Prof. Dr. Jürgen Klankermayer

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Working group vision and contribution to catalaix

The impending transition to a sustainable chemical industry requires the development of robust and selective catalyst systems with high productivity and novel reactivity. Correspondingly tailored catalyst systems are the focus of research and are intended to create the basis for the establishment of new sustainable reactions and processes for industrial use. On the one hand, small molecules should be activated efficiently, and synthetic building blocks made from carbon dioxide, hydrogen, or nitrogen should be made available for the construction of polymer structures. On the other hand, macromolecular raw materials should be selectively defunctionalized using new methods and then converted into important basic chemicals. The research in the Klankermayer working group has set itself the goal of developing novel molecular catalysts for these challenges and adapting them to the respective chemical transformation. The basis for this is the effective interaction of synthesis, spectroscopy, and computational chemistry, which then enables the translation of results from basic research into chemical applications in interdisciplinary collaboration. Recently, a tailor-made technology platform for the catalytic conversion of carbon dioxide, biomass, and polymers has been developed. With plastics, it was possible to integrate molecular hydrogen and biomass into the chemical recycling process. These examples confirmed the effectiveness of a multidimensional circular economy based on the Open-Loop concept, and now further developing and translating this approach is envisaged in **catalaix**.

Current & Previous Positions

Since 2021	Acting Director of the Institute for Technical and Macromolecular Chemistry
Since 2019	Professor (W3) “Translational Molecular Catalysis”, Institute for Technical and Macromolecular Chemistry, RWTH Aachen University Aachen, Germany
2016 – 2019	Professor (W2) “Translational Molecular Catalysis”, Institute for Technical and Macromolecular Chemistry, RWTH Aachen University Aachen, Germany
2009 – 2016	Professor as Junior-Professor (W1) “Mechanisms in Catalysis”, Institute for Technical and Macromolecular Chemistry, RWTH Aachen University Aachen, Germany
2004 – 2009	Scientific Assistant (C1), Institute for Technical and Macromolecular Chemistry, RWTH Aachen University Aachen, Germany

Education

2003 – 2004	Post-Doc, Dr. John M. Brown, Dyson Perrins Laboratory and Chemistry Research Laboratory, University of Oxford, U.K.
2002 – 2003	Post-Doc, Prof. Dr. François Mathey, École Polytechnique, Paris, France
1999 – 2002	PhD with Prof. Dr. Henri Brunner, University of Regensburg, Regensburg, Germany
1993 – 1999	Chemistry (Diploma), University of Regensburg, Regensburg, Germany

Fellowships and Awards

2023 Research prize of the Werner Siemens Foundation "Technologies for a sustainable use of resources"

2014 European Sustainable Chemistry Award of the European Chemical Society

Contributions to the science system

Since 2023	Member of the Management Board "QuinCAT, Quick Innovation in Catalysis"
Since 2022	Head of "CAT - Catalytic Center", RWTH Aachen University and Covestro AG
Since 2017	Head of the "Magnetic Resonance Center (MARC)", RWTH Aachen University
2013-2018	Co-Founder of "The Aachen-California Network (ACalNet)"
Since 2010	Co-Founder and Member of the Management Board "CMT – Center for Molecular Transformations", RWTH Aachen University

Selected Projects

2024 – 2025	Principal Investigator in Kopernikus Project P2X-3, Power-to-Polymers
2023 – 2025	Principal Investigator in ORAM - Development of a recycling and production system for the restoration of interior components and reduction of material consumption in aviation (BMWK)
2022 – 2025	Principal Investigator in the Priority Program "Molecular Machine Learning", SPP 2363
2022 – 2024	Alexander von Humboldt Foundation, Research Group Linkage Program with R. Tuba
2020 – 2024	Principal Investigator in Mix-UP - Mixed plastics biodegradation and upcycling, EU-BBI Horizon2020
2019 – 2025	Member of the Steering Committee and Principal Investigator in the Cluster of Excellence "The Fuel Science Center – Adaptive Conversion Systems for Renewable Energy and Carbon Sources", EXC 2186
2019 – 2022	Principal Investigator in Kopernikus Project P2X-*2*
2016 – 2021	Coordinator GreenSolRes "Demonstration of solvent and resin production from lignocellulosic biomass *via* the platform chemical levulinic acid", EU-BBI Horizon2020
2009 – 2018	Principal Investigator in the Cluster of Excellence "Tailor-made Fuels from Biomass", EXC 236

Most important scientific contributions

1. V. Farkas, M. Nagyhazi, P. T. Anastas, **J. Klankermayer**, R. Tuba: Making persistent plastics degradable; *ChemSusChem*, **2023**, *16*, e202300553.
   Catalytic transformation of polyethylene plastic waste to propene via a cascade reaction.
2. J.-D. Spöring, J. Wiesenthal, V. S. Pfennig, J. Gätgens, K. Beydoun, C. Bolm, **J. Klankermayer**, D. Rother: Effective production of selected dioxolanes by sequential bio- and chemocatalysis enabled by adapted solvent switching; *ChemSusChem*, **2023**, *16*, e202201981.
   Concatenated catalysis using bio- and chemocatalysis via an interdisciplinary approach.
3. K. Beydoun, **J. Klankermayer**: Efficient Plastic Waste Recycling to Value-Added Products by Integrated Biomass Processing; *ChemSusChem*, **2020**, *13*, 488.
   Integration of biogenic diols as renewable resource in the recycling process of polyoxymethylene ethers (POM polymers) and demonstration of the Open-Loop approach.
4. R. Meys, F. Frick, S. Westhues, A. Sternberg, **J. Klankermayer**, A. Bardow: Towards a circular economy for plastic packaging wastes – the environmental potential of chemical recycling; *Resour. Conserv. Recy.*, **2020**, *162*, 105010.

Life cycle analysis of chemical recycling processes using the Open-Loop concept based on catalytic hydrogenation.

5. B. G. Schieweck, N. F. Westhues, **J. Klankermayer**: A highly active non-precious transition metal catalyst for the hydrogenation of carbon dioxide to formates; *Chem. Sci.*, **2019**, *10*, 6519.
   Currently, the most effective transition metal catalyst for the hydrogenation of CO_2 to formates.
6. K. Beydoun, **J. Klankermayer**: Ruthenium-catalyzed synthesis of cyclic and linear acetals by the combined utilization of CO_2, H_2, and biomass derived diols; *Chem. Eur. J.*, **2019**, *25*, 11412.
   Integration of renewable energy and renewable carbon sources in the synthesis of an important platform molecule.
7. S. Westhues, J. Idel, **J. Klankermayer**: Molecular catalyst systems as key enablers for tailored polyesters and polycarbonate recycling concepts; *Sci. Adv.*, **2018**, *4*, eaat9669.
   Catalytic Recycling of essential polymers (PET, PC, PLA) with the integration of renewable energy and demonstration of the effectiveness of the Open-Loop approach.
8. B. G. Schieweck, **J. Klankermayer**: Tailor-made molecular cobalt catalyst system for the selective transformation of carbon dioxide to dialkoxymethane ethers. *Angew. Chem. Int. Ed.*, **2017**, *56*, 10854.
   First application of a non-precious metal catalyst system for the reduction of CO_2 to formaldehyde.
9. **J. Klankermayer**, S. Wesselbaum, K. Beydoun, W. Leitner: Selective catalytic synthesis using the combination of carbon dioxide and hydrogen: catalytic chess at the interface of energy and chemistry. *Angew. Chem. Int. Ed.*, **2016**, *55*, 7296.
   General introduction of the catalytic chess concept for the valorization of CO_2.
10. **J. Klankermayer**, W. Leitner: Love at second sight for CO_2 and H_2 in organic synthesis; *Science*, **2015**, 350, 629.
    Overview of the catalytic possibilities for the valorization of CO_2 in organic synthesis.

Patents

1. T. El-Hawary, C. Glotzbach, **J. Klankermayer**, W. Leitner, Y. Makhynya, H. Schumacher, N. Tenhumberg: Verfahren für die katalytische Herstellung von Formamid, DE102019111072A1, 29/10/2020.
2. T. R. Hembre, **J. Klankermayer**, W. Leitner, A. Rosen, S. Westhues: Immobilized Ruthenium-Triphos Catalysts for Selective Hydrogenolysis of Amides, WO002020006353A1, 02/01/2020.
3. T. R. Hembre, **J. Klankermayer**, W. Leitner, S. Westhues: Molecular Catalysts for Selective Hydrogenolysis of Amides, WO002019222063A1, 21/11/2019.
4. **J. Klankermayer**, W. Leitner, M. Meuresch: Method for the Reduction of Organic Molecules, US000010166534B2, 01/01/2019.
5. **J. Klankermayer**, R. Palkovits, L. Sandbrink, P. M. Schleker: Vinyltetrahydrofuranes, EP000003009430B1, 23/05/2018.
6. **J. Klankermayer**, W. Leitner, T. vom Stein, S. Wesselbaum: Reduction Method for the Reduction of Carbon Dioxide and Carbon Dioxide Derivatives, EP000002653457B1, 08/02/2017.
7. **J. Klankermayer**, W. Leitner, M. Meuresch: Method for the Reduction of Organic Molecules, WO002016128044A1, 18/08/2016.