Thin film mixed ionic electronic conducting membranes for oxygen separation

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Oxygen transport membranes consist of gas-tight Mixed Ionic Electronic Conductors (MIEC), which allow oxygen ion diffusion through vacancies in the crystal lattice and simultaneous transport of electrons in the opposite direction. Their major advantage is infinite oxygen selectivity, assuming no leakage through the membrane layer or the sealing, resulting in high purity oxygen, which can directly be provided to e.g. Oxyfuel power plants. Furthermore, these membranes can be used in membrane reactors in order to facilitate chemical reaction requiring oxygen. Thin membranes are favorable to obtain high permeation rates. However, a thickness reduction becomes more and more ineffective below a characteristic thickness L_c due to slow surface exchange kinetics. In order to use the potentially high fluxes of a thin membrane a fast incorporation/excorporation of the oxygen into/out of the membrane is necessary by using high surface porous catalyst layers.

As consequence an optimized membrane assembly is characterized by (i) high oxygen permeation rate, (ii) infinite oxygen selectivity, and (iii) low degradation rate. In order to address all of these goals at the same time, the development of nano-structured surface activated thin oxygen transport membranes is essential. Modeling activities, e.g. atomistic modeling of transport and surface phenomena, are necessary to support the experimental membrane development.

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