AIR2CO2: Advanced Integrated Reticular Sorbent-Coated System to Capture CO_2 from the Atmosphere

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Program Overview

$1 MM program (20% cost share)

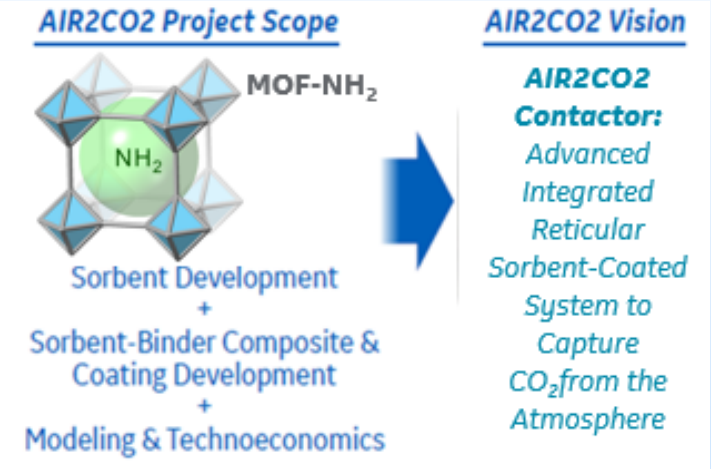
15-month program: 10/1/2020 to 12/31/2021

Project Participants:

- GE Research
- University of California, Berkeley

Overall Project Objectives:

Demonstrate AIR2CO2 material system that integrates pioneering metal-organic framework (MOF) sorbents and sorbent-binder composite coatings to capture and release atmospheric CO_2.



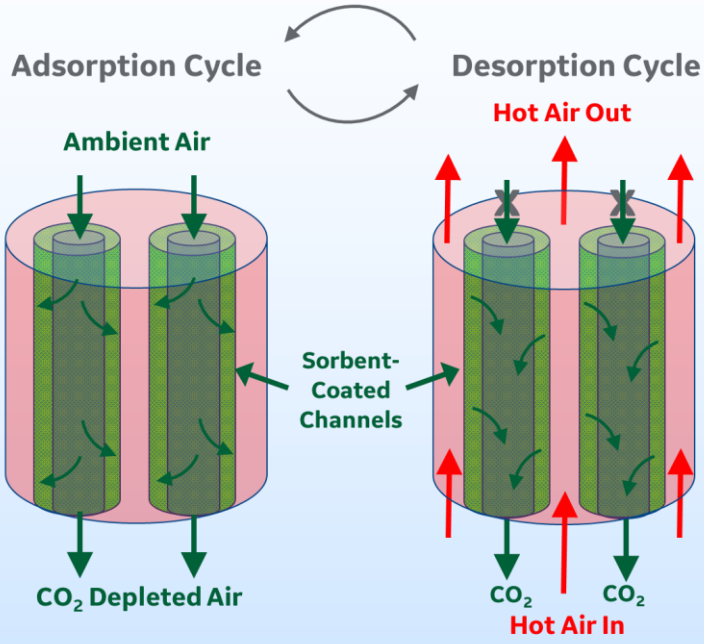
GE Research

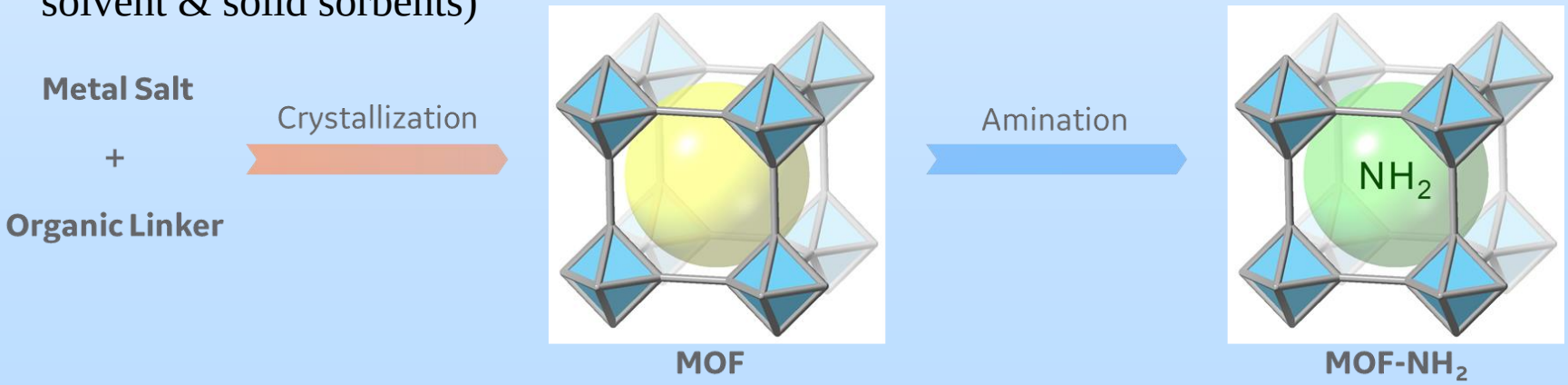
Berkeley UNIVERSITY OF CALIFORNIA

Technology Background

Two contactors operate in alternating adsorption and desorption modes to continuously remove CO_2 from air. Technical/economic advantages include:

- high amine loading of MOFs (3.3 gmol/kg)
- high thermal stability inherent to MOFs
- MOFs can be designed to exhibit high hydrolytic stability
- High CO_2 capacity, fast sorption kinetics, and novel contactor designs would reduce energy requirements by 60-70% vs state of the art DAC systems (liquid solvent & solid sorbents)





Technical Approach/Project Scope

Experimental design and work plan

Develop a sorbent-binder formulation that provides an adherent, thermally-stable coating to efficiently capture CO_2 from a simulated air stream under DAC relevant conditions.

Project schedule

- Manufacture 1 kg of benchmark sorbent
- Build AIR2CO2 lab-scale test apparatus
- Develop sorbent-binder composite coating
- Develop system and techno-economic models
- Integrate next generation sorbent-binder composite coating into contactor structure

Project success criteria

Demonstrate DAC performance with improved adsorption equilibrium loading, lower heat of desorption, and rapid sorption kinetics to enable a scalable, compact AIR2CO2 contactor design that reduces equipment size and pressure drop, and results in 60-70% lower energy requirements than current state-of-the-art solutions.

Team and Facilities

GE Research


Dr. David Moore
PI


Dr. Vitali Lissianski

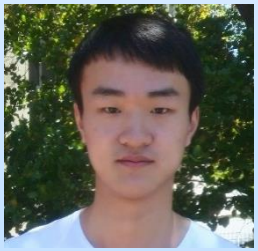

Dr. Mark Doherty


Mr. Dan Erno

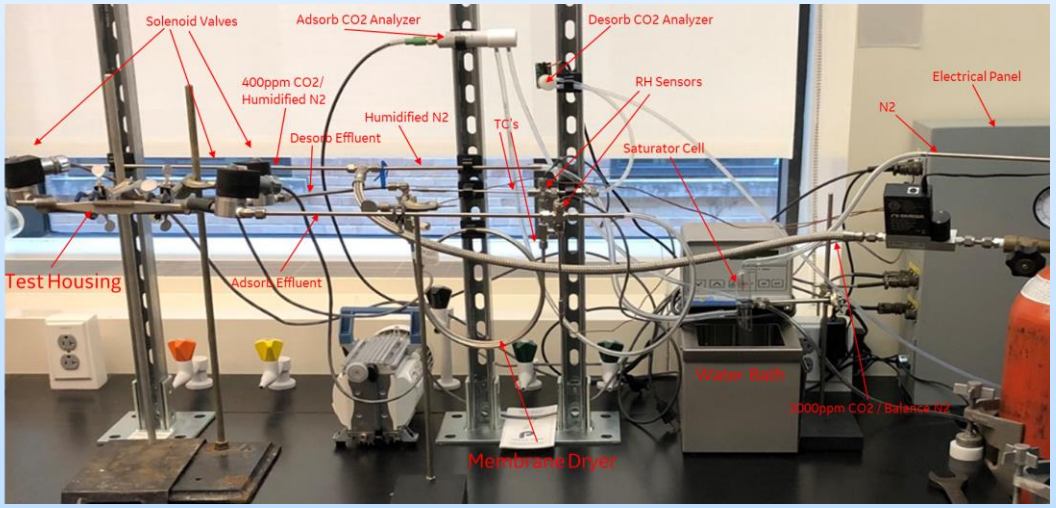

Mr. Mark Buckley

UC Berkeley


Prof. Omar Yahgi
Co-PI


Mr. Hao Lyu


Mr. Oscar Chen



AIR2CO2 Test Apparatus

Progress and Current Status of Project

Test Equipment:

AIR2CO2 lab-scale test apparatus designed and assembled at GE Research for evaluation of MOF-binder composite formulations under DAC relevant conditions.

Significant accomplishments:

- 1 kg benchmark MOF successfully scaled
- Next generation, high capacity sorbent under development
- AIR2CO2 lab-scale test apparatus commissioned
- Coating formulation and process development ongoing

Performance achieved so far:

Leading MOF-binder composite formulations exhibit only a ~20% decrease in sorption capacity versus the powdered sorbent. This is consistent with projected performance of the envisioned AIR2CO2 contactor relative to the powdered MOF as outlined in the state point data table.

Opportunities for Collaboration

Synergistic effects of collaboration:

Integration of other high-capacity sorbents into novel contactor geometries would provide multiple pathways to advance the technology.

Potential areas for collaboration:

Sorbent manufacturing and scale-up

Multi-component sorption measurements and modeling

Artificial intelligence-guided molecular screening

Systems design and integration

End-user applications, including CO_2 sequestration and utilization (fertilization, food & beverage, sustainable aviation fuels)