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Biomimetic Sorbents for CO2 Capture

A multidisciplinary team of Stanford researchers have developed a new class of tunable, zinc-based sorbents that use catalytic carbonate chemistry to efficiently capture carbon in the presence of water vapor. This biomimetic sorbent simulates the function of carbonic anhydrase, a natural enzyme for hydrating and dehydrating carbon. The functionalized substrate is designed to capture carbon from flue gas 6-8 orders of magnitude faster than conventional amine scrubbing technologies, without the energetic expense of heating water. Also, because the carbon capture is a chemical mechanism (compared with zeolite or metal-organic framework-based sorbents with a physical adsorption mechanism), they do not require an additional step to separate water from CO_2. These scalable biomimetic materials are particularly well-suited to capture carbon in coal-fired or natural gas power plants with significant water vapor in the flue gas.

Stage of Research
The inventors have synthesized and tested several functionalized sorbents for proof-of-principle studies.

Applications

- **Sorbent-based carbon capture** for coal-fired or natural gas process power plants

Advantages

- **Efficient adsorption kinetics:**
  - designed to capture carbon up to 6 orders of magnitude faster than conventional amine scrubbing technologies
  - selectively removes CO_2 from flue gas in the presence of water

- **Energy efficient** - no water needed (compared with amine scrubbing where heating water is the greatest energetic expense)
- **Tunable** - flexible tuning of the mesoporous structure can optimize the material for different applications and capture conditions
- **Scalable** - substrate is high surface area mesoporous carbon-based material with high working capacity
- **Simple regeneration:**
    - easy heat transfer
    - compared with physical adsorption mechanisms, this biomimetic substrate does not require an additional step to separate water from CO_2

Patents

- Published Application: 20140286844
- Issued: 9,155,996 (USA)

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