

# Ceramic membranes for the treatment of liquid and gaseous phases

Development and prototype production of ceramic membranes form a research focus of Fraunhofer IKTS.

The institute is focused on the development of membranes for microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), organic solvent nanofiltration (OSN), vapor permeation (VP), pervaporation (PV), gas separation (GS), membrane distillation (MD), membrane based extraction (membrane contactor) and membrane adsorption.

The successful research activities in the field of membrane technology in particular with the development of ceramic nanofiltration membranes have been awarded in 2015 by the American Ceramic Society ACerS with "The American Ceramic Society's Corporate Environmental Achievement" Award and in 2017 by the Fraunhofer Gesellschaft with the "Joseph von Fraunhofer" Award.

## Services offered:

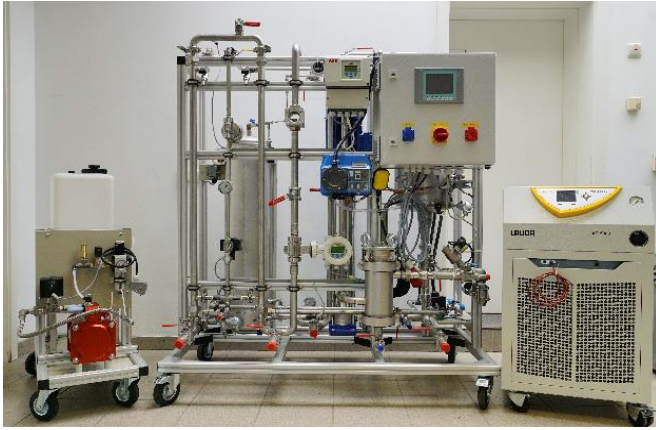
- Membrane development based on oxide ceramics ( $\text{Al}_2\text{O}_3$ ,  $\text{TiO}_2$ ,  $\text{ZrO}_2$ ,  $\text{SiO}_2$ ), zeolites (LTA, MFI, FAU), carbon (CNT, MSCM, ASCM) and inorganic/organic composite materials
- Membrane preparation on tubular and flat ceramic supports from own production as well as on customer substrates
- Membrane sample production for pilot and demonstration applications up to 1000  $\text{m}^2$ /year of membrane area
- Membrane characterization
- Development and construction of membrane (test) equipment and membrane housings
- Development of customer specific membrane processes (laboratory tests, concept development and piloting)
- Analysis and modeling of mass transfer
- Process engineering and plant design
- Prototype production of modules and test plants (lab to pilot scale)
- Customer support (by phone and on-site)

## Membranes for filtration

### Membrane type

### Median pore size

Microfiltration (MF)	$\alpha\text{-Al}_2\text{O}_3$ : 800 nm, 400 nm, 200 nm, 100 nm, 70 nm $\text{TiO}_2$ : 400 nm, 250 nm, 100 nm $\text{ZrO}_2$ : 100 nm
Ultrafiltration (UF)	$\text{TiO}_2$ : 30 nm, 10 nm, 5 nm $\text{ZrO}_2$ : 3 nm
Nanofiltration (NF)	$\text{TiO}_2$ : 1 nm, 0.9 nm
Low cut membranes (NF)	MWCO down to 200 g/mol (depending on process parameters)


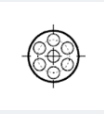
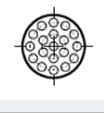
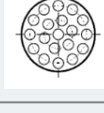
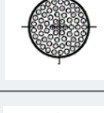
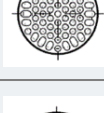
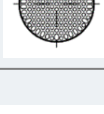


Pilot plant used for field testing, built by Fraunhofer IKTS.



Multi-stage automated gas permeation plant, built by Fraunhofer IKTS.

### Available tubular geometries

Article name	Outer diameter [mm]	Inner diameter [mm]	Number of channels [-]	Filtration area (1200 mm length) [m <sup>2</sup> ]
 AA	10.0	7.0	1	0.026
 BA	25.0	6.0	7	0.158
 CA	25.0	3.5	19	0.251
 CB	41.4	6.0	19	0.430
 EC	25.0	2.0	61	0.460
 EE	41.0	3.4	61	0.867
 HA	41.0	2.0	163	1.317

