Conductive Open Frameworks
Tech ID: 22314 / UC Case 2009-733-0

SUMMARY
UCLA researchers in the Department of Chemistry and Biochemistry have developed a 2D conducting covalent organic frameworks (COFs) with high charge carrier mobility. The multifunctional and conductive nature of the synthesized COFs in addition to its thermal stability, high-charge mobility, and pore accessibility enables for a wide range of applications in electronic devices.

BACKGROUND
A crucial characteristic of a semiconductor is the ability to control its electrical conductance, with charge carrier mobility being the most important property. In order to enhance the mobility of charge carriers in organic semiconductors, highly crystalline structures with close interactions between segments are essential. Furthermore, two-dimensional (2D) flat sheet structures constitute an ideal morphology for maximizing intermolecular interactions because they create a broad path for charge carriers moving from one sheet to another.

COFs are a class of porous crystalline materials constructed by the linkage of organic secondary building units through covalent bonds. 2D COFs are prepared by stacking the organic layers, resulting in electronic interactions between the different sheets. With electronic interactions between the layers, 2D COFs are a new class of conductive organic materials. This novel conductive organic materials exhibiting electronic and optoelectronic properties while being low cost, low weight, and easy to fabricate offers multiple applications in electronic devices.

INNOVATION
Dr. Omar Yaghi and colleagues at UCLA have synthesized two different 2D covalent organic frameworks (COFs) through laterally stacking covalently linked porphyrin units. The COFs have conductive properties with charge mobilities as high as 8.1 and 3.0 cm²V⁻¹s⁻¹. Such multifunctional conducting COFs in combination with the thermal stability, high charge mobility and pore accessibility enables applications towards many plastic electronics and optoelectronics.

APPLICATIONS
- Solar cells
- Fuel cells
- Functional electrical devices
- Catalysts for chemical reactions

ADVANTAGES
- Materials have high surface area as well as pore accessibility
- High stability associate with materials
- Easy reproducibility in synthesizing material
- High conducting efficacy arising from high electron/proton mobility

STATE OF DEVELOPMENT
Researchers have synthesized and characterized several semi-conductive open framework materials.

PATENT STATUS

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<td>Issued Patent</td>
<td>9,978,474</td>
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ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
- Multi-Dimensional Networks
- Catalytic Coupling Reactions Using Frameworks with Open-Metal-Sites
Gateway to Innovation, Research and Entrepreneurship

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