Karlsruhe Institute of Technology

Topics in Water Chemistry and Water Technology

Annual Report of the Chair of Water Chemistry and Water Technology and the DVGW Research Center at the Engler-Bunte-Institut **2025**

Dear colleagues and friends,

Again, the year 2025 has been dominated by international conflicts about territories as well as resources such as fossil fuels or rare earth elements. Hence, electrical vehicles are promoted in order to reduce the need for fossil fuels and to achieve the climate goals. Although research is steadily improving battery technologies, lithium is a key resource. In addition to mining of lithium in South America, extraction of lithium from geothermal waters from the Rhine valley might be an alternative for Germany (see the projects ThermIon and Schutzgrund on page 5).

Another major topic that is steadily gaining in importance in research and our daily life is artificial intelligence (AI). There are hundreds of models available optimized for language interpretation, coding, mathematics as well as for audio, image and video generation and editing. AI can be a handy tool as long as it has been trained properly. First in-house approaches to utilize AI (machine learning) for the segmentation of imaging data acquired by means of optical coherence tomography (OCT) revealed how tough and important such training is. Briefly, OCT imaging datasets contain intensity values as the result of incident light being reflected and scattered by the matter within the optical path (e.g., biofilm, membrane fouling layer, precipitations). The intensity depends on the optical properties of the sample and device-specific attenuation effects. Together, these issues affect the signal-to-noise ratio to some extent. Structures (e.g., regions of different intensities) are often easily identified by the operator. However, algorithms implemented into commonly used image analysis tools analyze the intensity distribution and do not 'see' and identify these structures. Hence, their segmentation into i.e. biomass and bulk phase is often faulty. Performing the segmentation manually is biased, too. However, based on our experience, manual segmentation seems to be the most promising approach for the provision of training data. This simple example shows that creating correct training data is a very important and rather tedious task. If we succeed, AI will support the segmentation of multi-object datasets. Finally, AI is supposed to provide new insights into the complexity of biofilm systems by finding interconnections between extrinsic and intrinsic factors.

By end of this year, two projects at the DVGW research center are finishing. The Demo-BioBZ project is operating a large scale demonstrator on the wastewater treatment plant in Goslar. It is showing that an activated sludge wastewater treatment can be upgraded in a way that electrical energy is gained by microbial fuel cells.

The H2Mare project investigating the offshore production of green hydrogen is also coming to an end. It revealed the complexity of such an integrated approach. Based on the findings it is concluded that water is a non-limited resource for the production of green hydrogen. The latter can further be processed to other chemical energy carriers by for example Fischer-Tropsch (FT) synthesis. However, both the production of ultrapure water for the electrolysis through reverse osmosis and ion exchange and the FT synthesis will result in brine and wastewater, which have to be processed before discharged into the sea.

The year 2025 is supposed to be the last one in which Harald Horn is contributing to this report as head of the institute since the plan is to retire by end of September 2026. Potential successors presented their research activities and teaching skills. We are thus confident that a new head of the institute will be in charge by October 1st 2026.

We wish you all the best for the year 2026 and hope you are enjoying reading about our recent research activities.

Michael Wagner and Harald Horn

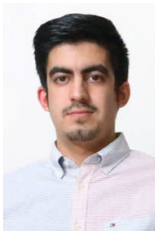
DVGW Forschungsstelle ebi

H_2Mare PtX-Wind: Water management for offshore Power-to-X plants – Treatment of waste water streams

Ben Schädlich

Yair Morales

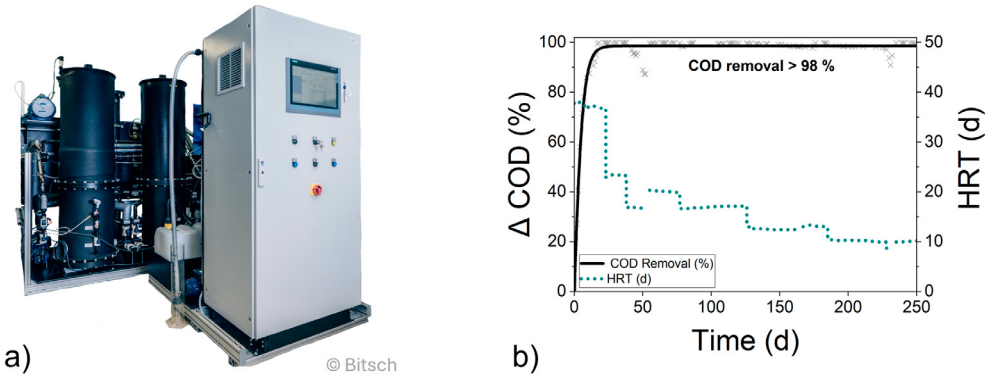
Jonas Ullmann



Mehran Aliaskari

Florencia Saravia

H_2Mare is one of the hydrogen flagship projects of the BMFTR which focuses on the offshore generation of green hydrogen along with Power-to-X (PtX) products such as methane and Fischer-Tropsch synthetic fuels. The DVGW Research Center at the Engler-Bunte-Institut at KIT, Water Chemistry and Water Technology is a key player within the subproject PtX-Wind, leading the water management works and collaborating with project partners on experimental research of different processes. Our team looks into the process chain to supply ultra-pure water and the development of suitable treatment strategies for different PtX-waste waters. In offshore applications, seawater desalination for ultra-pure water (UPW) production accounts for the majority of water management related CAPEX. Therefore, our team investigated the possibility of wastewater recirculation for various PtX wastewater streams. On a theoretical basis, a feasible recirculation potential was identified for wastewater streams from reverse-water-gas-shift reaction or methanation process. Treatment of these streams would reduce capital and operating costs of the seawater desalination by around 35%. Further experimental work focuses on the highly loaded waste water produced from the Fischer-Tropsch synthesis. Continuous long-term investigations using a 100 L anaerobic membrane bioreactor (AnMBR) demonstrate high removal efficiencies of more than 98% of organic carbon. Current research is examining post-treatment strategies, including aerobic biological processes and advanced oxidation. Overall, the findings indicate that despite the good performance of AnMBR treatment and subsequential treatment steps, the implementation of biological treatment processes remains an important challenge for offshore PtX plants, particularly due to footprint limitations and system complexity.



a) Anaerobic membrane bioreactor b) COD removal rate and hydraulic retention time (HRT) during long-term anaerobic treatment of Fischer-Tropsch waste water

Funding:

Federal Ministry of Research, Technology and Space (BMFTR)

Project Partners (see website):

https://www.wasserstoff-leitprojekte.de/projects/h2mare

Publications:

Aliaskari, M.; Horn, H.; Saravia, F. (2025) Real time monitoring of scaling behavior in bipolar membrane electrodialysis, Journal of Membrane Science, 727, 124063. doi:10.1016/j.memsci.2025.124063

KA4H$_2$ and H$_2$ZVK: Hydrogen Production in Waste Water Treatment Plants (WWTP)

Yair Morales

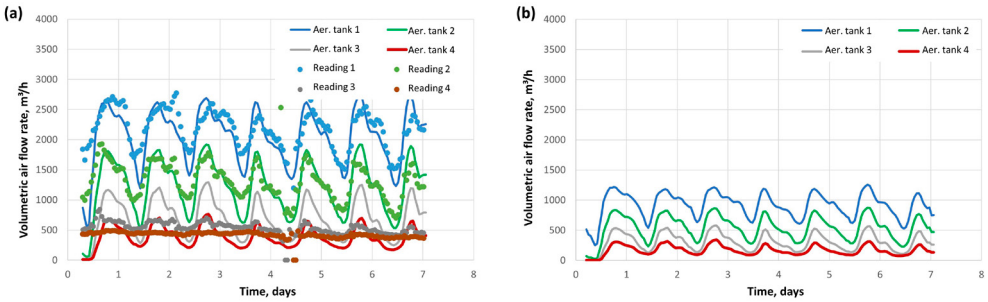
Jan Singer

Florencia Saravia

The use of biologically treated waste water to supply ultra-pure water for water electrolysis along other potential synergies of implementing hydrogen production in waste water treatment plants are being investigated in our project **KA4H$_2$** and feasibility study **H$_2$ZVK** at the WWTP Ulm-Steinhäule. The required water qualities for different types of electrolysers have been researched and treatment concepts are being developed for effluent samples of different WWTPs in Baden-Württemberg. First estimations indicate that waste water availability may not be a limiting factor for the installation of future hydrogen production plants in WWTP, but rather financial or infrastructural aspects in energy supply and hydrogen distribution.

During the production of ultrapure water, waste and backwash water are generated which partly include concentrated constituents and treatment chemicals like antiscalants. Direct discharge of these streams either back into the WWTP or to water bodies may be under most circumstances a conceivable option, considering the effect on water composition of the receiving water.

During the electrolysis process, oxygen is also produced which can be used at a WWTP in aeration tanks or for advanced purification as another synergetic option. Simulations of aeration tanks in **H$_2$ZVK** show a potential reduction of the required air volume by mixing electrolysis oxygen into the introduced air stream. The use of this electrolysis by-product could bring significant energy savings to the WWTP. The addressed potential approaches may vary from one site to another and shall be therefore evaluated for each specific WWTP.



(a) Simulated and recorded volumetric air flow rate in a series of aerated tanks in the WWTP Ulm-Steinhäule for one week of dry weather. (b) Resulting simulated volumetric air flow rate after an alternating mixing of electrolysis oxygen into the aeration system.

Publications:

Singer et al. 2025. Elektrolytische Gewinnung von Wasserstoff aus biologisch gereinigtem Abwasser Verfahrenstechnische Herausforderung und wertschöpfende (Koppel-)Produkte KA Korrespondenz Abwasser, Abfall (72) 11/25. DOI: 10.3242/kae2025.11.004

Baden-Württemberg
MINISTERIUM FÜR UMWELT, KLIMA UND ENERGIEWIRTSCHAFT

Funding:

Ministry of the Environment, Climate Protection and the Energy Sector Baden-Württemberg

Partners:

Institute of Urban Water Engineering, University of Kassel; Kassel

Umwelttechnik BW GmbH, Stuttgart

Zweckverband Klärwerk Steinhäule

Steinbeis Innovationszentrum energieplus

Quantification of wetting development in membrane distillation based on optical coherence tomography

Nurul F. Himma

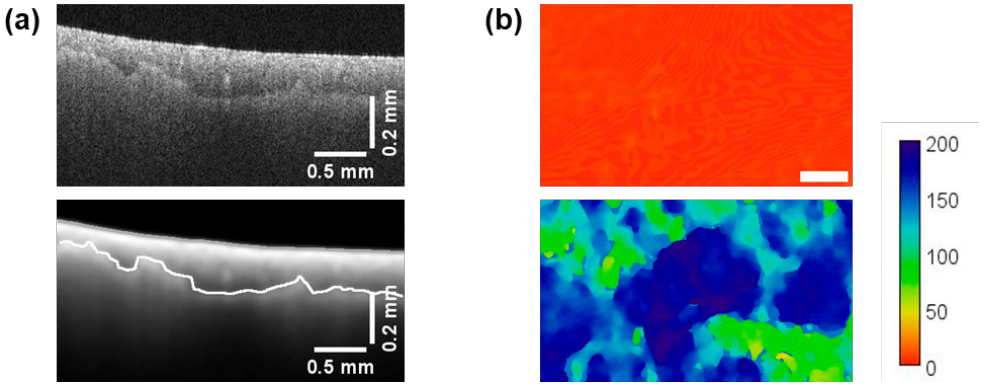
Harald Horn

Florencia Saravia

Michael Wagner

Motivated by the necessity of in situ, real-time monitoring of wetting development in membrane distillation (MD) to understand and prevent process failure, optical coherence tomography (OCT) based methods were developed. Novel approaches were proposed analyzing changes in the intensity distribution within OCT three-dimensional datasets, which successfully elucidated the spatial distribution of wetting in heat maps and enabled the quantification of wetting parameters, regardless of membrane shape and wetting heterogeneity.

Results emphasize that an increase in the **volume** of wetted membrane (expressed as the wetting ratio) does not necessarily correspond to the rise in the membrane area that is fully wetted (expressed as fully-wetted fraction). Observed at a high surfactant (cetyltrimethylammonium bromide, CTAB) concentration of 50 mg/L, wetting was more pronounced near the inlet of the MD module, characterized by a larger difference between the histogram at a given state compared to the reference state, increased wetting ratio and fully-wetted fraction. Moreover, wetting progress near the inlet was more abrupt and exhibited greater spatial heterogeneity compared to middle part of the bench-top membrane distillation setup. Subtle wetting progress at a low CTAB concentration of 10 mg/L was also successfully quantified. Results quantitatively confirm the visual observations and are in good agreement with macroscopic measurements such as electrical conductivity. The developed non-invasive approach and presented findings could pave the way for further advancements in understanding and controlling wetting, not only in MD applications, but also potentially in other membrane processes involving two-phase flow, such as gas-liquid membrane contactors and membrane biofilm reactors.



Wetting progress in a MD experiment performed with high surfactant concentration of 50 mg/L CTAB after 20 min operating time in the center of the test cell. (a) B-scans showing the wetting front determined based on the intensity derivative (white line in the bottom row) compared to the visual observation (top row). (b) Spatial distribution of wetting depicted as heat maps for t = 0 (top row) and t = 20 min (bottom row). Complete wetting is shown in dark blue colour. The calibration bar shows the wetting depth in µm. Scale bar equals 0.5 mm.

Funding:

Graduate Funding from the State (LGF) for Nurul F. Himma, awarded by Karlsruhe Institute of Technology and sponsored by the Baden-Württemberg Ministry for Science, Research, and Arts (MWK).

Publications:

Himma, N.F., Wagner, M., Horn, H., Saravia, F. (2025) In-situ monitoring and understanding of wetting in membrane distillation by means of optical coherence tomography. Separation and Purification Technology, 371, 133203. doi:10.1016/j.seppur.2025.133203

Lithium extraction from geothermal brines – different technologies and their impact on the reservoir

Sophie Oeppling

Alina Schlosser

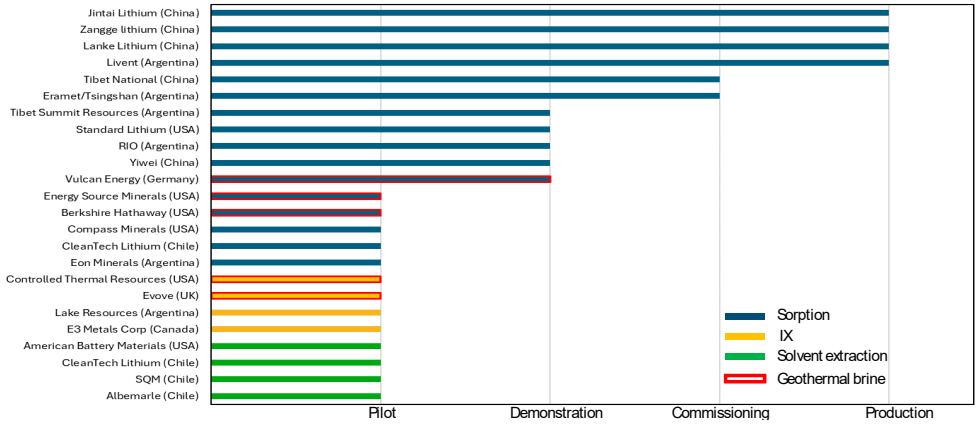
Florencia Saravia

The worldwide lithium demand is increasing mainly because of the growing electric vehicle sector. To be geopolitically independent, the extraction of lithium from regional resources is highly interesting. One of the promising lithium reserves in Europe is the geothermal reservoir in the Upper Rhine Valley. Two current projects are assessing advanced lithium-extraction technologies and their potential effects on geothermal brine resources.

The **ThermIon** project investigates innovative DLE technologies, considering the whole process chain. DVGW-EBI deals with the pretreatment of the brine for the lithium extraction, focusing on nanofiltration (NF). The performance of the NF membranes is strongly influenced by the geothermal power plant's predetermined conditions, such as temperatures reaching 60 °C, the specific water composition, and the inhibitors applied. Additionally, we contribute to several subtasks, including the development of lithium-extraction methods using monoselective electrodialysis and the investigation of processes for concentrating lithium solutions.

Lithium extraction can markedly change geothermal brine chemistry, with the nature and magnitude of these changes determined by the extraction method and the process design. After extraction, the altered brines will be reinjected into the reservoir, where they may initiate dissolution and precipitation processes within the rocks, that can lead to reservoir clogging.

The aim of the project **Schutzgrund** is to evaluate different extraction methods with regard to their effects on the subsurface, to understand the reactions and processes that occur through the reinjection of altered geothermal fluids, to derive scientific concepts for recognizing and evaluating chemical and physical changes in the reservoir rock and to enable methods for conserving geothermal resources and protecting the subsurface during the practical operation of geothermal plants. As a result, recommendations will be developed to support sustainable reservoir management.



Current DLE projects and project stages – main treatment. Data from Nicolaci et al. Direct Lithium Extraction: A Potential Game Changing Technology, Goldman Sachs (2023), expanded with updated data.

Funding:

ThermIon: Federal Ministry for Economic Affairs and Energy (BMWE)

Schutzgrund: Federal Ministry of Research, Technology and Space (BMFTR)

Project Partners (see website):

Thermion: https://thermion.info

Schutzgrund: https://www.ites.kit.edu/1125.php

Scalability of biological biogas upgrading in membrane biofilm reactors – MBfR-Skal

Andrea Hille-Reichel

Andreas Netsch

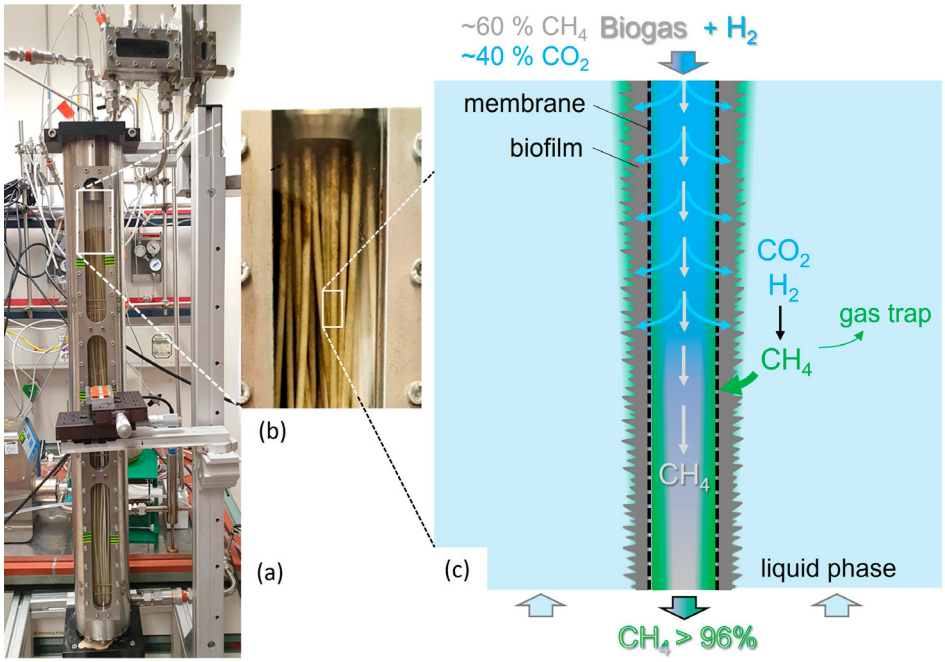
Süheyla Duran

Maximilian Miehle

The sustainable production of biomethane from biogas and sewage gas represents a key step toward a circular and climate-neutral energy sector. Conventional biogas contains approx. 40 % residual CO_2, which requires energy-intensive gas separation methods such as pressure swing adsorption prior to the introduction into the gas grid. The biological upgrading process offers a promising and energy-efficient alternative by utilizing hydrogenotrophic methanogenic archaea to convert the remaining CO_2 into methane with additional hydrogen, targeting a CH_4 content above 96 %.

In membrane biofilm reactors (MBfR), hydrophobic hollow-fiber or capillary membranes are employed as submerged substrata for biofilm growth. Gaseous substrates — CO_2 and H_2 — are fed through the membranes, enabling a direct delivery to the methanogenic biofilm while essential nutrients (N, P, S) are supplied via the liquid phase. This counter-diffusional configuration promises high methane production rates due to the efficient supply with substrates, while avoiding the substrate limitations typically caused by low gas solubility in biological gas fermentations. Previous laboratory-scale investigations (TRL 4–5, Figures (a) and (b)) have demonstrated methane production rates of up to 32 NL m^{-2} d^{-1} at cross-flow membrane operation (Figure (c)).

Building on these results, two upscaled 100 L MBfR systems (TRL 6) will be designed, constructed, and operated under realistic conditions, at the biogas plant in Mühlacker (15 months) and at the wastewater treatment plant in Mannheim (6 months). The systems will be tested under various operational conditions, including different feeding strategies and substrate supply modes, to optimize methane productivity. Finally, an economic assessment is carried out and the feasibility and potential for further scaling to TRL 7 is evaluated using the scaling parameters developed.



Photograph of the lab-scale membrane biofilm reactor (a) and the capillary membrane covered with biofilm (b). The schematic (c) displays the biological biogas upgrading process along a capillary membrane in an MBfR.

Funding:

Ministry of Science, Research and Arts Baden-Württemberg

TR Ministry of National Education, Directorate General for Higher & Foreign Education

Characterization of biofilm distribution and investigation of hydrodynamics in the rotating disc bioelectrochemical reactor (RDBER)

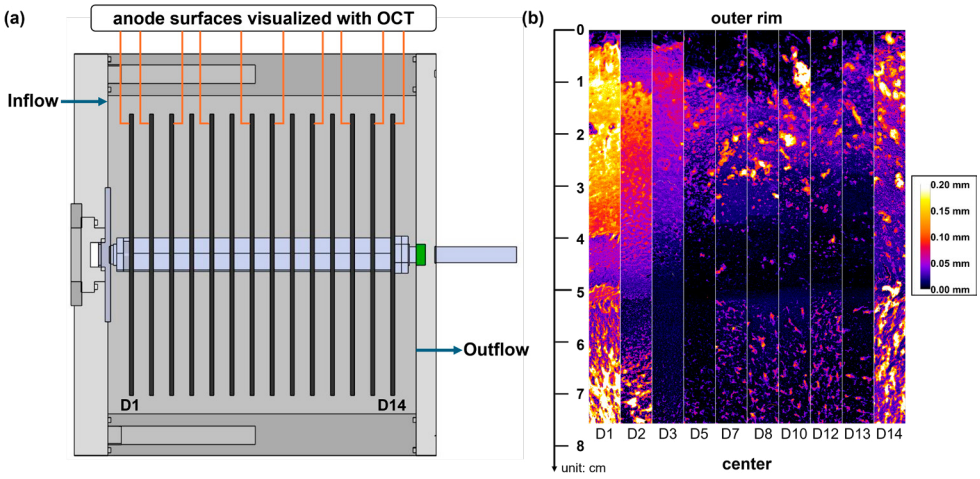
Andrea Hille-Reichel

Zhizhao Xiao

The rotating disc bioelectrochemical reactor (10 L and 100 L) is an innovative system designed and manufactured at EBI. Over the past several years, it has been applied in the projects BROWSE, PeePower, and KoalAplan, demonstrating its promising potential compared with common MEC reactor types. The development of this reactor aimed to improve scalability of bioelectrochemical systems, facilitating the transition from lab-scale and bench-scale to pilot-scale applications. However, several limitations were identified during its application. Specifically, heterogeneous and insufficient biofilm distribution within the reactor has constrained further optimization of the system performance.

After 89 days of operation of a propionate purification process (BROWSE), Optical Coherence Tomography (OCT) was applied to ten of the 28 disc surfaces along the anode stack (Figure (a)). Uneven biofilm distribution was observed, both, along the anode stack and along the radial direction. As can be seen in Figure (b), biofilm coverage and thickness were most pronounced on anodes 1, 2 and 14, whereas from anode 3 to 14, they were generally lower. These observations are reasonable, as discs 1 and 14 were positioned closed to liquid inflow and outflow, respectively, where higher relative velocities between liquid and anode surfaces likely led to better mass transfer. Since the distance between adjacent anodes was only 12 mm, the liquid in the gaps was presumably not easily exchanged with the bulk liquid, which may limit the biofilm growth towards to the center of the anodes.

Accordingly, the non-uniform biofilm distribution most probably reflects suboptimal fluid dynamics. Therefore, Computational Fluid Dynamics simulations are currently performed to better understand the interactions between flow, biofilm distribution, and system performance, which will allow for improvement of reactor configuration.



(a) Cross section of the 10-L RDBER denoting anode surfaces along the stack used for OCT measurement (cathode was removed for better visualization). For imaging, individual discs were submerged in tap water. (b) Height maps of biofilm derived from OCT-3D datasets. Brightness represents the thickness of biofilm.

Publications:

Xiao, Z., et al. (2025). "Impact of the rotational speed and counter electrode configuration on the performance of a rotating disc bioelectrochemical reactor (RDBER) operated as microbial electrolysis cell." Bioresource Technology Reports 31: 102208. doi.org/10.1016/j.biteb.2025.102208

Funding:

Federal Ministry of of Research, Technology and Space (BMFTR)

Karlsruhe Institute of Technology

The state of Baden-Württemberg through bwHPC

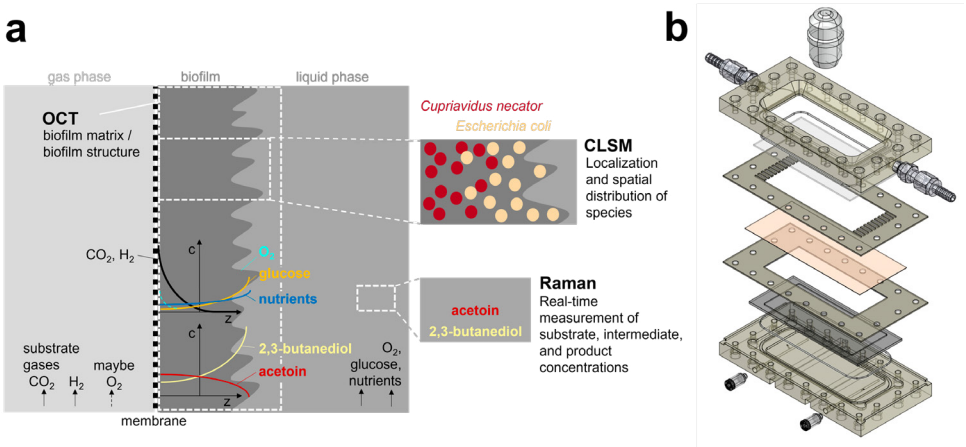
Establishing a CO_2- and glucose-based 2,3-butanediol production process based on the activity of a bacterial dual-species biofilm thriving on an electron-donor delivering membrane substratum

Andrea Hille-Reichel

Max Rümenapf

The project aims to design and operate a membrane biofilm reactor (MBfR) flow-cell in which a commensal dual-species biofilm produces the platform chemical 2,3-butanediol. The system combines the autotrophic acetoin (as cross feeding substrate) formation by *Cupriavidus necator* H16 with the heterotrophic conversion by a genetically modified *Escherichia coli* strain. Biofilm growth, structure and cellular activity/productivity will be characterized by using different imaging techniques (Confocal Laser Scanning Microscopy, Optical Coherence Tomography, Raman Microspectroscopy) and chemical analyses. These complementary methods enable a comprehensive in situ monitoring of the productive, membrane-bound biofilm under operating conditions. The findings will provide new insights into structure–function relationships in synthetic biofilms and contribute to the development of membrane-based bioprocesses for CO_2-dependent chemical production.

Within this research project, we aim to fundamentally investigate principles of biofilm-based production on active substrata and the robustness of cooperativity in applied biofilm processes. Overall, the work will help to harvest the tremendous benefit of productive biofilms as natural retentostats that can be applied in continuous processes.



(a) Anticipated concentration profiles of substrates, nutrients, intermediate, and products in the biofilm (left) as well as expected distribution of cell clusters of both species within the biofilm (right). Proposed imaging methods OCT, CLSM, and Raman, and goals of analyses. (b) Explosion view of the constructed MBfR flow-cell.

Funding:
German Research Foundation, DFG

Project Partners:
Institute of Technical Microbiology,
Hamburg University of Technology

New and Ongoing Research Projects

WATER QUALITY		
Stephan Zimmermann Shilpi Verma	Photocatalytic PFAS degradation with simulated sunlight	Karlsruhe Institute of Technology (KIT)
WATER TECHNOLOGY		
Jan Singer Yair Morales Florencia Saravia	Determination of General Conditions for the Use of Biologically Treated Waste Water for Hydrogen Electrolysis - Requirements for the Production of Ultra Pure Water and Treatment of Waste Water Streams	Ministry of the Environment, Climate Protection and the Energy Sector Baden-Württemberg
Florencia Saravia Mina Asani	Development of a Monitoring System for Detection of Biofilm Formation in Reverse Osmosis Membranes	Central Innovation Programme for Small and Medium-Sized Enterprises (ZIM); Federal Ministry for Economic Affairs and Energy (BMWE)
Nurul Faiqotul Himma Florencia Saravia	Membrane Distillation – Fouling and Wetting of Membranes	Karlsruhe Institute of Technology (KIT)
Yair Morales Florencia Saravia	*H_2Mare TransferWind* – Research, Transfer, Technology Platform	Federal Ministry of Research, Technology and Space (BMFTR)
Florencia Saravia Alina Schlosser	*ThermIon* – Extraction of Lithium from thermal brine	Federal Ministry for Economic Affairs and Energy (BMWE)
Florencia Saravia Sophie Oeppling	*Schutzgrund* – Studies on the Protection of the Subsurface from Modified Geothermal Fluids	Federal Ministry for Economic Affairs and Energy (BMWE)
Andreas Netsch Michael Wagner	*DEMO-BioBZ* – Development and Demonstation of an Energy-Efficient Bio-Electrochemical Waste Water Treatment	Federal Ministry of Research, Technology and Space (BMFTR)
BIOLOGICAL WASTE WATER TREATMENT		
Nikhil Shylaja Prakash Andrea Hille-Reichel	Municipal waste water as a source of ammonium nitrogen, hydrogen and bioplastics – the Büsnau biorefinery (KoalAplan)	ERDF, Ministry of Environment, Climate Protection and the Energy sector Baden-Württemberg, co-financed by the EU
BIOLOGICAL INTERFACES		
Süheyla Duran Andrea Hille-Reichel	Application of Membrane Biofilm Reactors for Biotechnological Production of Platform Chemicals	The Republic of Türkiye, Ministry of National Education; KIT
Michael Wagner	Visualization of the Mesoscopic Biofilm Structure by Means of Optical Coherence Tomography	Helmholtz Association
Max Rümenapf Andrea Hille-Reichel	Establishing a carbon dioxide- and glucose-based 2,3-butanediol production process based on the activity of a bacterial dual-species biofilm thriving on an electron-donor delivering membrane substratum	German Research Foundation (DFG)
Andreas Netsch Maximilian Miehle Andrea Hille-Reichel	Scalability of gas fermentation processes in membrane biofilm reactors	Ministry of Science, Research and Arts, Baden-Württemberg

THE WATER CHEMISTRY AND WATER TECHNOLOGY GROUP

Head of Chair

Prof. Dr. Harald Horn	Prof. Dr. Fritz H. Frimmel (retired)

DVGW Research Center

Dr.-Ing. Florencia Saravia	Deputy head, team leader research and development

Supervising Functions and Postdoctoral Positions

Dr. Andrea Hille-Reichel	Biological interfaces
Dr.-Ing. Andreas Netsch	Biofilm reactor design
Apl. Prof. Dr. Gisela Guthausen	NMR/MRI
Dr. Michael Wagner	Biofilm structure and function
Dr. Stephan Zimmermann	Degradation of PFAS in water by oxidation processes
Dipl.-Ing. (FH) Stephanie West	Head of the laboratory
Dr.-Ing. Ulrike Scherer	Water Research Network BW

DVGW Research Center

M. Sc. Yair Morales	Water treatment

PhD Students

M. Sc. Mehran Aliaskari	Bipolar membrane electrodialysis
M. Sc. Mélanie Apitzsch-Delavault	Evaluation of environmental impact of electrolysis capacity increase in Germany and Morocco by 2050
M. Sc. Süheyla Duran	Biotechnological production of platform chemicals
M. Sc. Nurul Faiqotul Himma	Membrane distillation
M. Sc. Oliver Kehl	Modelling the treatment performance of activated sludge plants
M. Sc. Lukas Lesmeister	Treatment processes for removal of PFASs (TZW) (Dr.-Ing. since October 2025)
M. Sc. Max Rümenapf	2,3-butanediol production process based on the activity of a bacterial dual-species biofilm
M. Sc. Maximilian Miehle	Bioproduction using biocatalyst for electrode assisted fermentation
M. Sc. Nikhil Shylaja Prakash	Wastewater treatment (Dr.-Ing. since August 2025)
M. Sc. Tim Schwarzenberger	Mono- and polychromatic UV disinfection (TZW) (Dr. since July 2025)
M. Sc. Zhizhao Xiao	Bioelectrochemical systems

DVGW Research Center (Project Engineers)

M. Sc. Sophie Oeppling	Water management in PtX processes
M. Sc. Jan Singer	Hydrogen production in municipal water treatment plants
M. Sc. Jonas Ullmann	Use of AI and machine learning for data analysis
Dipl.-Ing. Alina Schlosser	Extraction of lithium from thermal brines
Dr. Mina Ahsani	Biofilm sensor development

Guest Researchers

Dr. Chao Zhang	Humboldt Stipend
Prof. Shilpi Verma	WiSER – Women Involvement in Science & Engineering Research

Technical Staff

Axel Heidt	GC/ECD, GC/MS, IC, AOX
Rafael Peschke	HPLC, LC/MS, IC
Matthias Weber	LC/OCD, DOC/TOC

DVGW Research Center

Ulrich Reichert	ICP-MS, AAS, ICP-OES
Maya Frey	IC

DVGW Research Center

Sylvia Heck

Secretarial Office

Ursula Schäfer

Apprentices

Julia Gretschmann
Melvin Herzog

RECENT PUBLICATIONS

Peer-Reviewed Publications

Aliaskari, M., Horn, H., Saravia, F. (2025) Real time monitoring of scaling behavior in bipolar membrane electrodialysis. Journal of Membrane Science, 727, 124063.

Beratto-Ramos, A., Jaramillo, K., Zapata, P., Romero, J., Martínez, J., Meléndrez, M.F., Saravia, F., Horn, H., Borquez, R., Pino-Soto, L. (2025) Characterization and evaluation of the recovery process of saturated reverse osmosis membranes by chemical oxidation. Desalination, 594, 118273.

Bucs, S., Jung, O., Wagner, M., Saravia, F., Horn, H., Picioreanu, C. (2025) Raman micro-spectroscopy for the study of concentration polarization in the presence of biofouling in pressure driven membrane systems. Journal of Membrane Science, 713, 123219.

Himma, N.F., Wagner, M., Horn, H., Saravia, F. (2025) In-situ monitoring and understanding of wetting in membrane distillation by means of optical coherence tomography. Separation and Purification Technology, 371, 133203.

Kontschak, L., Gruschke, O., Trapp, L., Baser, H.N., MacKinnon, N., Rychen, P., Nirschl, H., Guthausen, G. (2025) MRI on ion exchange resins at different length scales. AIChE Journal 71(4), 18659.

Netsch, A., Latussek, I., Horn, H., Wagner, M. (2025) Detecting excess biofilm thickness in microbial electrolysis cells by real-time in-situ biofilm monitoring. Biotechnology and Bioengineering, 122(8), 2049–2062.

Netsch, A., Sen, S., Horn, H., Wagner, M. (2025) In situ biofilm monitoring using a heat transfer sensor: The impact of flow velocity in a pipe and planar system. Biosensors, 15(2), 93.

Omar, W., Palloks, S., Zhang, H., Pollard, M., Saravia, F., Wilhelm, M. (2025) A systematic study for predicting the performance of forward osmosis desalination using commercial low-cost superabsorber polymer (SAP) hydrogels as draw agent: water flux enhancement by tailoring process parameters. Environmental Science: Water Research & Technology.

Schmid, E., Lerner, R., Rudszuck, T., Nirschl, H., Guthausen, G. (2025) Inline monitoring of lithium brines with low-field NMR. Applied Sciences 15(18), 9987.

Schwantes, R., Morales, Y., Pomp, E., Singer, J., Chavan, K. and Saravia, F. (2025) Thermally driven ultrapure water production for water electrolysis – A techno-economic analysis of membrane distillation. Desalination, 118848.

Shylaja Prakash, N., Maurer, P., Horn, H., Saravia, F., Hille-Reichel, A. (2025) Separation of short-chain fatty acids from primary sludge into a particle-free permeate by coupling chamber filter-press and cross-flow microfiltration: Optimization, semi-continuous operation, and evaluation. Membranes, 15(1), 22.

Shylaja Prakash, N., Neske, W., Rümenapf, M., Xiao, Z., Netsch, A., Horn, H., Ullmann, J., Reiner, J., Hille-Reichel, A. (2025) Evaluation of key operational parameters in a novel pilot-scale rotating disk bioelectrochemical reactor for hydrogen production in a wastewater biorefinery. Chemical Engineering Journal, 525, 168691.

Tosun, J., Debus, M., Schaub, S., Klein, S., Scherer, U., Goeschl, T., Horn, H. (2025) Tap water consumption choices in out-of-home settings: Insights from a survey of German adults. International Journal of Water Resources Development, 41(3), 647–666.

Wittig, C., Wagner, M., Vallon, R., Crouzier, T., van der Wijngaart, W., Horn, H., Bagheri, S. (2025) The role of fluid friction in streamer formation and biofilm growth. npj Biofilms and Microbiomes, 11(1), 17.

Xiao, K., Horn, H., Abbt-Braun, G. (2025) A review on the recovery of humic substances from anaerobic digestate of sludge as a potential fertilizer: Quantification, efficiency and interaction with pollutants. Environmental Research, 267, 120710.

Xiao, Z., Rümenapf, M., Hackbarth, M., Hille-Reichel, A., Horn, H., Reiner, J.E. (2025) Impact of the rotational speed and counter electrode configuration on the performance of a rotating disc bioelectrochemical reactor (RDBER) operated as microbial electrolysis cell. Bioresource Technology Reports, 31, 102208.

Zhang, C., Li, Y., Zhu, J., Zhang, Z., Xie, Y., Fu, S., Zheng, W., Shen, Z., Ren, B., Chen, Z., He, H., Ying, G.-G., Horn, H., McKenna, A.M., Huang, M. (2025) Salinity stress modulates the dynamic co-occurrence interactions between DOM and microbial community profiles in a typical river–estuary–ocean continuum: From the Pearl River to South China Sea. ACS ES&T Water, 5(5), 2096–2109.

Zhu, C., Wu, L., Ning, D., Tian, R., Gao, S., Zhang, B., Zhao, J., Zhang, Y., Xiao, N., Wang, Y., Brown, M.R., Tu, Q.,…. Ju, F., Wells, G.F., Guo, J., He, Z., Nielsen, P.H., Wang, A., Zhang, Y., Chen, T., He, Q., Criddle, C.S., Wagner, M., Tiedje, J.M., Curtis, T.P., Wen, X., Yang, Y., Alvarez-Cohen, L., Stahl, D.A., Alvarez, P.J.J., Rittmann, B.E., Zhou, J. (2025) Global diversity and distribution of antibiotic resistance genes in human wastewater treatment systems. Nature Communications, 16(1), 4006.

Publications Series of the Institute

Volume 92: Andreas Netsch (2025) On-line monitoring of electroactive biofilms on the electrodes of bioelectrochemical systems by means of heat transfer biofilms sensors. ISSN 2747-819X

Volume 93: Nikhil Shylaja Prakash (2025) Processing particulate organic matter from municipal wastewater into a particle-free short-chain fatty acids stream for bio-based products recovery. ISSN 2747-819X

Conferences (Selection)

Aliaskari, M., Horn, H., Saravia, F.: Mitigating Alkaline Scaling in Bipolar Membrane Electrodialysis: From Real-Time Monitoring to Antiscalant Integration. 12th International Membrane Science & Technology Conference (IMSTEC), December 8-11, 2025 Surfers Paradise, Australia, oral presentation.

Himma, N. F., Wagner, M., Horn, H., Saravia., F.: In-situ monitoring and quantitative evaluation of wetting in membrane distillation by means of optical coherence tomography. 8th International Symposium on Membrane Technologies and Applications (MEMTEK), November 12–14, 2025 Izmir, Türkiye, oral presentation.

Netsch, A., Latussek, I., Horn, H., Wagner, M.: Detecting and controlling biofilm thickness in microbial electrolysis cells by in-situ biofilm monitoring. 9th World Conference of the International Society for Microbial Electrochemistry and Technology (ISMET), September 16-19, 2025 Leipzig, poster.

Schädlich, B., Morales, Y. Oeppling, S. Horn, H. Saravia, F. (2025) Untersuchungen zur anaeroben Behandlung von Fischer-Tropsch-Abwasser. 16. Aachener Tagung Wassertechnologie 2025, Aachen, Germany, 11-12 November, oral presentation.

Others (not peer-reviewed papers)

Singer et al. (2025) Elektrolytische Gewinnung von Wasserstoff aus biologisch gereinigtem Abwasser Verfahrenstechnische Herausforderung und wertschöpfende (Koppel-)Produkte KA Korrespondenz Abwasser, Abfall (72) 11/25.

From left to right: (first row) Ulrich Reichert, Harald Horn, Mina Ahsani, Sylvia Heck, Nurul Faiqotul Himma, Ursula Schäfer, Florencia Saravia, Axel Heidt, Ben Schädlich, Rafael Peschke, Yair Morales, Michael Wagner
(second row) Jonas Ullmann, Sanchi Rithe, Sophie Oeppling, Alina Schlosser, Mehran Aliaskari, Stephanie West, Andreas Netsch, Matthias Weber, Maya Frey, Zhizhao Xiao, Andreas Hille-Reichel, Max Rümenapf, Chao Zhang

FUNDING

We gratefully acknowledge the following institutions and associations for their financial support:

Alexander von Humboldt Foundation

Baden-Württemberg Stiftung

Central Innovation Programme for Small and Medium-Sized Enterprises (ZIM)

European Commission – European Support Instrument

Federal Minister for Economic Affairs and Energy (BMWE)

Federal Ministry of of Research, Technology and Space (BMFTR)

German Research Foundation (DFG)

German Technical and Scientific Association for Gas and Water (DVGW)

Gesellschaft der Freunde des Engler-Bunte-Instituts

Helmholtz Association

Karlsruhe Institute of Technology (KIT)

Ministry of Science, Research and Arts Baden-Württemberg (MWK)

Ministry of the Environment, Climate Protection and the Energy Sector Baden-Württemberg

The State of Baden-Württemberg through bwHPC

The Republic of Türkiye Ministry of National Education

Contact
Prof. Dr. Harald Horn
Chair of Water Chemistry and Water Technology and
DVGW Research Center at the Engler-Bunte-Institut of KIT

Engler-Bunte-Ring 9
76131 Karlsruhe, Germany

Phone: +49 721 608-42581
Fax: +49 721 608-46497
Web: https://wasserchemie.ebi.kit.edu/

All e-mail addresses have either the form:
name.surname@kit.edu or
name.surname@partner.kit.edu or
surname@dvgw-ebi.de

Duplication as digital and printed version:

Printed by Karlsruhe Institute of Technology (KIT), Karlsruhe (150 copies)
Topics in Water Chemistry and Water Technology,
Number 31, published annually since 1995

The information printed in this newsletter is current as of November 30, 2025.

Issued by

Karlsruhe Institute of Technology (KIT)

President Prof. Dr. Jan S. Hesthaven
Kaiserstraße 12
76131 Karlsruhe, Germany
www.kit.edu