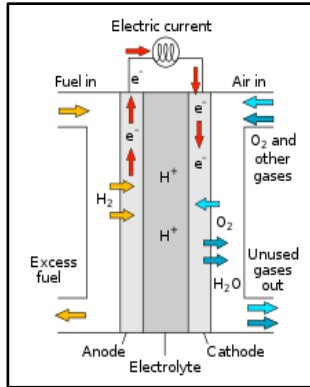


Cavity Microelectrodes to Study Fuel Cell Fe-N-C Cathode Catalysts

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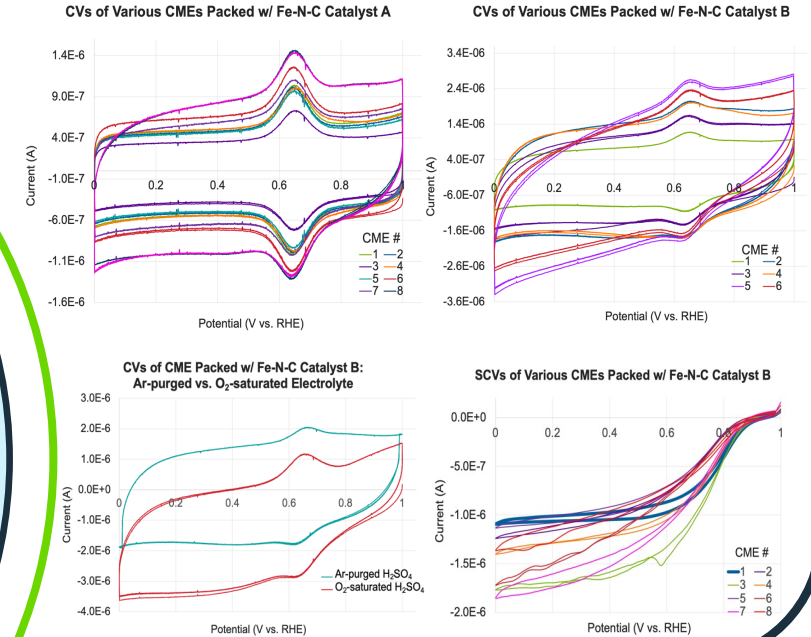
Introduction



- Fuel cells electrochemically convert $O_2 + H_2 \rightarrow$ electricity + H_2O
- * Anode: $H_2 \rightarrow 2H^+ + 2e^-$ ($E_r = 0\text{ V}$)
- * Cathode: $\frac{1}{2}O_2 + 2H^+ + 2e^- \rightarrow H_2O$ ($E_r = 1.23\text{ V}$)
- Oxygen reduction reaction (ORR):** kinetically slow rxn, underscoring the value of developing cathode catalyst materials
- Fuel cells usually use costly Pt catalysts
- Fe-N-C catalysts:** best Pt-group metal (PGM)-free cathodes
- Rotating Ring Disk Electrode:** traditional characterization method for ORR catalysts, but requires additives \rightarrow
- Need to improve **catalysts** and **characterization means**

Results and Data

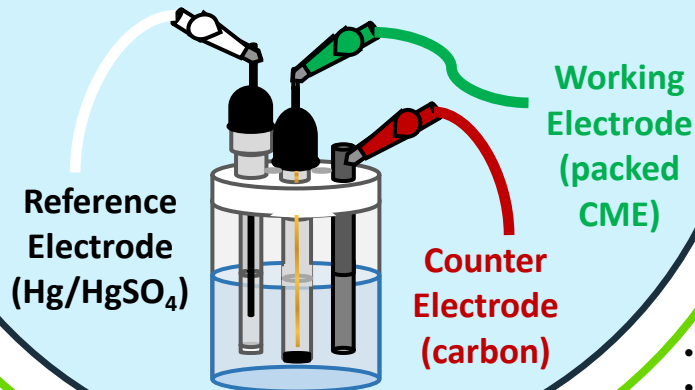
**Catalyst Synthesis Details: A and B were synthesized at ANL, using Fe_2O_3 precursors of size 5 nm and 20-30 nm, respectively. **



Research Highlights

With **cavity microelectrode (CME)s**, can Fe-N-C catalysts be **reproducibly** tested in powder form to evaluate their performance toward the ORR?

What testing parameters affect the reproducibility of these catalysts' electroactivities?



Materials And Methods

Packing

Testing

Unpacking

- "Mortar-and-pestle" method to push catalyst powder into cleaned cavity
- Cavity tip then wiped off with X-Acto knife
- Ar-purged (bckgrd.) or O_2 -saturated 0.5 M H_2SO_4 (ORR) electrolyte
- Cyclic voltammetry (CV)
- Staircase voltammetry (SCV)
- Sequential sonication:
 - Organic solvent;
 - Dilute acid;
 - H_2O ;
 - Organic solvent
- Drying with heat gun
- CV to verify complete catalyst powder removal from cavity

Conclusions

- CMEs** can be **consistently packed** and **cleaned** to permit re-use
- Background CVs** and **ORR** properties were broadly **reproducible**
- Slight variations may have resulted from insufficient catalyst packing and the degradation of the catalyst material over time

Future work can continue testing CMEs with different PGM-free catalysts; develop high-throughput cells to test multiple catalysts; and quantify catalyst packing via microscopy