An Intensified Electro-Catalytic Process for Production of Formic Acid from Power Plant CO₂ Emissions

FE-00031720

Jesse Thompson and Kunlei Liu

University of Kentucky - Center for Applied Energy Research
http://www.caer.uky.edu/powergen/home.shtml
Project Overview

• Develop and test a novel electro-catalytic method for the production of high-value formic acid from coal-derived CO₂ as a strategy to offset the cost of CO₂ capture.

• The project will involve the development and testing of an engineered catalyst to selectively reduce CO₂ directly and exclusively to formic acid, along with process intensification aspects of the reactor design.

• **Project Period:** 1/1/2019 - 6/30/2021 (30 months)

• **Funding:** Federal - $800K; CS - $201K; Total - $1M
Technology Background

UKy-CAER Andora Process

To provide a selective and robust process, the UKy-CAER Andora process focuses on:

1. Use of a charge transfer mediator to limit the cell voltage and degradation pathways of the electrochemical process
2. Separate charging and formic acid production reactors/cells to effectively encapsulate the catalyst and provide a steady stream of formic acid
Technology Background

UKy-CAER Andora Process

Oxidized Methyl Viologen (MV) enters reduction cell;
When MV is reduced it changes from clear to dark blue.
## Project Summary

<table>
<thead>
<tr>
<th>Task</th>
<th>Timeline</th>
<th>Status/Success Criteria</th>
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</thead>
<tbody>
<tr>
<td>Technology Maturation Plan</td>
<td>-</td>
<td>Initial TMP competed; will continue to update during project</td>
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<tr>
<td>Development of catalysts</td>
<td>Initial 24 months</td>
<td>Long term stability (less than 25% deactivation) at &gt;100hr of continuous operation and formic acid production</td>
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<tr>
<td>Flow-through reactor design, fabrication and commissioning</td>
<td>Initial 24 months</td>
<td>Electrochemical cell carrier charge efficiency of greater than 60%; Production cell capable of supporting flow rate of 2 mL/min during continuous operation</td>
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<td>Lab-scale reactor testing</td>
<td>Initial 24 months</td>
<td>Continuous operation of reduction and production cells with a formic acid production of 25 mM and a selectivity of greater than 80%</td>
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<td>Life Cycle and Technical and Economic studies</td>
<td>Final 6 months</td>
<td>Demonstrate the proposed process to be a substantive CO₂ mitigation option</td>
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Acknowledgements

- Andy Aureillo

- Professor Yong Hwan Kim

- UKy-CAER Team: James Landon, Ayo Omosebi, Daniel Moreno, Keemia Abad