Towards an aerobic, thermophilic electrosynthesis process for the production of polyhydroxyalkanoates (PHAs)

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Electroautotrophic microorganisms thrive using a cathode as electron and energy source and couple this to the simultaneous fixation of carbon dioxide. This process has the potential of providing a future technology using carbon dioxide as a feedstock and addressing the demand of storage solutions for excess electrical energy. From a thermophilic cathodic enrichment we isolated a novel electroautotrophic species belonging to the physiological group of the Knallgasbacteria. Using this strain as a model organism for electroautotrophic growth and a biocatalyst in a bioelectrochemical system, our aim is to establish a biotechnological process for the production of PHA from carbon dioxide and electrical energy. The isolate was found to be a novel species of the genus *Kyrpidia*. In an inoculated microbial electrosynthesis cell, current densities up to -95 µA/cm^2 were observed, in contrast to a sterile control showing a current density of -25 µA/cm^2. SEM pictures of a cathode poised at -500 mV vs. SHE showed a distinctly higher cell number than the micrographs of a control electrode. For a deeper understanding of the molecular mechanisms behind this process, transcriptomic studies were conducted and the results indicate a specific physiological answer towards growth on cathode surfaces. However, further studies are required to elucidate the mechanism of electron uptake by the novel *Kyrpidia* species. To harvest the capability of the microorganism to produce PHA from CO_2, we designed a scalable bioreactor based on the idea of a rotating disc reactor, which allows the cells to be fed with sufficient amounts of carbon dioxide and oxygen.