Novel Biorefinery Concepts for a Biobased Economy

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The talk will deal with novel biorefinery concepts to realize a biobased economy. Conversion of biomass into chemical monomers and polymers is in the focus.
A crucial difference between plant biomass and mineral oil lies in the quantity and locality of its availability. While mineral oil and its primary products can be transported through pipelines in great quantities without any problems and at little cost, plant products accumulate in smaller amounts across large areas. Transport across long distances is energetically expensive and does not pay off. The advantages of biotechnological processes are that they require comparatively simple facilities. This fact enables smaller industries to operate locally where the biomass accumulates e.g. as agricultural leftovers. We are working on small scaled biorefinery concepts which will be realized in container scale with modular set up, to react on changing substrate conditions as well as market demand for products and to be put in place at local farmsteads. These small scaled biorefineries use pretreatment, fermentation and chemical conversion modules to fulfill adaption to existing needs. An important technical issue is the purification of the products from diluted aqueous solutions that come when working with biomass. One solution here is the production of gases from intermediates. Outgasing from fermentation broth with following gas purification is much more greener, easier and energy saving than the separation of different liquid products. Additionally the products, does not accumulate in the reaction vessel, whereby the productivity of the microbes is not limited by product-related toxicity. No distillation is required to extract the final product from the aqueous solution in the bio-reactor. There are already promising results of strain improvement for efficient gas fermentations and many more will be realized in the near future. But even the used gaseous separation techniques are in the need of optimization and make high demands on reactor design and safety aspects. Most of the valuable gases for further chemical treatment are explosive or flammable, what raises new aspects of materials used and explosion control. The use of micro-reaction technique is essential for the handling of this “novel” kind of fermentation products and will enable a safe and efficient synthesis of none explosive, and therefore safe to store, intermediates directly after the fermenter. Thereby safety aspects as well as economical processes will be enabled, and a modular set-up on product side can be realized by variable micro-reactors used to synthesize different products from out of the gaseous substrates.

Another challenge in process optimization is the fermentational production of biogenic polymers such as microbial exopolysaccharides. These highly viscous products represent a challenge for fermentation process and down-stream processing. Up to now, solely less research is done in the field of fermenter design for microbial exopolysaccharides, as well as down-stream processing. We are working in these fields by use of different novel microbial exopolysaccharide producers. An overview of microbial exopolysaccharide production and their possible fields of application will be given.