# Composite aerogel for efficient CO2 adsorption from flue gas

Novel composite aerogel maintaining its performance over 20 regeneration cycles.

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**A composite aerogel for efficient $CO_2$ adsorption, utilizing $MnO_2$ functionalized electrochemically exfoliated graphene (MEEG) crosslinked with chitosan (CS).**

**The MEEG-CS aerogels feature a unique honeycomb structure and electrical conductivity facilitates direct electrical heating, resulting in rapid regeneration times.**

**This aerogel exhibited a $CO_2$ adsorption capacity of 3.94 mmol $g^{-1}$ and a selectivity of 65.2, maintaining its performance over 20 regeneration cycles.**

**Provisional patent filed.**

## Background

There has been an increased demand in recent years for $CO_2$ capture and storage technologies, due to the well-known shifting towards a net-zero emissions world. $CO_2$ adsorption materials have gained popularity as an economical capture strategy in large-scale development. Conventional materials such as activated carbon, organic polymers, zeolites, and metal-organic frameworks (MOFs) are limited, as they are susceptible to corrosion and use toxic reagents.

Aerogels are advantageous over conventional materials due to their mechanical properties, low density, and large surface area, allowing for efficient $CO_2$ adsorption. This innovative approach offers additional advantages, including enhanced adsorption capacity, improved kinetics, and potential for regeneration and reusability. By optimizing the composition and structure of composite aerogels, researchers aim to develop cost-effective and energy-efficient solutions for carbon capture and storage, contributing to mitigating greenhouse gas emissions and addressing climate change challenges in industrial processes.

## Competitive Advantages

- Excellent $CO_2$ adsorption capacity of 3.94 mmol $g^{-1}$ and a selectivity of 65.2 over 20 regeneration cycles.
- Exceptional high thermal (above 200°C) and water stability (RH>99%).
- Increased energy savings and rapid regeneration times due to high electrical conductivity (18.4 ± 0.2 S $m^{-1}$).
- Long-term reliability and durability ensured by excellent mechanical properties, including compression strength, flexibility, and ability to stand independently.

## Areas of Application

- Industrial Carbon Capture Systems
- Greenhouse Gas Removal from Ambient Air
- Portable Carbon Capture Devices
- Enhanced Oil Recovery (EOR)

## Publication and Resources

- Publication: Sustainable $CO_2$ adsorbent via amine–phosphate coupling of glycated chitosan and electrochemically exfoliated graphene
- Researcher Profile: Dr. Giovanniantonio Natale
- Lab website: Complex Fluids Lab

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