Insights into the electrochemical reduction of CO$_2$ on tin electrodes

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Sn Electrodes for CO₂ Reduction

Motivation: Why CO₂ Reduction?

Identifying Questions to Answer

Design & Execution

Analysis of Results

Key Findings & Takeaways

Summary
It makes sense **economically**

**Oil refineries** (hydrogen)

- tCO₂ / yr: 20M
- Value: $10B

**Corn ethanol** (fermentation)

- tCO₂ / yr: 45M
- Value: $18B

**Natural gas** fields (CO₂ removal)

- tCO₂ / yr: 32M
- Value: $12B

$30-40 billion left on the table

Calculations provided by Opus 12
Electroreduction of CO$_2$

**Key areas to improve**

- Selectivity
- Activity
- Stability
- Energy efficiency

Products formed from CO₂

Key Question
Why is tin (Sn) such a good catalyst for formic acid production?

Calculations provided by Opus 12
Custom Electrochemical Cell

CO$_2$ reduction on Sn electrodes

How does CO$_2$ reduction on Sn compare to other metals?

Feaster, J.T., et al. *In prep.* 2015
Understanding Sn CO$_2$ reduction

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Putting it all together
Summary

✓ Thoroughly investigated Sn CO₂ reduction as a function of potential

✓ Identified the primary factor for high selectivity for formate production on Sn (optimal *OCHO binding energy)

✓ Proposed a mechanism that takes into account both oxygen and carbon binding energies
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Questions