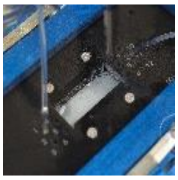  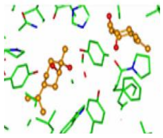 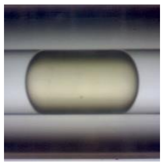

ESAB Webinar

Biocatalysis for the Synthesis of Biomaterials

March 25th 2022 ***14.00-16.00 Central European Time (CET)***
09.00-11.00 a.m. Eastern Daylight Time (EDT)
08.00-10.00 a.m. Central Daylight Time (CDT)

Chairs: Jennifer Littlechild (University of Exeter)
Francisc Peter (University Politehnica of Timişoara)
Roland Wohlgemuth (Lodz University of Technology)

PROGRAMME

14.00 CET **Prof. Dr. Richard A. Gross, Center for Biotechnology and Interdisciplinary Studies, Department of Chemical & Biological Engineering, Rensselaer Polytechnic Institute (RPI), Biotechnology Building, 110 8th Street, Troy, NY 12180, USA**

Modified sophorolipids: a versatile family of molecules for emulsification and bioactivity

Sophorolipids are glycolipids produced by bioconversion of a wide range of renewable feedstocks normally consisting of a source of mixtures of sugars and lipids. They combine green chemistry and a lower carbon footprint while proving safe to the environment. Sophorolipids are fully biodegradable and to have a low acute toxicity. Furthermore, they can be produced in volumetric yields of about 200 g/L. Our laboratory has focused on modification or molecular editing of sophorolipids (SLs) to tailor their properties for a wide range of applications. The methods used such as esterification of the sophorolipid carboxylic acid are readily scalable and result in improvements in their cost-performance. This presentation will describe methods used for SL modification and correlations between sophorolipid structure-function. Included in that discussion will be characterization of how the ester moiety of SL-ester derivatives influence their critical micelle concentrations, minimum surface tensions, emulsification properties with important oil phases and antimicrobial activity.

14.30 CET **Prof. Dr. Stefaan De Wildeman, B4Plastics, Dilsen-Stokkem, Belgium**

The moment durable plastics became too durable for this world

Since their origin, plastics have been durable lightweight materials for functional articles such as fibers, films, parts and sheets. They have merged with our lives as silent spies that commissioned prosperity without claiming anything back. If time is money, why spend a thought on such a cheap thing as plastics? So, we never checked their resources. We hardly noticed their presence.

Till now – because suddenly they came back. In places they became much more remarkable than before – although much smaller. As microplastics. In our food. In our natural habitats. In our bodies. And in our anxious dreams. And now that we woke up from those dreams, people learned to understand that durability can be too durable. It is time to give up on our first generation of plastics. Let's thank them for what they brought, but let's welcome their successors.

Those new generation of plastics that can be made from local renewables, produced in our own countries, understood and enjoyed by their users, and designed for smart recycling – into industry or into Nature. For their re-design, it requires scientific know-how. For their success, it requires industrial cooperation and human education. And for their glory, it requires innovators that guide us from the Old to the New. B4plastics is on a mission.

15.00 CET Prof. Dr. Claudia Schmidt-Dannert, University of Minnesota, Dept. Biochemistry, Molecular Biology and Biophysics, St. Paul, MN, USA

Design and production of a resilient and self-regenerating living composite material

Engineering cells to produce a self-organizing composite materials can give rise to new types of functional, living materials that can self-produce and self-repair. Approaches in synthetic biology and materials sciences are therefore increasingly combined to fabricate Engineered Living Materials (ELMs). Yet, so far very few examples exist for “truly” living materials where material fabrication is driven by its living component engineered for autonomous self-fabrication and organization as well as self-regeneration. In addition, most ELM examples are based on common chassis organisms that lack resilience and long-term viability for applications outside the laboratory. In this presentation I will discuss our current work to diversify the ELM landscape towards the design of robust and resilient materials where the living component drives silica bio-composite formation. As our living component, we have engineered spore forming *B. subtilis* cells to secrete self-assembling protein scaffold that are functionalized for cross-linking of cells and silica biomineralization. Cells are engineered for attachment to scaffolds via polar flagella. For long-term storage of genetic programming and to maintain the structural integrity of the formed material, *B. subtilis* cells are also modified to produce endospores that are not released. We then identified silica biomineralization peptides that when fused to the secreted protein scaffold matrix polymerize silica for the fabrication of a biocomposite material with enhanced mechanical properties. The resulting ELM can be regenerated from a cured piece of silica material and new functions can easily be integrated into the material by co-cultivation of different engineered *B. subtilis* strains. This work together with other efforts in our group on the design of self-assembling, functional materials provide exciting opportunities for the design of a multitude of genetically programmable functional and living materials for a range of applications.

15.30 CET Prof. Dr. Lucia Gardossi and Dr. Anamaria Todea, Department of Chemical and Pharmaceutical Sciences, University of Trieste, Italy

Rational eco-design and synthesis of biobased polyesters

The research on biocatalyzed polycondensation has delivered an array of polyesters having molecular weights below 20,000 g mol^{-1} but characterized by controlled structures and desired functionalities. Their unique catalytic efficiency under mild conditions enables enzymes to catalyze the polycondensation of monomers bearing labile lateral moieties that can be easily accessed via post-polymerization modifications. Here we describe examples of integrated experimental-computational approaches for the rational planning and implementation of enzymatic polycondensation using lipases and cutinases. They rely on molecular visualization, molecular modeling, molecular dynamics, bioinformatics and chemometrics, which are methods requiring modest computational power.

References

[1] Sara Fortuna, Marco Cespugli, Anamaria Todea, Alessandro Pellis, Lucia Gardossi, Criteria for Engineering Cutinases: Bioinformatics Analysis of Catalophores, *Catalysts* 11, 784 (2021). https://doi.org/10.3390/catal11070784

[2] Alessandro Pellis, Lucia Gardossi, Integrating computational and experimental methods for efficient biocatalytic synthesis of polyesters, in: Enzymatic polymerization (N. Bruns, K. Loos, Eds.), *Methods Enzymol.*, 627, 23-55 (2019). https://doi.org/10.1016/bs.mie.2019.07.040.

[3] Anamaria Todea, Sara Fortuna, Cynthia Ebert, Fioretta Asaro, Stefano Tomada, Marco Cespugli, Fabio Hollan, Lucia Gardossi, Rational guidelines for the two-step scalability of enzymatic polycondensation: experimental and computational optimization of the enzymatic synthesis of poly(glycerolazelate). *ChemSusChem*, in press (2022). https://doi.org/10.1002/cssc.202102657

[4] Valerio Ferrario, Anamaria Todea, Lisa Wolansky, Nicola Piovesan, Alice Guarneri, Doris Ribitsch, Georg M. Guebitz, Lucia Gardossi, Alessandro Pellis, Effect of binding modules fused to cutinase on the enzymatic synthesis of polyesters. *Catalysts* 12, 303 (2022). https://doi.org/10.3390/catal12030303.

ABOUT THE SPEAKERS

Professor Dr. Richard A. Gross is Full Professor and a Constellation Chaired Professor at Rensselaer Polytechnic Institute (RPI). His research combines mild enzyme and green chemical pathways to develop next-generation bio-based chemicals and materials. Current research targets include: enzyme catalysts for polymer biorecycling/modification, engineering bacterial cellulose thickness/porosity/morphology for advanced material applications, bio-composites, scalable protease-catalyzed routes to polypeptides, lipase-catalyzed routes to bioresorbable polyesters and molecular editing of glycolipids to develop therapeutics. He has about 500 publications in peer reviewed journals, been cited about 29,000 times (h-index 90, i10-index 308); edited 11 books and has 26 patents (granted or filed). He was the recipient of the 2003 Presidential Green Chemistry Award in the academic category. In 2010, he was the Turner Alfrey Visiting Professor and in 2014, he became a Fellow of the ACS Polymer Division. He has directed NSF Industrial University Cooperative Research Centers in Biodegradable Polymers (1993-1998 and Biocatalysis/Bioprocessing of Macromolecules (2001-2017). In 2017, he received the lifetime achievement award by the Bioenvironmental Polymer Society (BEPS). In 2019, he was the recipient of the ACS Award for Affordable Green Chemistry. He founded and Chaired the Inaugural Gordon Research Conference on Biomass to Biobased Chemicals and Materials Jordan Hotel at Sunday River (7/14/2019 - 7/19/2019). In January of 2022, he assumed the position of Editor in Chief of Industrial Biotechnology.

Prof. Dr. Stefaan De Wildeman graduated as a Bio-engineer (KU Leuven, 1998) and finished his PhD after discovering a new dehalorespiring bacterial species (Ghent University, 2002). He joined DSM in 2002 and increasingly explored new biobased building blocks (B4) for novel materials. From there, Stefaan co-developed the Master "BioBased Materials" and created the Chair of Building Blocks at Maastricht University. His hunger for social impact Made him the founder of B4Plastics – a polymer architecture company Designing novel polymeric backbones from new BioBased Building Blocks (B4), with highest speed and accuracy. Since 2020, B4Plastics joined the top-2% league of Green Deal Scale-Ups in Europe and became Winner of the Food Planet Prize 2021 – the biggest environmental award in the world today – for its breakthrough development of degradable fishing gear.

Prof. Dr. Claudia Schmidt-Dannert is a Distinguished McKnight Professor and Kirkwood Chair of Biochemistry in the Dept. of Biochemistry and the Director of the Biotechnology Institute at the University of Minnesota. She completed her B.S. and M.S. in Biochemistry and Genetics at the TU Braunschweig and performed her PhD research at the National Research Center for Biotechnology in Braunschweig. She then moved to the University of Stuttgart and became group leader of the Molecular Biotechnology Group in the Institute of Technical Biochemistry. In 1998, she received a habilitation-fellowship from the German Science Foundation for "molecular breeding of pathways" and with this project, joined Prof. Arnold's group at the Caltech. In 2000, she joined the faculty at the University of Minnesota. Current major efforts in her group focus on using synthetic biology approaches for the design of genetically programmable materials for biosynthesis, biocatalysis and other applications, including the fabrication living materials. Dr. Schmidt-Dannert has published numerous manuscripts, patents, and book chapters; serves as Editor and board member of several journals and received several awards such as a David and Lucile Packard Fellowship and McKnight Fellow- and Professorships.

ABOUT THE SPEAKERS

Prof. Dr. Lucia Gardossi, received her PhD in Medicinal Chemistry at the University of Trieste and spent two years as an associate researcher at MIT (Cambridge - USA) in the laboratory of Prof. Alexander Klibanov. Her research integrates experimental and computational approaches for the development of sustainable enzymatic processes applicable to industry. Between 2009 and 2012 she coordinated a scientific cooperation project between Europe and Russia for the rational development of industrial enzymes. In 2007 she was co-founder and scientific director of the university spin-off SPRIN SpA. In 2020 she was awarded the Tecnovisionarie International Award for the theme "Interpreting the circular economy through innovation", promoted by the Women and Technology Association. Since 2017 she has been a member of the board of the Italian Technology Cluster for Green Chemistry and Bioeconomy and she coordinates its Scientific and Technical Committee. She is active in various working groups at European and Italian level which aim to promote the bioeconomy and sustainable chemistry. In particular she was vice chair of the Advisory Group SC2 of the European Commission for the Horizon 2020 program and is currently a member of the Italian National Coordination Group for the Bioeconomy of the Presidency of the Council of Ministers.

Dr. Anamaria Todea received her PhD in Chemical Engineering in 2015 at University Politehnica Timisoara Romania under the supervision of Prof. Francisc Peter. Since February 2018 she held a lecturer position at the same university, performing research activities in the Biocatalysis Group and teaching bachelor and master students in chemical and food engineering. In March 2020 she gained an Associate Researcher position at University of Trieste, Italy in the Laboratory of Applied Computational Biocatalysis headed by Prof. Lucia Gardossi, currently being Principal Investigator of a Marie Sklodowska Curie Individual Fellowship in the Department of Chemical and Pharmaceutical Sciences. She has expertise in biotechnology and biocatalysis, mainly in enzymatic polyester synthesis based on renewable building blocks and development and characterization of stable and tailor-made biocatalysts, focused on covalent binding and sol-gel entrapment. Her research skills and scientific expertise were acquired in 7 prestigious International Institutions from Romania, Austria, Netherlands, Hungary, and Italy. During her research activities she has been involved in a series of multidisciplinary national and international collaboration with academia and industry.

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 webinar:

22nd April 2022 14.00-16.00 CET	Advances in the Analysis of Enzymatic Reactions organized by Roland Wohlgemuth and Jennifer Littlechild

HOW TO JOIN ESAB

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