PHASE CHANGE ADSORBENTS FOR STORAGE AND SEPARATION APPLICATIONS

Tech ID: 33265 / UC Case 2024-007-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	12,643,087	06/02/2026	2024-007

BRIEF DESCRIPTION

UC Berkeley researchers have engineered a class of metal-organic frameworks (MOFs) that undergo a reversible, structural phase change from a collapsed state to an expanded state. These MOFs feature a unique "breathing" mechanism that results in stepped adsorption isotherms. Unlike traditional adsorbents that saturate gradually, these frameworks remain closed until a specific threshold pressure is reached, at which point they expand to provide high-capacity storage. A key innovation of this technology is its tunability; by substituting nitrogen for carbon in the aromatic rings of the ligands (such as pyrazolate-based ligands), the researchers can precisely shift the step pressure position. This allows the material to be customized for the capture and release of specific gases based on targeted operating pressures and temperatures.

SUGGESTED USES

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Carbon Capture and Sequestration: Selectively capturing CO2 from industrial flue gas streams at specific pressures while minimizing the energy required for release.

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Natural Gas and Hydrogen Storage: Providing high-density storage for fuel-cell vehicles, where the stepped isotherm allows for more efficient delivery of gas at usable pressures.

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Hydrocarbon Separations: Efficiently separating isomers or similar gases in petrochemical refining by tuning the framework to expand only in the presence of specific molecules.

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Specialty Gas Purification: Removing trace contaminants from industrial gases by leveraging the threshold-gating mechanism of the collapsed state.

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Thermal Energy Storage: Utilizing the heat of adsorption/desorption associated with the phase change for compact thermal management systems.

ADVANTAGES

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Tunable Selectivity: The ability to adjust the nitrogen content in the ligand rings allows for "bespoke" adsorbents designed for specific industrial pressure ranges.

»

High Working Capacity: The sharp "step" in the isotherm maximizes the amount of gas that can be stored and subsequently released between charge and discharge pressures.

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INVENTORS

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OTHER INFORMATION

CATEGORIZED AS

» **Energy**
» Other
» Storage/Battery
» **Materials & Chemicals**
» Chemicals
» Other
» **Research Tools**
» Other

RELATED CASES

2024-007-0

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Low Regeneration Energy: Because the material returns to a collapsed state upon desorption, it often requires less heat or vacuum to "reset" the material compared to rigid adsorbents.

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Structural Stability: The MOF maintains its integrity through repeated expansion and contraction cycles, ensuring a long operational lifespan.

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Material Versatility: Compatible with multiple transition metals, allowing for optimization of the chemical affinity for different guest molecules.

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Next-Generation Metal-Organic Frameworks With High Deliverable Capacities For Gas Storage Applications
- Porous Polymer Networks For Per- And Poly-Fluoroalkyl Substance Separations
- Selective Carbon Monoxide Uptake via Metal Carbanion Functionalized Metal-Organic Frameworks
- Structures and Apparatus using Three-Dimensional Linked Networks
- Gas Separations With Redox-Active Metal-Organic Frameworks
- Metal-Organic Frameworks For Aromatic Hydrocarbon Separations
- Novel Porous Organic Polymers for Ammonia Adsorption
- Isothermal Carbon Capture And Release Of Carbon Dioxide With Molecular Polyamines
- Selective Nitrogen Adsorption Using a Vanadium Metal-Organic Framework
- Metal-Organic Frameworks for H2 Adsorption and Drug Delivery
- Separation Of 1-Butene From 2-Butene Using Framework Open Metal Sites
- Redox-Active Metal-Organic Frameworks for the Catalytic Oxidation of Hydrocarbons

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