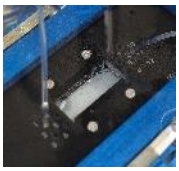
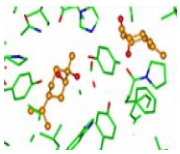
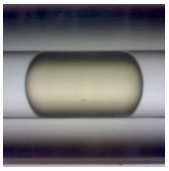


ESAB Webinar

Biocatalysis and Functional Genomics

Friday, 30th July 2021 at 14:00 – 16:00 CET
Welcome Address: Willi Meier DECHEMA, Frankfurt
Chairs: Jennifer Littlechild University of Exeter, ESAB Vice Chair; Margarita Kambourova, Bulgarian Academy of Sciences; Roland Wohlgemuth, Lodz University of Technology, ESAB Chair

PROGRAMME

14.00 Prof. Huimin Zhao, Steven Miller Chair of Chemical and Biomolecular Engineering, Prof. of Chemistry, Biophysics and Bioengineering, University of Illinois at Urbana-Champaign, USA

Expanding the Boundary of Biocatalysis
Biocatalysis has been increasingly used for practical synthesis of chemicals, fuels, and materials thanks to recent advances in synthetic biology and enzyme engineering. In this talk, I will discuss our effort in the design of novel chemoenzymatic routes and repurposed enzymes for synthesis of fine chemicals by exploring the synergy between biocatalysis and chemical catalysis. Particularly, I will highlight two of our recent projects including: (1) integrating biocatalysis with photocatalysis to create artificial photoenzymes with new-to-nature reactivities, and (2) developing machine learning algorithms and automation tools for enzyme discovery and engineering.

14.30 Dr. Ilya Kublanov, Winogradsky Institute of Microbiology, Federal Research Center of Biotechnology, Russian Academy of Science, Moscow, Russia

Cultivated Archaea as a Source of Novel Glycosidases.
Glycosidases – a class of enzymes capable of glycosidic bonds hydrolysis in oligo- and polysaccharides and sugar-containing compounds. There is a great variety of polysaccharides and as a consequence, a quite high number of different glycosidases distinguished both by catalytic action and/or structure. Many of these are highly demandable for applications, including for the food and pulp industries and biofuels production. Due to the limited number of cultivated microorganisms and the progress in the development of various cultivation-free methods, including, sequencing and proteomics, as well as in bioinformatic approaches for the obtained data analysis, cultivation has become almost extinct in bioprospecting pipelines. Currently there are a number of cultivation-free technologies for enzymes bioprospecting, some of which (such as metagenomic sequencing) rely on the current knowledge of the enzymes diversity, while some others (functional metagenomics, activity-based protein profiling) are capable of completely novel enzyme family mining. Yet, some of them are still complicated and to a certain extent limited, and have little to say about what happens *in vivo*. Thus, a cultivation approach, coupled with all of the complementary techniques mentioned above, have become relevant again. Due to difficulties in isolation and cultivation and lack of generally available archaeal genetic tools Archaea and their enzymes are still poorly investigated compared to Bacteria. I will describe 3 examples of hyperthermophilic and halophilic archaea isolated on β-linked polysaccharides as sole carbon and energy sources. The archaea were able to grow on polysaccharides through the synthesis of i) one unique multidomain multifunctional glycosidase, ii) several novel glycosidases, or iii) a large set of glycosidases from known families. Despite a variety of methods in the field of functional genomic analysis, proteomics and enzymology that were used for detection and characterization of these glycosidases, cultivation played a crucial role since it helped to use years of natural selection for biocatalysts obtaining, and also because it played the role of a test system of predicted activities *in vivo*.

15.00 Prof. Wolfgang Streit, Department of Microbiology and Biotechnology, Universität Hamburg, Germany

The global Plastic Crisis: Mining Non-Cultivated Bacteria for Plastic Degrading Enzymes.

Plastics are widely used in our economy and each year, at least 350-400 million tons are being produced. Due to poor recycling and low circular use, millions of tons accumulate annually in terrestrial or marine environments. Today it has become clear that plastic causes adverse effects in all ecosystems and that microplastics are of particular concern to our health. Therefore, recent microbial research has addressed the question, if and to which extent microorganisms can degrade plastics in the environment. Enzymes available act mainly on the high molecular weight polymers of polyethylene terephthalate (PET) and ester-based polyurethane (PUR). The currently known PETases form five distinct phylogenetic clusters. In my presentation I will highlight research efforts in my group that focus on the isolation of plastic-active microorganisms and enzymes using *omic* approaches in combination with HMM-searches in global databases. We are currently testing and benchmarking all known PETases and building a PETase toolbox with more than 60 enzymes. Ongoing research provides strong evidence that the bacteroidetal and some proteobacterial enzymes are involved in degradation of PET in marine habitats.

15.30 Prof. John McGeehan, Director, Centre of Enzyme Innovation, School of Biological Science, University of Portsmouth, UK

Biocatalysis as a low energy route to plastic recycling and upcycling

Following the discovery of enzymes that are capable of breaking down man-made plastics we turned out attention towards uncovering the detailed workings of PETase and MHETase, a synergistic enzyme pair that can deconstruct polyethylene terephthalate (PET). Found in single-use drinks bottles, packaging, clothing and carpets, PET can take centuries to decompose, and together with other plastics, is accumulating in our environment at a staggering rate. A biological catalyst that can break PET down into its original building blocks opens new opportunities for recycling towards a circular plastics economy. We have shown that a combination of structural, biophysical and biochemical approaches can productively inform the engineering of these enzymes to increase the speed of breakdown. We are targeting the vast resource of sequences that code for thermotolerant enzymes that can be employed to breakdown PET at its glass transition temperature, while also combining various binding domains and generating new scaffolds for further engineering. Our latest studies compare the technoeconomic and life cycle assessment of enzyme-based recycled PET (rPET) versus fossil derived virgin PET (vPET) and reveal comparative costs, but with significant savings in energy and reductions in greenhouse gas emissions. We are now partnering with industry to push forward the application of these bio-based technologies at scale.

Resources:

BBC Earth Interview https://www.facebook.com/118883634811868/videos/1811492739009038

Bloomberg Interview https://youtu.be/DDhPuyrSq3E

ABOUT THE SPEAKERS

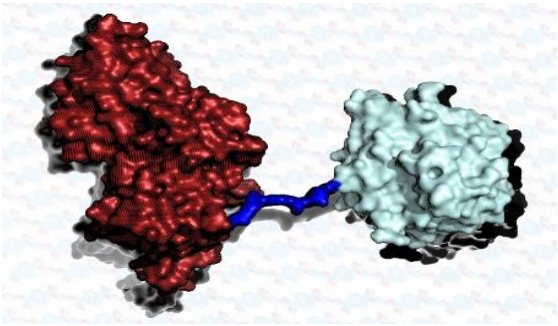
Huimin Zhao is the Steven L. Miller Chair of chemical and biomolecular engineering, and professor of chemistry, biochemistry, biophysics, and bioengineering at the University of Illinois at Urbana-Champaign (UIUC). He received his B.S. degree in Biology from the University of Science and Technology of China in 1992 and his Ph.D. degree in Chemistry from the California Institute of Technology in 1998 under the guidance of Nobel Laureate Dr. Frances Arnold. Prior to joining UIUC in 2000, he was a project leader at the Industrial Biotechnology Laboratory of the Dow Chemical Company. He was promoted to full professor in 2008. Dr. Zhao has authored and co-authored over 360 research articles and over 30 issued and pending patent applications with several being licensed by industry. In addition, he has given plenary, keynote or invited lectures in over 410 international meetings, universities, industries, and research institutes. Thirty-one (31) of his former graduate students and postdocs became professors or principal investigators in the United States (9), China (Mainland 16, Taiwan 1), Korea (2), Singapore (2), and Egypt (1).

Dr. Zhao received numerous research and teaching awards and honors such as ECI Enzyme Engineering Award (2019), Marvin Johnson Award (2018), Charles Thom Award (2016), Elmer Gaden Award (2014), Guggenheim Fellowship (2012), Fellow of the American Association for the Advancement of Science (AAAS) (2010), Fellow of the American Institute of Medical and Biological Engineering (AIMBE) (2009), the American Chemical Society (ACS) Division of Biochemical Technology Young Investigator Award (2008), and National Science Foundation CAREER Award (2004). Dr. Zhao served as a consultant for over 10 companies such as Pfizer, Maxygen, BP, Gevo, and zuChem, and a Scientific Advisory Board member of Gevo, Myriant Technologies, Toulouse White Biotechnology (TWB), AgriMetis, and Bota Biosciences. He is currently an advisor to the Department of Energy's Biological and Environmental Research program and the director of NSF AI Research Institute for Molecule Synthesis (https://moleculemaker.org). In addition, he is the theme leader of the Biosystems Design theme in the Carl R. Woese Institute for Genomic Biology and the leader of the Conversion theme in the DOE's Center for Advanced Bioenergy & Bioproducts Innovation (CABBI) at UIUC. Dr. Zhao is an Associate Editor of *ACS Catalysis* and an editor of *ACS Synthetic Biology*, *Journal of Industrial Microbiology and Biotechnology*, *the CRISPR Journal*, *Scientific Reports*, *Synthetic and Systems Biotechnology*, and *Engineering in Life Sciences*. His primary research interests are in the development and applications of synthetic biology, machine learning, and laboratory automation tools to address society's most daunting challenges in health, energy, and sustainability, and in the fundamental aspects of enzyme catalysis, cell metabolism, gene regulation, and cell differentiation.

Ilya Kublanov is the head of the Extremophiles Metabolism Laboratory in the Federal Research Center "Biotechnology", Russian Academy of Sciences. He received his PhD in 2007 both in Winogradsky Institute of Microbiology, Russia (microbiology) and University of Nantes, France (microbiology/biochemistry) for his thesis work "New Hydrolytic Enzymes from Thermophiles". Since then he is working in Winogradsky Institute of Microbiology (now a part of FRC "Biotechnology"), in the Laboratory of Hyperthermophilic Microbial Communities, headed by Prof. Bonch-Osmolovskaya, one of the world's main experts in diversity and ecology of thermophilic microorganisms. From 2017 he is heading his own laboratory, focusing on the reconstruction of novel extremophilic microorganisms metabolism. His main interests are linked with extremophilic prokaryotes, their enzymes and metabolic pathways. He participated in and/or supervised work on isolation and characterization of tens of novel taxa of thermophilic, halophilic and acidophilic bacteria and archaea including those representing the deepest phylogenetic lineages (novel phyla), as well as in the proposal of novel pathways, such as the novel pathway of xanthan degradation, and a novel variant of the Calvin cycle. His special interest is connected with the search for novel thermostable hydrolases, such as cellulases, keratinases or esterases. Ilya has participated in numerous scientific cruises and expeditions to various extreme environments including those located in remote and hard-to-get-to regions. Amongst the latter was a recent expedition to Chukotka hot springs (Far East of Russia), located in the permafrost area and never previously studied by microbiologists. Ilya Kublanov has published more than 90 papers (according to Scopus) and given invited talks at international and national symposia.

Wolfgang Streit completed a degree in biology at the Philipps University of Marburg, Germany, until 1989, where he was awarded a doctorate in 1993 for his work on the microbiology of rhizobia. From 1995 to 1997 he was a postdoc at the University of California, Davis (USA). From 1997 to 1998 he conducted research at Bielefeld University and then headed a working group at the Georg-August University of Göttingen at the Institute for Microbiology and Genetics, where he completed his habilitation in microbiology in July 2002. From 2004 to 2006 he was professor for enzyme technology at the University of Duisburg-Essen in the chemistry department. Since 2006, Wolfgang Streit is a professor and head of the Department of Microbiology and Biotechnology at the University of Hamburg. The mining and utilization of uncultivated microorganisms for biotechnology as well as the identification of new enzymes and valuable biomolecules is one of the main topics in the lab. The group also investigates the molecular processes that lead to the formation of microbial biofilms.
Wolfgang Streit is a member of the Association for General and Applied Microbiology, DECHEMA, American Society for Microbiology and Hamburg School of Food Science. He is co-editor of the journals Applied Environmental Microbiology, Frontiers of Microbiology and Journal of Molecular Biotechnology and was co-editor of RÖMPP online (2009-2015). He is the coordinator of the several Network programs including EraNet networks "MetaCat" and "MarBioTech".

John McGeehan is a Professor of Structural Biology focused on the global challenge of plastic pollution and leads a team of scientists researching natural enzyme discovery and engineering. natural enzyme discovery and engineering. John graduated from the University of Glasgow in 1993, with a BSc (Hons) degree in Microbiology, before going on to complete a PhD in Virology at the MRC Virology Unit, Glasgow. His research career continued at the University of York, before joining the University of Portsmouth in 2000, working on DNA-binding proteins. In 2005, he completed a Postdoctoral Fellowship with the EMBL-Grenoble, France, researching crystallography at the large European synchrotron. In 2007, he re-joined the University of Portsmouth as an RCUK Fellow, was appointed to Reader in 2012 and Professor in 2016. He founded the Centre for Enzyme Innovation in 2019 where he is currently Director. Their work on PET-digesting enzymes has been widely covered in the media following two key papers in 2018 and 2020 in the journal PNAS, and the project received the Times Higher Education STEM Research Project of the Year in 2019. The group is rapidly expanding due to a £5.8 million grant from Research England which has allowed the recruitment of 15 additional researchers for the new Centre for Enzyme Innovation (www.port.ac.uk/cei). The focus of the group remains the engineering of biological catalysis for the breakdown of a wide range of natural and synthetic polymers. The group recently joined the BOTTLE (www.BOTTLE.org) consortium which offers new opportunities for true interdisciplinary research across the diverse areas required to tackle the global plastic pollution crisis.



NEXT ESAB WEBINARS

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

Schedule and Topics of next ESAB webinars:

16 Aug. 2021, 16.00-18.00 CET	Joint US-European Webinar on Biocatalysis and Bioeconomy Education, organized by ESAB/ DECHEMA/SKB/GBS
3 Sept. 2021, 14.00-16.00 CET	Standards for Reporting Biocatalysis Experiments organized by Peter Halling
22 Oct. 2021, 14.00-16.00 CET	Synthetic Biology and Metabolic Engineering Tools and Methodologies organized by Frangiskos Kolisis and Roland Wohlgemuth

HOW TO JOIN ESAB

You are cordially invited to join ESAB online *via* https://esabweb.org/Join+us/Application+form.html
Personal membership is free.

ESAB, founded in 1980, 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 can be found on the ESAB website www.esabweb.org
ESAB - European Society of Applied Biocatalysis (esabweb.org)