Complex Mixed Ligand Open Framework Materials
Tech ID: 29951 / UC Case 2009-554-0

SUMMARY
UCLA researchers in the Department of Chemistry and Biochemistry have developed a novel multifarious mixed functionalized metal-organic framework (MOF), which has been demonstrated to be successful in gas storage and separation.

BACKGROUND
Adding complexity and increasing the number of building units to crystalline structures usually leads to either mixed phases or amorphous materials. The addition of different links to zeolitic imidazolate and MOFs has been limited to two linkers. Post-synthetically, MOFs can be modified with four different functionalities, but variations in link ratios and functionalities in these systems have not been demonstrated. Controllable and facile synthesis of multifarious MOF materials that have greater than two different functional groups is essential for creating complex architectures, which can have applications in catalysis and gas storage and separation.

INNOVATION
Researchers led by Professor Omar Yaghi have developed a unique method to synthesize complex MOFs with up to eight different bridging ligands without creating mixed phases or amorphous materials. These multivariate (MTV) MOF structures have an ordered backbone but the distribution of functional groups is disordered within one crystal phase. Compared to MOF-5, which is known to uptake large amounts of gases, the hydrogen uptake of MTV-MOF-5-AHI is up to 85% greater. Similarly, MTV-MOF-5-EHI has shown to be 400% more selective for carbon dioxide over carbon monoxide. These complex pore environments not only have promising applications in gas separation and storage, but also could be explored for new and unusual properties for catalytic applications.

APPLICATIONS
- Catalysis
- Chemical separation
- Gas storage

ADVANTAGES
- Open framework with two or more different organic linkers with various chemical functionalities
- Complex architectures
- Multifarious materials
- Tuning of crystal for multiple catalytic reactions
- Selective separation of combinations of gases

STATE OF DEVELOPMENT
Several mixed link open framework materials have been synthesized and extensively characterized.

RELATED MATERIALS

PATENT STATUS

<table>
<thead>
<tr>
<th>Country</th>
<th>Type</th>
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<tr>
<td>Japan</td>
<td>Issued Patent</td>
<td>5698229</td>
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ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
- Multi-Dimensional Networks
- Catalytic Coupling Reactions Using Frameworks with Open-Metal-Sites
- Oxidative CH Activation of Non-Activated Alkanes Using Metal-Organic Frameworks (MOFs) as Catalysts
- Metallation of Open Frameworks
- Reversible Ethylene Oxide Capture in Metal Organic Frameworks (MOFs)
Gateway to Innovation, Research and Entrepreneurship

- Design and Synthesis of New Metal-Organic Frameworks (MOFs) With Unique Topologies
- Metal Triazolites
- Conductive-Organometallic Framework
- Adsorptive Gas Separation of Carbon Dioxide from Methane by Zeolitic Imidazolate Frameworks (ZIFs)
- BORGIS: Beyond Open Reticulated Geometries
- Carbon Dioxide Capture and Storage Using Open Frameworks
- Conductive Open Frameworks

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