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Pure oxygen gas supplied by ceramic oxygen transport membranes can facilitate reduced CO_2 emissions through more efficient gasification processes and CO_2 capture and storage. Tubular membranes have some advantages compared to planar membranes, such as better resistance to thermal gradients and a more straightforward sealing. The active oxygen separation layer in the membrane should be as thin as possible and therefore supported on a highly porous tubular substrate. The tubular, multilayered membranes consist of a porous support tube, porous inner and outer catalyst layers and a dense thin membrane permeable only to oxygen ions (Figure 1). Different material combinations fulfilling requirements such as thermal expansion match, high oxygen flux, and chemical compatibility and stability under various operation conditions will be discussed, as well as their performance. The main focus, however, will be on the processing of this multilayered structure, especially the shaping of the porous, tubular support.

Tubular porous supports of 3 mol% yttria-stabilized zirconia were manufactured using thermoplastic extrusion. Two types of poreformers (spherical graphite (d_{50} 18 µm) and polymethyl methacrylate (d_{50} 10 µm)) have been used as sacrificial fugitives to form connected macropores, since their spherical geometry limits preferential orientation during extrusion. Their difference in decomposition temperatures also allows a high volume fraction of pore formers without deformation during de-binding. The influence of the amount of pore formers (relative to the amount of ceramic and thermoplastics) on the microstructure of sintered samples, as well as the extrudability and ease of de-binding of the feedstock, has been studied. Ceramics with 1-20 µm pores, open porosities exceeding 65 % and gas permeabilities exceeding 10^{-14} m^2 could be produced, demonstrating that porous tubes with high gas permeability can be fabricated by thermoplastic extrusion.

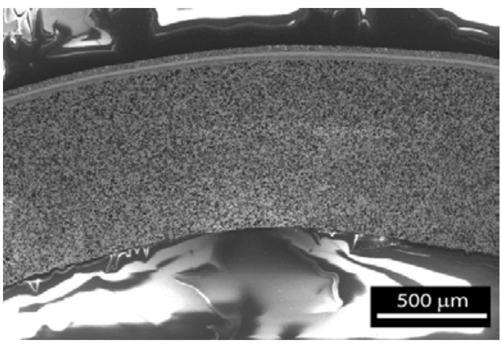

Figure 1. Oxygen transport membrane.