Research and Development on Oxygen Transport Membranes at the Technical University of Denmark from Materials to Modules - DTU Orbit (30/11/2018)

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Oxygen transport membranes (OTMs) are inorganic, high temperature devices that have the potential to efficiently supply oxygen to combustion processes, for example for oxy-fired (biomass) gasification or in the cement and steel industry. This work reviews aspects of material selection, design, characterization and testing of single phase and composite based OTMs that are taking place at the Technical University of Denmark (DTU). The focus will be on high performance asymmetric OTMs, in which a dense thin film oxygen separation membrane is deposited on a porous mechanically supporting layer. An OTM material should ideally have high ionic and electronic conductivity as well as good chemical stability under both oxidizing and reducing conditions. Strategies for increasing the performance by using composite dual phase membranes consisting of an ionic conductor and a electronic conductor will be discussed. Particularly membranes based on i) La0.6Sr0.4FeO3 (LSF) and CGO and ii) 10Sc1YSZ ((Y2O3)0.01(Sc2O3)0.10(ZrO2)0.89) and MnCo2O4 seem to be promising combinations and results on manufacturing and testing, including long-term results for >1500 h, of these membranes will be presented. The second part of the presentation will focus on module design and application oriented testing. Here first results from integration of OTMs into the slip stream of a biomass gasifier will be shown. Also highlights from the "Highly Efficient Tubular Membranes for Oxy-Combustion (HETMOC)“ European FP7 project are included. In this project a proof-of-concept module with 25 one-end closed BCSF (BaxSr1-xCo0.8Fe0.2O3) tubes was designed and tested in a high pressure test stand designed at DTU. To maximize the partial pressure difference across the membrane, high pressure up to 5 bar was applied on the feed side and a vacuum pump was used to lower the pressure on the permeate side. Results on performance and long-term stability as well as problems encountered during the project will be presented.

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