Process Systems Engineering for sustainable Polyhydroxybutyrate (PHB) production

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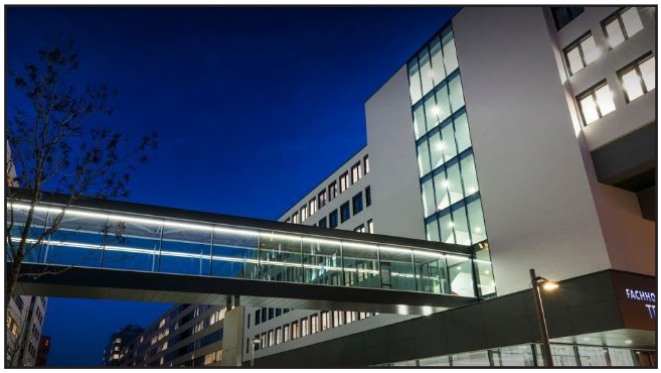
Abstract:

Polyhydroxybutyrate (PHB) is an established biopolymer, with the potential to replace PP to a significant extent, however, production from carbohydrates as practiced today is costly and not fully sustainable. A process systems engineering approach was followed to develop a process for PHB production using CO2 as sole carbon source. To this end, several mutants of Synechocystis sp. PCC 6714 were produced using accelerated natural mutation. In order to make an easily scalable, alternative approach to the normally done two-step process -comprising of growth phase and a limitation phase- a one-step cultivation was optimized. The multivariate experimental design approach was used for the optimization of the one-step, self-limiting media. During one-step cultivation of mutant MT_a24 with optimized media 30 ± 4 % dry cell weight PHB, corresponding to 1.16 g L-1 PHB, was obtained. Using pulse experiments it could be shown that phosphate is the key driver of glycogen synthesis in Synechocystis sp. PCC 6714 and it can be used to boost glycogen productivity. The maximum glycogen content acquired was 2.6 g L-1 for mutant MT_a24 using phosphate feeding and CO2 as an only carbon source. PHB from CO2 can become a cost-effective and sustainable commodity polymer, being biobased and biodegradable. A potential novel application is as oil binder.

Biography:

Dr. Maximilian Lackner MBA earned his PhD from Vienna University of Technology in 2003. He completed his habilitation in 2009. From 2004 to 2011, he worked in the polymer industry in Austria and China in several senior leadership positions. In 2011, Dr. Lackner founded a company for anti-microbial polymers.



Publication of speakers:

- G. Totschnig, M. Lackner, R. Shau, M. Ortsiefer, J. Rosskopf, M.-C. Amann, et al., " High-speed vertical-cavity surface-emitting laser (VCSEL) absorption spectroscopy of ammonia \$({rm NH}_{3})\$ near 1.54 \$mu {rm m}\$ ", Appl. Phys. B, vol. 76, pp. 603-608, 2003.
- L. S. Rothman, "The HITRAN 2004 molecular spectroscopic database", J. Quant. Spectrosc. Radiat. Transfer, vol. 96, pp. 139-204, 2005.
- M. E. Webber, D. S. Baer and R. K. Hanson, " Ammonia monitoring near 1.5 \$mu {rm m}\$ with diode-laser absorption sensors ", Appl. Optics, vol. 40, pp. 2031-2042, 2001.
- H. P. Zappe, M. Hess, M. Moser, R. Hvel, K. Gulden, H.-P. Gauggel, et al., "Narrow-linewidth vertical-cavity surface-emitting lasers for oxygen detection", Appl. Optics, vol. 39, no. 15, pp. 2475-2479, 2000.
- M. Maute, B. Kgel, G. Bhm, P. Meissner and M.-C. Amann, " MEMS-tunable 1.55 \$mu {rm m}\$ VCSEL with extended tuning range incorporating a buried tunnel junction ", IEEE Photon. Technol. Lett., vol. 18, pp. 688-690, 2006

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