PreSens
PRECISION SENSING

Scientific Paper:

Bioengineering (2022) 9, 204

Lab-Scale Cultivation of *Cupriavidus necator* on Explosive Gas Mixtures: Carbon Dioxide Fixation into Polyhydroxybutyrate

Vera Lambauer[1,2] and Regina Kratzer[1,2]
[1]Austian Centre of Industrial Biotechnology (ACIB), Graz, Austria
[2]Institute of Biotechnology and Biochemical Engineering, Graz University of Technology, NAWI Graz, Graz, Austria

Abstract:

Aerobic, hydrogen oxidizing bacteria are capable of efficient, non-phototrophic CO_2 assimilation, using H_2 as a reducing agent. The presence of explosive gas mixtures requires strict safety measures for bioreactor and process design. Here, we report a simplified, reproducible, and safe cultivation method to produce *Cupriavidus necator* H16 on a gram scale. Conditions for long-term strain maintenance and mineral media composition were optimized. Cultivations on the gaseous substrates H_2, O_2, and CO_2 were accomplished in an explosion-proof bioreactor situated in a strong, grounded fume hood. Cells grew under O_2 control and H_2 and CO_2 excess. The starting gas mixture was H_2:CO_2:O_2 in a ratio of 85:10:2 (partial pressure of O_2 0.02 atm). Dissolved oxygen was measured online and was kept below 1.6 mg/L by a stepwise increase of the O_2 supply. Use of gas compositions within the explosion limits of oxyhydrogen facilitated production of 13.1±0.4 g/L total biomass (gram cell dry mass) with a content of 79±2% poly-(R)-3-hydroxybutyrate in a simple cultivation set-up with dissolved oxygen as the single controlled parameter. Approximately 98% of the obtained PHB was formed from CO_2.

Keywords: non-phototrophic CO_2 assimilation, Knallgas cultivation, Chemolithotrophs, ATEX compliant bioreactor, dissolved oxygen control