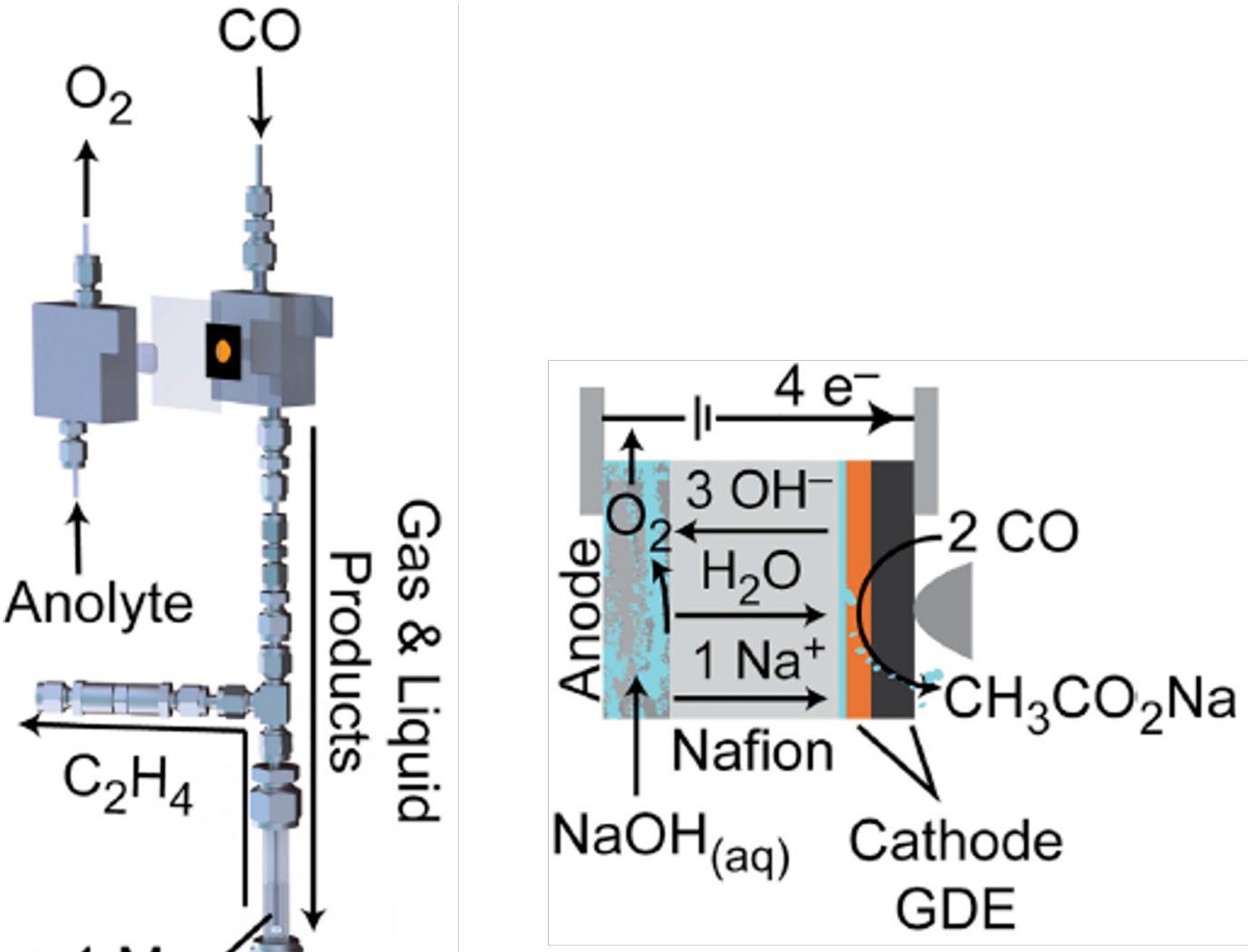
Docket #: S18-314

Electrolysis Cell for Concentrated Chemical Product Streams from CO or CO2

Stanford researchers in the Kanan group have developed a patented electrolysis cell for generating and extracting concentrated liquid and gas product streams from CO and CO_2. Prior C_{2+} products electrosynthesis designs suffer from dilute product streams due to low single-pass conversion, compounded by the challenge of managing mixed-phase products (gaseous ethylene alongside liquid products like acetic acid, ethanol, propanol, etc.). To overcome this, the cell combines interdigitated flow fields, gas diffusion electrodes (GDEs), and a Nafion membrane to simultaneously achieve high current density (100 mA cm?²), high selectivity, and high single-pass CO conversion (68%) at moderate cell voltages. The Nafion membrane transports concentrated liquid products (up to 1.1 M sodium acetate) away from the GDE while remaining easily isolated from the gas product stream. This design improves water/ion flux efficiency at the electrode to extract concentrated product streams, with potential for scale-up and extension to CO_2 electrolysis.



Gas diffusion electrode cell configuration and charge flow schematic
(Image courtesy Ripatti et al. Joule (2018)).

Stage of Development - Prototype

The Kanan group demonstrated >100 mA/cm^2 CO reduction to C_{2+} products and direct production of 1.1 M acetate at a cell potential of 2.4 V over 24 hours using a cell with the GDE directly contacting a Nafion membrane.

Applications

- Synthesis of isotopically-labeled compounds
- Feedstock synthesis for resource-constrained environments (e.g., potassium acetate growth media)
- Carbon capture and conversion (CO/CO_2 utilization)

Advantages

- High conversion rates of CO to C_{2+} products (~849 µmol/cm^2h C_{2+} products)
- High single pass conversion of 68%, which avoids typical CO_2 electrolysis low-conversion limitation
- High faradic efficiency of 75% for CO reduction at 100 mA/cm^2 (operates at low cell voltages)

Publications

- Ripatti, D. S., Veltman, T. R., & Kanan, M. W. (2019). Carbon monoxide gas diffusion electrolysis that produces concentrated C2 products with high single-pass conversion. *Joule, 3*(1), 240-256. DOI: 10.1016/j.joule.2018.10.007

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