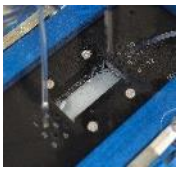

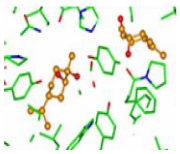
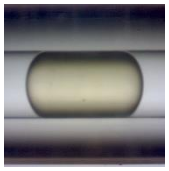

ESAB European Society of Applied Biocatalysis

ESAB Webinar

Biocatalytic Process Engineering

October 21st 2022

13.00-15.30 British Summer Time (BST)
14.00-16.30 Central European Time (CET)
09.00-11.30 Brasília Time (BRT)
08.00-10.30 Eastern Daylight Time (EDT)

Chairs: Polona Žnidaršič Plazl (University of Ljubljana)
Roland Wohlgemuth (Lodz University of Technology)

PROGRAMME

14.00 Prof. Dr. Andreas Liese, Institute of Technical Biocatalysis, Hamburg University of Technology TUHH, Germany

Facing Climate Challenge by Technical Biocatalysis

We are in a decade, where the climate change becomes clearly observable to the public. To establish a livable environment and society for the future, we need to come up with new processes, that are resource as well as energy saving, which is enabled by the responsible use of our resources, ideally sustainable resources. To realize this, we need also to develop new bioprocess technologies, that enable a circular bioeconomy, making use also of spent materials.

This will be discussed on the example of 2 case studies, namely responsible use of phosphor [1] as well as efficient aeration technologies [2].

To develop and operate such technologies, we require STEM (science, technology, engineering, mathematics) trained lab and production workers as well as scientists. This is our motivation for inspiring youngsters for STEM.

References

[1] Niklas Widderich, Natalie Mayer, Anna Joelle Ruff, Bernd Reckels, Florian Lohkamp, Christian Visscher, Ulrich Schwaneberg, Martin Kaltschmitt, Andreas Liese, Paul Bubenheim, Conditioning of Feed Material Prior to Feeding: Approaches for a Sustainable Phosphorus Utilization. *Sustainability* 14, 3998 (2022). https://doi.org/10.3390/su14073998.

[2] Benjamin Thomas, Daniel Ohde, Simon Matthes, Claudia Engelmann, Paul Bubenheim, Koichi Terasaka, Michael Schlüter, Andreas Liese, Comparative investigation of fine bubble and macrobubble aeration on gas utility and biotransformation productivity. Biotechnol. Bioeng. 118 (1), 130-141 (2021), https://doi.org/10.1002/bit.27556.

14.30 Prof. Dr. Kathrin Castiglione, Department of Chemical and Biological Engineering, Institute of Bioprocess Engineering, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany

Engineering of biocatalytic preparations: alternatives to the use of whole cells and isolated enzymes

One of the first decisions to be made when introducing a new biocatalytic process is whether to use whole cells or isolated enzymes. Both approaches have their specific advantages and challenges. Whole cells with overexpressed enzymes are cheap to produce and often the preferred option for cofactor-dependent biotransformations due to intracellular cofactor supply. However, host cell enzymes can catalyze undesirable side reactions, and the cell wall can cause diffusion limitations that reduce catalyst activity. Both disadvantages can be circumvented by using isolated enzymes instead, but they are expensive - depending on the degree of purification - and it is sometimes necessary to immobilize them to reduce catalyst costs by facilitating their reuse. In addition, if more than one enzyme is to be used in a process, the biocatalyst preparations must be reconsidered as incompatibilities may occur.

In this webinar, we will present two platform technologies that can help overcome common drawbacks of whole-cell and isolated enzyme applications: While cellular envelopes are suitable to avoid mass transfer limitations and undesired side reactions in whole cells, nanoscale enzyme membrane reactors can help to realize multi-enzyme syntheses with incompatible reaction steps that would otherwise lead to significantly reduced or no product formation.

15.00 Prof. Dr. Luciana Rocha Barros Gonçalves, Chemical Engineering Department, Federal University of Ceara, Fortaleza, Brazil

Heterogeneous biocatalysts for industrial application: Challenges and trends

In order to design innovative products and processes that also meet the criteria of sustainability, increasing emphasis on renewable feed-stocks and green chemistry has been given. To achieve that goal, biocatalytic processes will play an important role in the next generation of industrial processes. Nevertheless, when compared to conventional industrial chemistry, bioprocesses and biocatalysis is a rather young technology. Although biocatalysts are highly biodegradable and considered natural products, they also have some drawbacks, since enzymes have high molecular complexity, high production costs and intrinsic fragility. Several strategies have been developed in order to stabilize enzymes under process conditions: chemical modification, enzyme immobilization, aggregation, modern techniques of protein engineering and so on. Enzyme improvement via immobilization is a useful technique of enzyme engineering, which allows not only the re-use of enzymes but also the enhancement of enzyme properties. Some reasons to engineer enzymes include: better accommodating unnatural substrates, increasing their stability under the reaction conditions and creating new reactions or new biochemical pathways. With this in mind, some immobilization strategies, supports (at different scales) and ways of conducting processes will be discussed.

15.30 Prof. Dr. Bernd Nidetzky, Institute of Biotechnology and Biochemical Engineering, Graz University of Technology, NAWI Graz, and Austrian Centre of Industrial Biotechnology (acib), Graz, Austria

Enzyme cascade reactions for synthesis: natural product glycosides and oligosaccharides

Cascade biocatalysis has received attention considerably for application in organic synthesis. It follows the idea to innovate synthetic routes to complex molecules based on overall transformations that result from telescoping multiple enzymatic reactions into one pot, without requirement for the isolation of intermediates. Glycosylation is the major reaction in carbohydrate synthetic chemistry and resulting products (e.g., oligosaccharides, natural product glycosides) are important chemicals, ingredients and pharmaceuticals. Enzyme cascade transformations via phosphorylated or nucleotide-activated sugars enable biocatalytic glycosylations to be carried out at an efficiency that can potentially meet the high demands of an industrial production. However, scaling up and implementation of cascade transformations in actual processes comes with significant challenges of reaction engineering and control. In this talk covering process engineering aspects of cascade biocatalysis, I will discuss recent advances in the development of cascade reactions with enzymes dependent on sugar 1-phosphate (phosphorylases) and sugar nucleotide (glycosyltransferases) donor substrates. The phosphorylases are used in oligosaccharide synthesis. The glycosyltransferases are shown for the synthesis of natural product glycosides.

16.00 Prof. Dr. Anne S. Meyer, Protein Chemistry & Enzyme Technology Section, Department of Biotechnology and Biomedicine, DTU Bioengineering, Technical University of Denmark, Kgs. Lyngby, Denmark

Enzymatic degradation of poly(ethylene terephthalate) (PET): New insight into the significance of PET crystallinity and new assay methods

While products made of plastic have become a useful and ubiquitous part of our life, the accumulation of plastics in landfills, soil and oceans has become a modern environmental crisis. The most desirable properties of plastics – durability, low cost and easy processing – have now become major drawbacks. For example, about 10 million tons of plastic waste enter the oceans every year, equivalent to a truckload every minute. One widely used plastic is poly(ethylene terephthalate) (PET), which currently constitutes ~ 9% of all plastic produced. Taking an estimated 450 years to decompose, it was a sensation when in 2016 [1] it was found that the microbe *Ideonella sakaiense*s could degrade PET. Since then, research into enzymes that catalyze degradation of PET has surged. In this presentation, new results on the significance of PET substrate crystallinity on enzymatic PET degradation will be discussed [2]. Then, a novel method for controlled modification of PET crystallinity for investigating the efficacy of PET degrading enzymes in response to PET crystallinity [3] will be outlined, and a new continuous assay for fast exploration and robust kinetic characterization of PET degrading enzymes will be presented. The overall aim is to improve the understanding of enzymatic PET degradation in relation to development of efficient enzymatic PET recycling processes.

References

[1] Shosuke Yoshida, Kazumi Hiraga, Toshihiko Takehana, Ikuo Taniguchi, Hironao Yamaji, Yasuhito Maeda, Kiyotsuna Toyohara, Kenji Miyamoto, Yoshiharu Kimura, Kohei Oda, A bacterium that degrades and assimilates poly(ethylene terephthalate). *Science*, 351 (6278), 1196-1199 (2016). https://doi.org/10.1126/science.aad635

[2] Thore Bach Thomsen, Cameron J. Hunt, Anne S. Meyer, Influence of substrate crystallinity and glass transition temperature on enzymatic degradation of polyethylene terephthalate (PET). *New Biotechnol*. 69, 28-35 (2022). https://doi.org/10.1016/j.nbt.2022.02.006

[3] Thore Bach Thomsen, Cameron J. Hunt, Anne S. Meyer, Standardized method for controlled modification of poly (ethylene terephthalate) (PET) crystallinity for assaying PET degrading enzymes. *MethodsX* 2022, 9, 101815. https://doi.org/10.1016/j.mex.2022.101815

ABOUT THE SPEAKERS

Andreas Liese is head of the Institute of Technical Biocatalysis at the Hamburg University of Technology (TUHH) in Germany (www.technical-biocatalysis.com). His research is focused on fundamental and applied aspects of technical biocatalysis, including process analytical technologies, multiphase systems and chemo- as well as electroenzymatic reaction sequences. He and his team are unifying these concepts with the development of technologies to establish smart reactors. Besides this, his team is active in STEM (science, technology, engineering and mathematics) motivation/education of pupils with different programs (www.kinderforscher.de, www.nachwuchscampus.de and www.kniffelix.de).
After carrying out his doctoral research at the Research Center Jülich, he Received his PhD degree in 1998 from the University of Bonn. From 1998 to 2003 Liese was assistant professor at the University of Bonn and at the same time head of the Enzyme Group at the Institute of Biotechnology II (Prof. Dr. C. Wandrey) within the Research Center Jülich. During a sabbatical in 2000 at Pfizer Global Research and Development, San Diego, USA, he there initiated a R&D group on biocatalysis. From 2003 to 2004 he worked as associate professor at the University of Münster, soon receiving a full professorship for Technical Biocatalysis 2004 at the Hamburg University of Technology (TUHH) as the director of the Institute of Technical Biocatalysis. He is elected chairman of the steering committee "BioTechNet" of the DECHEMA since 2020 and elected member of the of Deutsche Akademie der Technikwissenschaften – acatech.

Kathrin Castiglione is Full Professor for Bioprocess Engineering at the Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany) since 2018. Her research in the field of biocatalysis focuses on the multi-enzymatic production of fine chemicals and the development of new platform technologies to perform challenging cascade reactions.
She studied Molecular Biotechnology and received her PhD in Bioprocess Engineering from the Technical University of Munich (Germany) in 2009. After a research stay at the Toyama Prefectural University in Japan in the laboratory of Prof. Yasuhisa Asano in 2010, she established an independent junior research group at the Technical University of Munich. During her professional career, Kathrin Castiglione has received various scholarships and awards, amongst others she was postdoctoral fellow of the Japanese Society for the Promotion of Science, Junior Fellow of the Technical University of Munich, and was awarded two prizes for excellent university teaching in the last two years.

Luciana Gonçalves is a Professor of Chemical Engineering at the Federal University of Ceara, Brazil, since 1998. She received her diploma in Chemical Engineering in 1994, and her Chemical Engineering B.S. and PhD degrees in 1996 and 2001 at the Federal University of São Carlos, São Paulo, Brazil.
She is interested in bioprocess and heterogeneous biocatalysts, working mainly on the following topics: engineering of enzyme reactions, immobilization of enzymes, preparation and application of heterogeneous biocatalysts, use of waste and development of bioprocesses. The research in her lab includes enzyme production (recombinant L-arabinose isomerase), enzyme immobilization (lipases and beta-galactosidase) and use of agroindustrial residues (cashew apple and chitosan) to obtain bio-based products and biofuels.

ABOUT THE SPEAKERS

Bernd Nidetzky is Full Professor of Biotechnology at Graz University of Technology (TU Graz) in Austria. At TU Graz, he is Head of the Institute of Biotechnology and Biochemical Engineering. There, he also serves as Head of TU Graz Field of Expertise in Human & Biotechnology. Since 2014, he is Scientific Director (CSO) of acib (Austrian Centre of Industrial Biotechnology), the major Austrian institution for collaborative research between academia and industry in industrial biotechnology focused on bioproduction.
Bernd Nidetzky is an engineer in chemistry by training from TU Graz, with specialisation in biochemistry and biotechnology. He holds a doctoral degree in engineering (biotechnology) also from TU Graz. After about 10 years at the University of Natural Resources and Life Sciences (BOKU) in Vienna where he received a Habilitation in Biotechnology and Enzymology, Nidetzky joined TU Graz in 2002 for his current academic position.
The main research theme of Bernd Nidetzky is enzymes of carbohydrate processing. The research covers mechanistic and applied aspects of the enzymes, to a similar degree and always in depth. Nidetzky is interested in the biochemical engineering sciences promoting the successful use of the enzymes in industrial processes.

Anne S. Meyer is Professor of Enzyme Technology, Head of the Protein Chemistr & Enzyme Technology Section of about 75 persons, incl. ~ 25 PhD students. She i also group leader of Enzyme Technology, Dept. of Biotechnology and Biomedicin Technical University of Denmark (DTU).
Anne holds an MSc from the University of Copenhagen, and an MSc from the University of Reading, UK, and a PhD from DTU (1993). She has been at DTU sinc 1988 in various positions, and has had two postdoc stays in the USA at University California Davis. She became Full Professor in 2006 and headed Center for Bio-Process Engineering at DTU until summer 2018, where she assumed her current role as Head of the Protein Chemistry & Enzyme Technology Section. For 3 years, from 2017-2019, she was also a visiting professor at Dept. Chemical and Biomolecular Engineering, University of Melbourne, Australia. Her research is within applied technology, including enzyme enzymatic biorefining of biomass, agro-industrial side streams, starch, pectin, and seaweeds for production of bioactive and functional compounds, as well as enzymatic degradation of plastic and enzymatic conversion of CO2. She has particular experience within enzymatic plant biomass modification, pectin technology, bioinformatics & enzyme kinetics, and enzymatic synthesis of human milk oligosaccharides. The Protein Chemistry & Enzyme Technology Section has > 1000 m^2 lab space with state-of-the art equipment for carbohydrate analysis, LC-MS/MS, HPAEC (Dionex), SEC, Maldi-TOF, protein crystallization, protein biophysics equipment, enzyme assays, and has an enzyme production platform for recombinant production of enzymes, and a Digital Enzymology unit for bioinformatics and protein modeling work, and access to proteomics. She has published almost 400 peer-reviewed papers within the field of enzyme catalysis, enzymatic conversion, discovery, biocatalytic carbohydrate synthesis, and pectin/refining technology. Citations: She currently has 18,000+ Web-of-Science citations and WoS h-index of 70 (Google Scholar: 28000+ citations, h-index 90, i10-index 320). Editor: Biotechnology Advances, Enzyme and Microbial Technology, Ed. Board: New Biotechnology.

NEXT ESAB WEBINARS

ESAB aims to promote the development of Applied Biocatalysis and takes initiatives in areas of growing scientific & industrial interest in the field.

Schedule and Topics of the next ESAB webinars:

18th November 2022 10.00-12.00 CET	Enzymatic Reaction Mechanisms and their Biocatalytic Applications, organized by Jennifer Littlechild and Roland Wohlgemuth
16th December 2022 14.00-16.00 CET	Biocatalytic Total Synthesis organized by Roland Wohlgemuth and Jennifer Littlechild

HOW TO JOIN ESAB

You are cordially invited to join ESAB by completing the membership application form online *via* https://esabweb.org/Join+us/Application+form.html
Personal membership is free.
Institutional membership is welcome and is currently being established as new membership category.

ESAB has been founded in 1980 and has the mission of promoting the development of Applied Biocatalysis throughout Europe. The aims of ESAB are to promote initiatives in areas of growing scientific and industrial interest of importance within the field of Applied Biocatalysis.

Further information on ESAB Conferences and other activities can be found on the ESAB website www.esabweb.org
ESAB - European Society of Applied Biocatalysis (esabweb.org)