Optimization of PolyHydroxyAlkanoate Bioelectrosynthesis by the thermophilic bacterium Kypridia spormannii

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The electrosynthesis of valuable compounds by biofilms on electrodes is intensively studied since few years. However, the actual biofilms growing so far on cathode produce mainly small inexpensive compounds such as acetate or ethanol. A novel Knallgas bacteria, *Kypridia spormannii* have been recently described to grow on cathode in thermophilic and microaerophilic conditions, producing significant amount of PolyHydroxyAlkanoates (PHAs) (Reiner et al., 2018). These PHA are promising sustainable bioplastic polymers with the potential to replace petroleum-derived plastics in a variety of applications. However, the effect of culture conditions and electrode properties on the growth of *K. spormannii* biofilm and PHA production is still unclear.

We present in this study the successful development and operation of autotrophic biocathode whereby the electroactive biofilm was able to grow by utilizing CO$_2$ and a cathode as the sole carbon and electron source, respectively. We report for the first time, the effect of operating conditions of the Bioelectrochemical system (BES), cathode materials and cathode surface modification on current consumption, biofilm formation, PHA productivity and overall coulombic efficiency of a *K. spormannii* culture growing on electrodes. In particular, the focus of this study lies on optimization of three main operating conditions, which are the applied cathode potential, pH buffer and the oxygen concentration in the feed gas. Increased biofilm formation and PHA production was observed at an applied potential of -844mV vs. SCE, pH 6.5, O$_2$ saturation of 2.5%, and for a graphite cathode modified by CO$_2$ activation. The PHA concentration in the biofilm reached a maximum of ≈40 μg·cm$^{-2}$ after optimization. The resultant PHA yield reported after optimization is increased by 12.2 times in comparison to previous results. In conclusion, these findings take microbial electrosynthesis of PHA a step forward towards practical implementation.