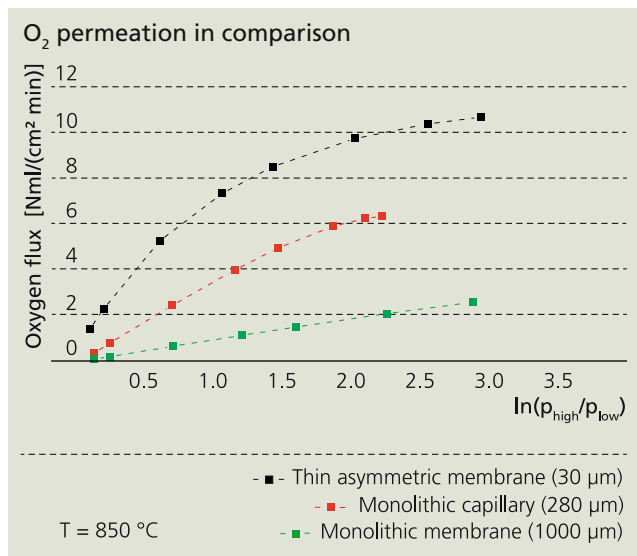


THIN SUPPORTED MEMBRANE LAYERS FOR OXYGEN GENERATORS

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Oxygen is one of the most frequently required industrial gases, with around 100 million metric tons consumed worldwide every year. Conventional production processes are very energy-intensive and the price of O₂ increases sharply for lower purchase quantities. The O₂ generators based on mixed conductive ceramic membranes (mixed ionic electronic conductor – MIEC) developed at Fraunhofer IKTS are an alternative. Gas separation is highly selective at approx. 850 °C via the coupled transport of oxide ions and electronic charge carriers. Up to now, membrane tubes or capillaries – so-called monolithic membranes – have been used in O₂ generators by IKTS. The relatively large wall thickness of these membranes (e.g. 280 μm for the capillaries) meant that large quantities (approx. 300 to 400 capillaries for 1 Nm³ of O₂/h) were required. By contrast, lower membrane thicknesses lead to a considerable increase in O₂ permeation. In order to ensure the mechanical stability of membranes with thicknesses of 20 to 30 μm, these are applied onto an open-pored carrier ceramic (asymmetrical membranes). Manufacturing of such “asymmetric MIEC membranes” of BSCF (Ba_{0,5}Sr_{0,5}Co_{0,8}Fe_{0,2}O_{3-x}) was simplified and drastically optimized within the EU project “HETMOC” (Grant Agreement No. 268165). For the first time, membranes with a length of 750 mm were manufactured in a quantity sufficient for testing in a pilot plant. All in all, 3 modules, each of them equipped with 25 asymmetric membrane tubes, were tested successfully for several months at 5 bar air-side pressure by the project partner DTU of Denmark. The following chart compares the area-normalized O₂ permeation of an asymmetric membrane, a capillary, and a monolithic membrane tube. Since the asymmetric membrane’s flow rate is multiple times that of a monolithic membrane, the required number of membranes produced decreases considerably. The purity of the O₂ produced by asymmetric membranes is re-

duced to approx. 96–98 vol % O₂ because of few pinholes inside the thin separation layer, which are hard to eliminate. Nevertheless, it was possible to realize smaller and cheaper O₂ generators



by using the new asymmetric MIEC membranes. Accordingly, such membranes are presently used in the project “IBIS” (BMBF: 01LY1616A), which deals with the O₂ enrichment of combustion air in an industrial furnace. Fuel gas savings are expected.



- 1 SEM image of an asymmetric BSCF membrane.
- 2 Pilot plant for overpressure operation (source: DTU, HETMOC).
- 3 Scheme of a pilot plant equipped with asymmetric membranes (source: DTU, “HETMOC”).