METAL-ORGANIC FRAMEWORKS FOR THE SEPARATION OF O_2 FROM AIR

Sandia National Laboratories

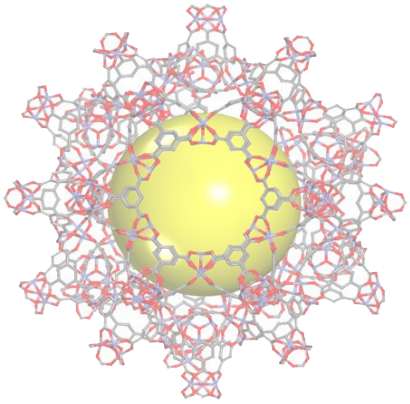
Patent Pending
Technology Readiness Level: 3-4
Basic technological components are integrated to establish that the pieces will work together

Pure molecular oxygen is important to many industrial processes such as oxy-fuel combustion, steel production, on-board oxygen generation in military aircraft and medical oxygen concentrators. Industrial-scale oxygen separation is conventionally carried out by cryogenic air separation. Cryogenic air separation produces high quality O_2 (99% oxygen purity), however, it is energy intensive, expensive and requires large housing facilities. A competing technology, pressure swing adsorption (PSA), can carry out O_2 separation on a smaller scale, but its application is limited to processes that require lower purity O_2. PSA processes rely on adsorbents such as zeolites, to capture N_2 from air, however, zeolites are costly, inefficient and unable to produce high oxygen purity.

Seeking a more effective alternative to zeolites, Sandia researchers looked to Metal-Organic Frameworks (MOFs). MOFs are crystalline, porous materials in which a metal center is bound to organic molecules by mild self-assembly chemical synthesis. During synthesis, MOFs can be modified to be highly selective for a certain molecule. The MOFs designed by Sandia researchers are designed to be highly selective for O_2 over N_2, resulting in the simultaneous separation of nitrogen and other air components from oxygen. When incorporated into the PSA process, MOFs have the ability to produce a purer form of oxygen, rivaling the purity from cryogenic air separation. MOFs offer better sorbent purity, fewer structural defects, and can store greater amounts of adsorbates compared to zeolites. Additionally, MOFs provide the ability to perform O_2 separation under mild conditions (ambient pressure and temperature), potentially revolutionizing the swing adsorption process and increasing the potential application fields.

TECHNICAL BENEFITS

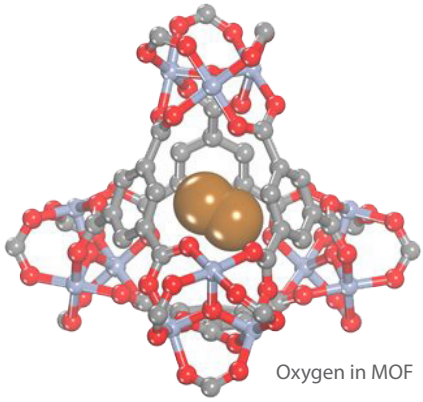
- Increased efficiency
- Reduced cost
- Can be implemented on a smaller scale
- O_2 separation at ambient temperature & pressure
- Produces high purity O_2



Mesoporous cages in MOF for O_2

INDUSTRIES & APPLICATIONS

- Stationary energy process
- Industrial machinery
- Oil & gas
- Medical
- Military
- Oxy-fuel



Oxygen in MOF

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