyChain project investigates how new value chains emerge that support the industry in CO2-emission-free operation when 1000 GW electrolysers populate the world in 2050.

12.20 – 12.40

Dr. Edgar Harzfeld (Stralsund University)

Optimization of energy storage systems

The storage of electrical energy from fluctuating sources requires new methods for determining the expansion capacity of energy storage systems. Using a complex model, it is shown which installation capacties are necessary to implement a 100% regenerative energy supply.

12.40 – 13.00

Dr. Kas Hemmes (TUD)

The potential role of fuel assisted electrolysis in an integrated energy system of the future

Following the principles of aluminium production, oxygen formation in electrolysis can be avoided by adding fuel to that electrode with the benefit of reduced electric power needed for the production of aluminium/hydrogen respectively. The use of biogas as that fuel is particularly interesting since de facto the biogas will be upgraded to pure hydrogen next to the conversion of electricity to hydrogen. The system is complementary to the Superwind system for flexible production of hydrogen and power (built around an internal reforming fuel cell) together forming ideal stepping stones or even cornerstones in the development of a hydrogen economy.

15.00 – 15.20

Robert de Kler, MSc (ECN part of TNO)

The future value of power

Businesscases for industrial electrification and specifically electrochemical systems are highly dependent on future power prices and industrial demand. Recently, we developed a modelling and simulation tool that predicts future energy prices and electrification technology utilization and thereby facilitates discussions on strategic investments. This model is fed by future conventional and renewable energy supply scenario's, electrification options and their characteristics (like capex and opex) and energy price mechanisms. In the presentation we will show the outcomes of the model for different national scenario's and the utilization of different electrification technologies, like water electrolysis, flow barreries and electric heating.

15.20 – 15.40

Prof. Andrea Ramirez (TUD)

Exploring the techno-economic and environmental tradeoffs of designing load-following electrochemical based processes

There is limited understanding of the techno-economic and environmental implications of designing load-following electrochemical processes that could act as energy storage options to support the deployment of renewables.

This presentation will show potential trade-offs in terms of plant design, economics and carbon footprinting of developing electrochemical processes when moving from continuous production systems towards load-following and semi-batch designs. Using two case studies (electrochemical production of ethylene and methanol), the presentation highlights the challenges found in the assessment including the limitations imposed by up and downstream processes, the increase in complexity as well as hotspots in the economics and carbon footprinting.

15.40 – 16.00

Ing. Rob van der Sluis (MTSA Technopower BV)

Power2Power: the missing link in Energy Transition

Wind and solar are the main renewable energy sources. However, roughly 80% of the electricity produced daily is generated in just 5-6 hours. Should we switch completely to sustainable energy, we would be 'in the dark' for 18 hours without countermeasures.

Converting electricity to hydrogen via electrolysis during peak production and using this for heat and electricity during "the dark hours" is called Power2Power, the missing link in Energy Transition. A consortium of technology partners from Gelderland is working on realization of a comprehensive Power2Power demo. This presentation outlines the technical and commercial aspects with a view to the future.

16.00 – 16.20

Bernhard Weninger, MSc (TUD)

Renewable Hydrogen and Electricity Dispatch with Multiple Ni−Fe Electrode Storage

Here we introduce a hybrid hydrogen–electrical energy storage concept that provides the flexibility to follow and balance fluctuations in electrical supply as battery, while providing hydrogen output on demand. The configuration consist of multiple electrodes with different functionalities. Charging the storage electrodes requires most of the energy and will be done with electricity surplus. When electricity is scarce, hydrogen can be produced from the storage electrodes. The process of storage and controlled release of hydrogen costs about 3% additional energy. The addition of earth abundant iron facilitates electrochemical hydrogen storage with a potential storage density of 18.5 kg H_2/m^3