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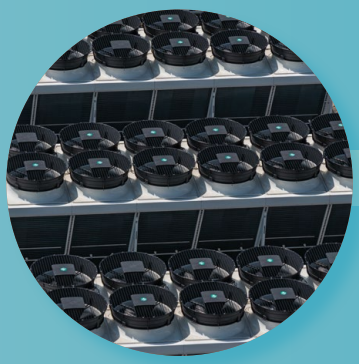
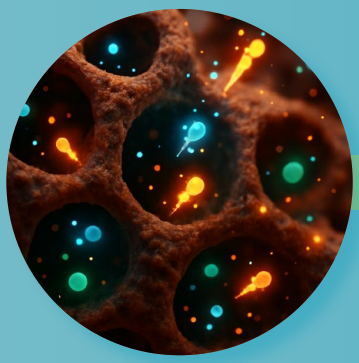
Optimize Porous Material Performance & Predict Real-World Behavior



Vapour & Gas Sorption Isotherms

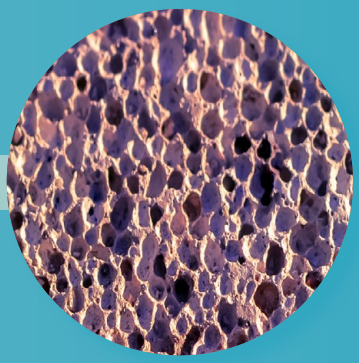
Sorption Kinetics

Surface Energy & Heterogeneity



Thermodynamic Properties

Pore Volume & Distribution



BET Surface Area

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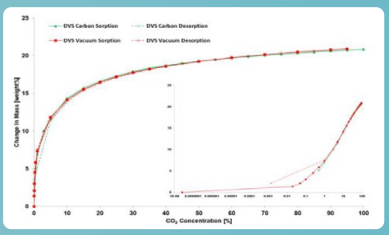
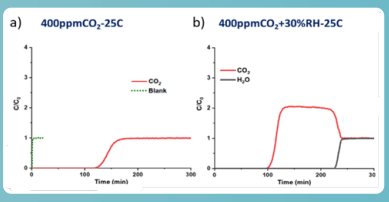
Empowering Porous Materials Optimization for the World's Leading Research Organizations

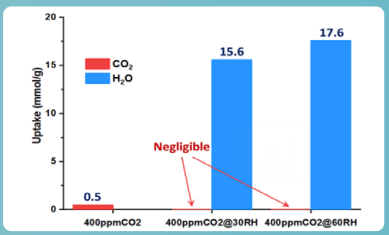
Our Instruments in Action



Sorption & desorption isotherms of CO_2 on Zeolite 13X using the DVS Carbon & DVS Vacuum. In the bottom right is the sorption plotted on a log scale



Breakthrough curves of zeolite 13X at 400 ppm and 25 °C at (a) 0% RH(b) 30% RH



Uptake of CO_2 and H_2O by zeolite 13X at a concentration of 400 ppm CO_2 and a temperature of 25 °C, with varying relative humidity

Case Study 621

The Problem: The study investigates the performance of Zeolite 13X for Direct Air Capture (DAC) of CO_2 at atmospheric levels (~400 ppm). While Zeolite 13X is cost-effective and exhibits high CO_2 affinity, its performance in real-world conditions—especially under humidity—is poorly understood and crucial for evaluating its true potential in DAC systems.

The Techniques:
- Dynamic Vapor Sorption (DVS)
- Breakthrough Analysis (BTA)

The Research: Experiments using DVS Carbon, DVS Vacuum, and BTA Frontier instruments assessed CO_2 and H_2O sorption behavior of Zeolite 13X at various humidity levels, temperatures, and CO_2 concentrations representative of ambient air.

The Results: Zeolite 13X effectively captures CO_2 at low concentrations in dry conditions (0.34–0.36 mmol/g). However, increasing humidity drastically reduces CO_2 uptake, with near-zero uptake at 60% RH due to competitive water adsorption. This highlights significant limitations for real-world DAC use unless humidity is controlled or compensated in process design.

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