# Oxygen and carbon dioxide separation membranes based on mixed conductors

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# OXYGEN AND CARBON DIOXIDE SEPARATION MEMBRANES BASED ON MIXED CONDUCTORS

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Gas separation is one of the key technologies to improve the efficiency of combustion process, and to reduce the emission of global warming gases. By using pure or concentrated oxygen, flame temperature governing the Carnot efficiency and the concentration of $CO_2$ in exhaust gas can be raised. Among a number of oxygen separation techniques such as cryogenic separation, oxygen separation membranes based on mixed oxide-ion and electronic conductors have been attracting much attention because of its high selectivity (100% in principle) and the ease of integration into various combustion systems. Figure 1(a) shows how the oxygen separation membrane works; only oxygen can penetrate as a result of ambipolar diffusion of oxide ions and electrons caused by an oxygen potential gradient. To date, a number of oxygen separation membranes such as perovskite-type oxides and dual-phase-type composites containing transition metals have been developed; however, to use the membranes in the expected applications, oxygen permeation flux governed by surface exchange kinetics and the tolerance of $CO_2$, which is a main constituent of exhaust gas, need to be further improved. Recently, our group has succeeded in improving the oxygen permeation flux of Ba-Sr-Co-Fe-based oxygen separation membranes by surface modification using a porous body [1]. In which, weight relaxation performed at 400 °C revealed the enhancement of the surface exchange reaction. The chemical surface exchange coefficient ($k_{chem}$) was 3.1 times larger for the sample with the porous body coating. A technique to further increse the oxygen flux will be discussed. In addition, how the $CO_2$ tolerance of Ba-Sr-Co-Fe-based oxides can be managed will be presented.

As well as oxygen separation, $CO_2$ separation is of great interest in the context of $CO_2$ capture and storage. As an analogous application using mixed conduction, $CO_2$ separation membranes has been studied [2]. In this case, as shown in Fig. 1(b), the mixed conduction of oxide ions and carbonate ions plays a key role. In this study, a composite material comprising Sm-doped $CeO_2$ and molten carbonates was prepared. The composite was found to permeate $CO_2$ at around 900°C. The $CO_2$ permeation flux was investigated with respect to its microstructure and electrical conductivity.

References

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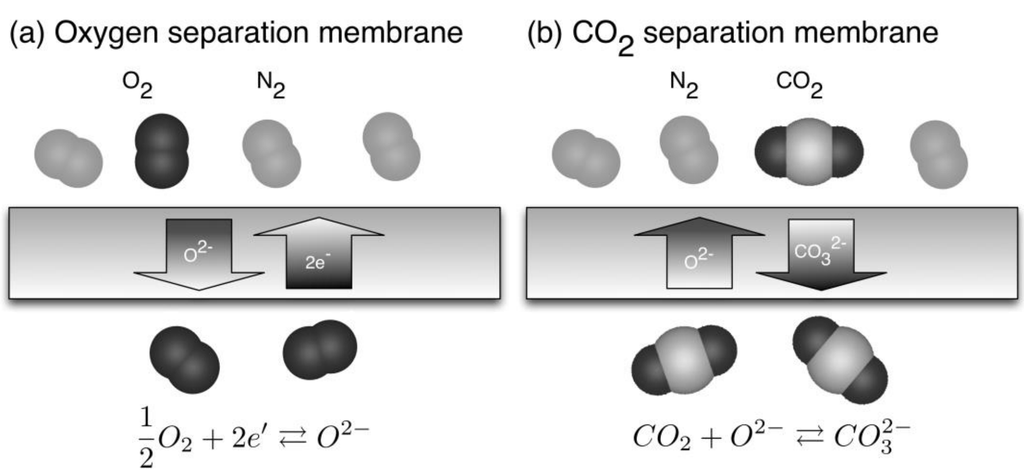


*Figure 1 – Principles of (a) oxygen separation and (b) $CO_2$ separation membranes based on mixed conduction.*