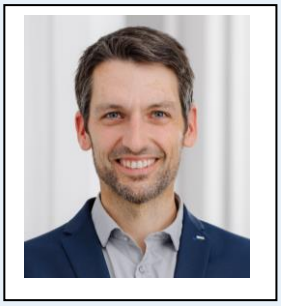
Prof. Dr. rer. nat. habil. Lars Lauterbach

(*12.07.1980, married, one child: 2021)
RWTH Aachen University
Institute for Applied Microbiology
Professor for Synthetic Microbiology
Worringerweg 1, D-52074 Aachen
Phone: +49 241 80 26616, abc@xyz.rwth-aachen.de



ORCID: 0000-0002-6601-6473
URL for web site: www.iamb.rwth-aachen.de
https://scholar.google.de/citations?hl=de&user=vC7-NDMAAAAJ

Working group vision and contribution to catalaix

Our research group is dedicated to the design of biocatalytic energy modules for a future circular (bio)economy. Our CatalAix projects focus on the application of sustainably produced hydrogen (H_2) to replace food competing glucose in fermentation processes. Our contributions include metabolic engineering of recombinant H_2-oxidizing bacteria to facilitate the production of reduced molecules, such as biopolymers, while investigating their metabolic adaptations. Our research also includes strategies to decouple cellular metabolism from H_2-driven biocatalysis, exploring the integration of H_2 energy modules into prokaryotic and eukaryotic production hosts for monomer and lipid synthesis and optimising gas fermentation processes for improved process efficiency.

Current & Previous Positions

Since 2021	**Univ.-Professor in Synthetic Microbiology** at RWTH Aachen University, Germany
2018 - 2021	**Team leader** at Technische Universität Berlin, Germany
2015 – 2018	**Senior scientist** with Dr. O. Lenz at Technische Universität Berlin, Germany
2013/ 2015	**PostDoc** with Prof. S. Cramer at University of California, Davis, U.S.A.
2013 - 2014	**PostDoc** with Dr. Oliver Lenz at Technische Universität Berlin, Germany
2012 - 2012	**Research scientist** with Prof. Dr. Kylie Vincent at University of Oxford, U.K.

Education

2021	**Habilitation** (Post lecturer qualification) in Biochemistry with Prof. S. Leimkühler at University Potsdam, Germany
2013	**PhD** in Microbiology with Prof. B. Friedrich at, Humboldt-Universität zu Berlin, Germany
2007	**Diplom in Applied Biology** (Master equivalent) at University of Stuttgart, Germany

Fellowships and Awards

2022	**Speed Fund** award by RWTH profile area for Master student program
2022	**Sustainable Fund** award by RWTH for living algae fascade
2019	**Forum Junger Spitzenforscher**, 4th place, science competition -climate change
2017 + 2018	**Fonds of the chemical industry**, award for material cost allowances
2013	**EMBO short term fellowship** as PostDoc at Department of Chemistry, University of California, Davis, U.S.A.
2008 - 2013	**Fellow** of the "Berlin International Graduate School of Natural Science and Engineering" (BIG-NSE) at Technische Universität Berlin, Germany
2006 - 2007	**Scholarship** by Mercator-Foundation for master thesis at Newcastle upon Tyne, U.K.

Contributions to the science system

Since 2022	Member of the **Examining Committee**, RWTH Aachen University
Since 2022	Member of the **Quality Improvement Fund**, RWTH Aachen University
Since 2020	**Review Editor** "Frontiers in Catalysis – Biocatalysis"

Selected Projects

Since 2021 PI of the national **Cluster of Excellence** "Fuel Science Center"
Since 2021 Core Group PI of the **Bioeconomy Science Center**, NRW, Germany
Since 2021 PI of the national **Priority Program "eBiotech"**
Since 2021 PI of the **H2020, MSCA** training network "ConCO2rde"

Most important scientific contributions

(1) Al-Shameri A, Siebert DL, Sutiono S, Lauterbach L, Sieber V. (2023) Hydrogenase-based oxidative biocatalysis without oxygen. **Nat. Commun.** 14(1):2693. DOI: 10.1038/s41467-023-38227-9.

This publication focuses on hydrogenase-based oxidative biocatalysis. The research explores the mechanism and potential applications of this process, providing valuable insights into hydrogenases by enabling oxidative biocatalysis under oxygen-free conditions.

(2) Kulka-Peschke CJ, Schulz A-C, Lorent C, Rippers Y, Wahlefeld S, Preissler J, Schulz C, Wiemann C, Bernitzky CCM, Karafoulidi-Retsou C, Wrathall SLD, Procacci B, Matsuura H, Greetham GM, Teutloff C, Lauterbach L, Higuchi Y, Ishii M, Hunt NT, Lenz O, Zebger I, Horch M Reversible glutamate coordination to high-valent nickel protects the active site of a [NiFe] hydrogenase from oxygen **J. Am. Chem. Soc.** 2022, 144, 37, 17022–17032 DOI: 10.1021/jacs.2c06400

This study investigates the protective role of reversible glutamate coordination at the active site in certain [NiFe] hydrogenases, protecting their active site from oxygen exposure. The studycontributes to the understanding of the interaction between hydrogenases and oxygen, which is crucial in the context of biotechnology.

(3) Zill D, Lettau E, Lorent C, Seifert F, Singh P, Lauterbach L. § 2022 Crucial role of the chaperonin GroES/EL for heterologous production of the soluble methane monooxygenase from *Methylomonas methanica* MC09 **ChemBioChem** 23, e202200195. https://doi.org/10.1002/cbic.202200195

This work highlights the importance of the chaperonin GroES/EL in the heterologous production of soluble methane monooxygenase as an key enzyme for methane conversion. Such findings are important for synthetic microbiology as they shed light on the role of chaperones in the production of bioactive molecules and enable the design of artificial methane-converting production hosts.

(4) Lupacchini S, Appel J, Stauder R, Bolay P, Klähn S, Lettau E, Adrian L, Lauterbach L, Bühler B, Schmid A, Toepel J. 2021 Rewiring cyanobacterial photosynthesis by the implementation of an oxygen-tolerant hydrogenase. **Metab Eng.** 68:199-209. https://doi.org/10.1016/j.ymben.2021.10.006

This study explores the integration of an oxygen-tolerant hydrogenase to rewire cyanobacterial photosynthesis. It demonstrates the potential of cyanobacteria for future light-driven hydrogen production in decentralised photoreactors.

(5) Lorent L, Pelmenschikov V, Frielingsdorf S, Schoknecht J, Caserta G, Yoda Y, Wang H, Tamasaku K, Lenz O, Cramer SP, Horch M, Lauterbach L, Zebger I 2021 Exploring structure and function of redox intermediates of [NiFe]-hydrogenases by an advanced experimental approach for solvated, lyophilized and crystallized metalloenzymes **Angew. Chem. Int. Ed.** 60,15854–15862 (Highlighted as front cover) https://doi.org/10.1002/anie.202100451

This work focuses on the investigation of the redox intermediates during H_2 conversion in [NiFe]-hydrogenases using advanced experimental approaches. Understanding the details of these enzymes is crucial for the design of new efficient chemical catalysts for H_2 conversion based on abundant metals.

(6) Al-Shameri A, Willot SJ-P, Paul CE, Hollmann F, Lauterbach L 2020 H_2 as a fuel for flavin- and H_2O_2-dependent biocatalytic reactions **Chem. Commun.** 56, 9667 – 9670 doi.org/10.1039/D0CC03229H

This work explores the use of H_2 as a fuel for flavin- and H_2O_2-dependent biocatalytic reactions. The work is significant in biocatalysis as it represents a novel approach to hydrogen fueling of enzymatic processes.

(7) Al-Shameri A, M Petrich M-C, Puring Kj, Apfel U-P, Nestl BM, Lauterbach L 2020 Powering artificial enzymatic cascades with electrical energy **Angew. Chem. Int. Ed.** 59:10929–10933 (Highlighted as front cover) doi.org/10.1002/anie.202001302

This paper focuses on the use of electrical energy to power artificial enzymatic cascades. We demonstrate the production of methylated N-heterocycles from diamines with up to 99 % product formation as well as excellent regioselective labeling with stable isotope. The platform can be applied for a broad panel of oxidoreductases to exploit electrical energy for the synthesis of fine chemicals.

(8) Al-Shameri A, Borlinghaus N, Scheller P, Nestl BM, Lauterbach L 2019 Synthesis of N-heterocycles from diamines via H_2-driven NADPH recycling in the presence of O_2. **Green Chem** 21: 1396-1400 https://doi.org/10.1039/C8GC03798A

In this study, we describe an enzymatic cascade involving an oxidase, an imine reductase and a hydrogenase for the H_2-driven synthesis of N-heterocycles. Improved variants of putrescine oxidase enabled efficient one-pot production of substituted N-heterocycles and provided insights into the specificity of the oxidase with a high enantiomeric excess.

(9) Lauterbach L, Lenz O 2018 How to make the reducing power of H_2 available for in vivo biosyntheses and biotransformations. **Curr Opin Chem Biol.** 49:91-96 Review DOI: 10.1016/j.cbpa.2018.11.020

This review discusses strategies to harness the reducing power of H_2 for *in vivo* biosyntheses and biotransformations. It provides an overview of key concepts in synthetic microbiology and outlines methods to harness the potential of H_2 in biological processes.

(10) Lauterbach L, Lenz O. 2013 Catalytic water production by oxygen-tolerant [NiFe]-hydrogenase during H_2 cycling in the presence of O_2, **J. Am. Chem. Soc.** 135, 17897-17905. DOI: 10.1021/ja408420d

Here we have shown that, in the presence of twice the ambient O_2 concentration, up to 3% of the electrons generated by H_2 oxidation serve as "health insurance" and are reused for O_2 reduction. The O_2 tolerance of this hydrogenase makes it very attractive for biotechnological applications in cofactor regeneration.

Patents

(1) Vincent KA, Lauterbach L, Lenz O, Cofactor regeneration system, WO20130760A2

This invention relates to cofactor regeneration systems comprising a first electron transfer component (NADH:acceptor oxido-reductase or NADPH:acceptor oxido-reductase) and a second electron transfer component (hydrogenase moiety or non-biological nanoparticles). These components are immobilised on an electrically conductive surface to allow regeneration of the cofactor.

(2) Vincent KA, Reeve H, Rowbotham J, Lent O, Lauterbach L, Lonsdale T, Huang A, Cofactor labelling with hydrogen isotopes PCT/EP2019/053447

This invention describes a cofactor regeneration system for labelling molecules with stable isotopes. A strategy is presented that uses H_2 as a clean reductant and ^2H_2O as a source of deuterium atoms to generate and recycle [4-^{2}H]-NADH, allowing asymmetric deuteration in various organic molecules with exceptional selectivity.