Electrocatalytic Reduction of Carbon Dioxide to Carbon Monoxide or Formate by Enzymes in *Clostridium thermoaceticum*

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Enzymes and microbial cells can be used as catalysts. Carbon dioxide could be electrochemically converted to carbon monoxide or formate with high efficiency by the enzymes in *Clostridium thermoaceticum*. In the presence of CODH (Carbon Monoxide Dehydrogenase), carbon dioxide reduction to carbon monoxide occurs around -570 mV vs. NHE (only ~100 mV overvoltage) with 100 % current efficiency. Turnover number is 700 h^{-1} and pH optimum is 6.3. If *Clostridium thermoaceticum* itself or a mixture of enzymes from it was employed, formate, CO, and H_2 were produced together and formate was the major product with 50~80 % current efficiency.