TECHNOLOGY OFFER:
NOVEL METAL-ORGANIC FRAMEWORK (MOF) MEMBRANES FOR H_2 SEPARATION

OVERVIEW

Category: Membrane ☑, Catalyst ☐, Reactor ☐, Process ☐, R&D knowledge ☑, Other ☐

Benefit summary: A thin-layer MOF membrane on a porous ceramic support can remove hydrogen from other gases. Example: The H_2/CO_2 separation factor is 70 – 80, the hydrogen permeance about 6 x 10^{-8} mol $m^{-2}s^{-1}Pa^{-1}$ for type ZIF-100 (room temperature). For Mg-MOF-74/ CPO-27-Mg, the H_2/CO_2 separation factor is 30 with a hydrogen permeance of 8 x 10^{-8} mol $m^{-2}s^{-1}Pa^{-1}$ (room temperature).

Development status: Discs of 2 cm diameter are available, first scale up experiments show that it is possible to grow the MOF layers on tubular ceramic supports.

IP status: No patents, but numerous published papers.

NOVELTY

- **Technology benefit description**: By using hydrogen-selective membranes as a supported thin MOF layer on porous alumina supports, hydrogen can be removed from gas streams or even under in situ reaction conditions at temperatures < 300 °C from chemical reactors. Examples are: Dehydrogenations, methane aromatization, methane coupling.
- **Technology uniqueness and comparison vs state-of-the-art**: There exist numerous hydrogen-selective membranes. Having a look into the Robeson plot (next page), it can be seen that the performance of our MOF membrane is above the line for the existing polymer membranes.

DEVELOPMENT

- **Technology Readiness Level**: TRL 1 ☐; 2 ☐; 3 ☐; 4 ☐; 5 ☐; 6 ☐; 7 ☐; 8 ☐; 9 ☐
- **Development status**: Tubular porous alumina discs of 2 cm diameter are available. These discs have been tested under lab conditions up to 200 °C. First scale up experiments show that it is possible to grow the MOF layer on tubular ceramic supports such as 1 cm porous ceramic tubes, or 1 mm hollow fibers.

INTELLECTUAL PROPERTY

Patent / application N°	Title	Countries	Status	Priority date
No patents				

TECHNOLOGY PROVIDER

- **Technology provided by**: Leibniz University Hannover, Institute of Physical Chemistry and Electrochemistry, contact person J. Caro.
- **Related expertise**: J. Caro has published more than 200 papers on membranes and membrane reactors.

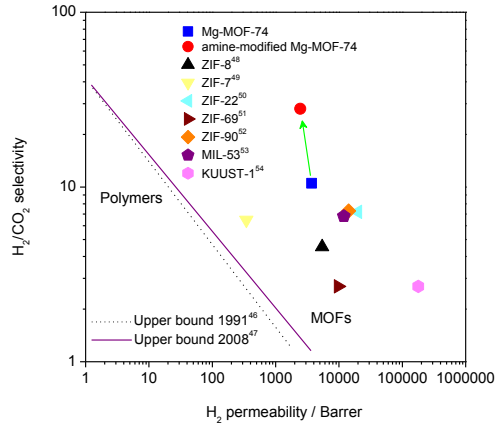
TECHNICAL DETAILS

- **Description**: …

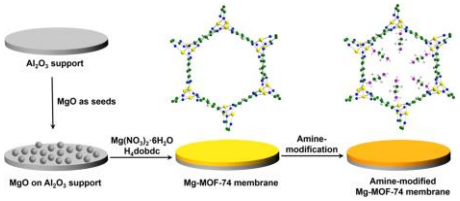
As described in the publications (see below), a 5 – 10 µm thick MOF layer can be crystallized on the porous alumina support. This MOF is the hydrophilic top layer which separates hydrogen from other gases.

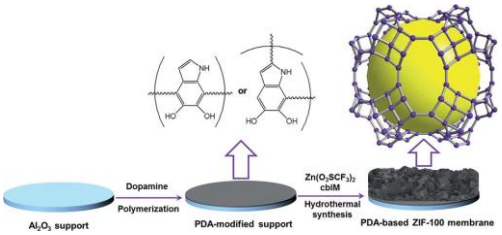
This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 263007.

The Robeson plot shows that our MOF membranes are for separation of H_2/CO_2 superior compared with the existing polymer membranes.



Left is shown the principle of the Amine-modified Mg-MOF-74/CPO-27-Mg membrane with enhanced H_2/CO_2 separation, right the Polydopamine-based synthesis of zeolite imidazolate framework ZIF-100 membrane with high H_2/CO_2 selectivity.





N. Wang, A. Mundstock, Y. Liu, A. Huang, J. Caro, Amine-modified Mg-MOF-74/CPO-27-Mg membrane with enhanced H2/CO2 separation. Chemi. Engin. Sci. 124 (2015) 27-36.

N. Wang, Y. Liu, Z. Qiao, L. Diestel, J. Zhou, A. Huang, J. Caro, Polydopamine-based synthesis of zeolite imidazolate framework ZIF-100 membrane with high H2/CO2 selectivity. J. of Materials Chemistry A 3 (2015) 4722-4728.

LICENSING

- **Collaboration type sought**: Scale up, pilot testing
- **Support provided**: Tests under lab conditions up to 5 bar and 200 °C…

CONTACT DETAILS

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