**Tandem CO2 Electrolysis System for Chemical Production**

**Abstract:**

As our society faces the pressing challenges of climate change and global warming, driven in part by increasing atmospheric CO2 levels, reducing CO2 emissions has become a critical mission in the pursuit of a sustainable future. Traditional chemical industry processes often rely on fossil fuels, which inevitably emit substantial quantities of CO2. In response, electrochemical processes have garnered interest for their potential to be more environmentally friendly and exhibit a smaller carbon footprint when powered by renewable energy sources.

Our research group is currently dedicated to the development of CO2 electrolysis devices that convert CO2 into value-added chemicals and fuels through innovative electrocatalyst design and reactor engineering. In this presentation, we will showcase our recent work on a two-step tandem CO2 electrolysis system. We have reported an internally coupled purification strategy that significantly enhances acetate concentration and purity in CO electrolysis. This approach employs an alkaline-stable anion exchange membrane with high ethanol permeability and a selective ethanol partial oxidation anode to regulate the CO reduction product stream.

We successfully demonstrated a stable 120-hour continuous operation of the CO electrolyzer at a current density of 200 mA cm-2 and a full-cell potential of less than 2.3 V, consistently producing a 1.9 M acetate product stream with a purity of 97.7%. This performance is among the best reported in the literature [1]. The ability to convert CO2 into acetate has opened up the possibility of developing an electrochemical-biological hybrid approach to produce food from CO2, offering much higher efficiency than natural photosynthetic pathways [2].

References:

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2. E. C. Hann, S. Overa, M. Harland-Dunaway, A. F. Narvaez, D. N. Le, M. L. Orozco-Cardenas, F. Jiao\* and R. E. Jinkerson\*. A hybrid inorganic-biological artificial photosynthesis system for energy-efficient food production. Nature Food 3, 461 (2022). 10.1038/s43016-022-00530-x