Funding scheme: FP7-NMP-2010-LARGE-4
Grant Agreement: N° 263007

TECHNOLOGY OFFER:
IPOSS® MEMBRANES

OVERVIEW

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

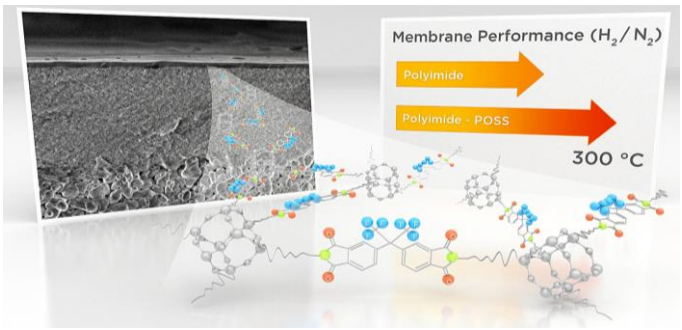
Benefit summary: iPOSS® polyPOSSimide hybrid organic-inorganic membranes consists of a network of alternating, covalently bonded imide and POSS groups. The membranes show high gas permselectivity and stability at temperatures up to 300 °C. The synthesis technique, interfacial polymerization, results in defect-free membranes that can be produced on a large scale. The length and the flexibility of the imide groups can be tailored to obtain suitable selectivity and permeability characteristics.

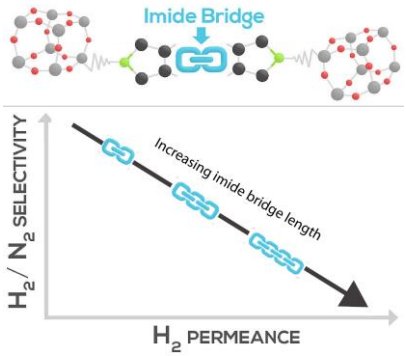
Development status: Lab-scale production of membrane layers via a simple interfacial polymerization. First test on tubular supports have been performed. Next step is the further scale up of manufacture to pilot scale.

IP status: Patent application WO 2015/030594 A1

NOVELTY

- **Technology benefit description**: This technology represents a new membrane concept. The membranes consist of a hyper-cross-linked network of alternating inorganic and organic groups. Such networks behave distinct from conventional polymeric or inorganic membrane systems. By changing the precursor chemistry and synthesis conditions, we can design materials for high performance applications. The membranes have, for instance, a high performance in the separation of carbon dioxide from methane at ambient/moderate temperatures, and show persisting selectivity at high temperatures (up to 300 °C). The unprecedented characteristics of these membranes originate from the hyper-cross-linked periodic network of covalently bound organic and POSS moieties. The performance of the membranes can be tuned by for instance selecting other organic bridging molecules.
- **Technology uniqueness and comparison vs state-of-the-art**: This technology allows, for the first time, the synthesis of large surface areas of ultrathin (~100 nm) hybrid membranes. Their hybrid nature allows for membrane gas separation at temperatures up to 300 °C. State-of-the-art polymeric membranes fail at temperatures of about 200 °C. The membranes can be made in a very facile and inexpensive manner, on large scale, and the approach is compatible with existing technology for large-scale production of reverse osmosis and nanofiltration membranes.





DEVELOPMENT

- **Technology Readiness Level**: TRL 1 ☐; 2 ☐; 3 ☐; 4 ☐; 5 ☐; 6 ☐; 7 ☐; 8 ☐; 9 ☐
- **Development status**: …

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

INTELLECTUAL PROPERTY

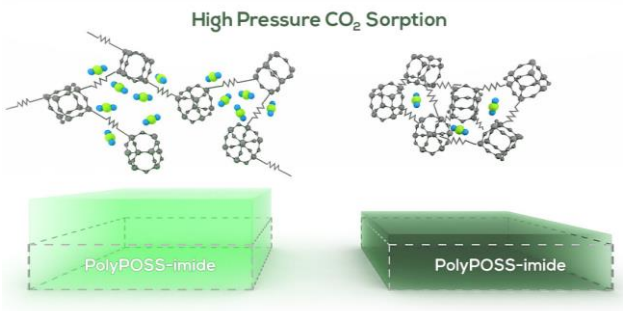
Patent / application N°	Title	Countries	Status	Priority date
WO 2015/030594 A1	Highly crosslinked hybrides polyimide-silsesquioxane membranes	81 Designated States	Published	02-09-2013

TECHNOLOGY PROVIDER

- **Technology provided by**: University of Twente, Films in Fluids/Inorganic Membranes group, Prof. Nieck Benes
- **Related expertise**: Membrane synthesis and characterization, inorganic and hybrid thin film membranes, in-situ/in-operando characterization of thin films in compressed gases, aggressive solvents, and at elevated temperatures. Broad knowledge on polymeric, inorganic and hybrid systems. In-situ characterization of materials that allow for fundamental understanding of material behavior under relevant conditions for chemical processes.

TECHNICAL DETAILS

Description: A two-step method for the facile production of ultrathin films of inorganic–organic hybrid materials that provide gas separation selectivity up to 300 °C in combination with chemical versatility and large-scale defect-free processability. The films are made by interfacial polycondensation of an ammonium chloride salt- functionalized POSS and hexafluoroisopropylidene dianhydride (6-FDA), followed by thermal imidization. In the first step, a thin-film polyPOSS–(amic acid) network is formed via a polycondensation reaction at the interface between two immiscible solvents. A water-soluble octa-ammonium POSS in alkaline solution and 6-FDA in toluene were used as the amine and anhydride sources, respectively. In the second step the amic acid groups are converted into cyclic imide groups via thermal imidization at temperatures up to 300 °C in either air or an inert atmosphere.



LICENSING

- **Collaboration type sought**: Further development of hybrid membranes for processes that operate under harsh process conditions (high temperature, pressure and presence of penetrants such as CO_2, solvents, vapors, steam). Application studies of the membranes, where the properties are tailored for the specific application. Further scale up of the method. Finally, commercialization.
- **Support provided**: Tests under lab conditions up to 5 bar and 200 °C.

CONTACT DETAILS

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