membranes

Article

Development of a membrane module prototype for oxygen separation in industrial applications

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Supplementary Material

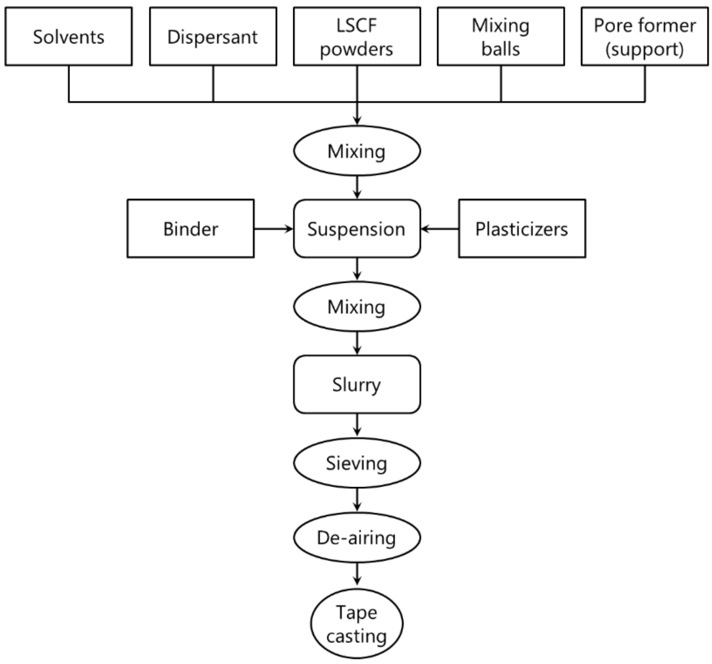


Figure S1. Scheme of the procedure followed for the slurry preparation.

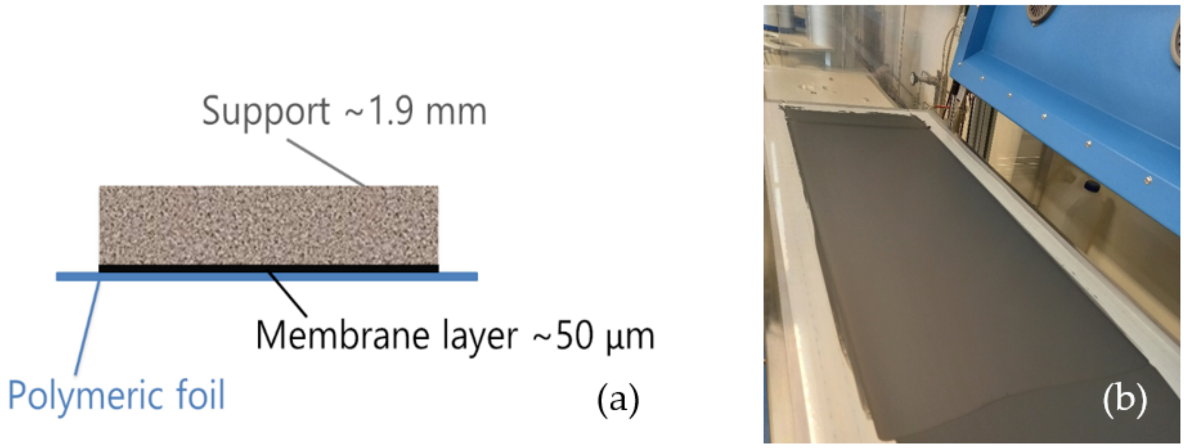
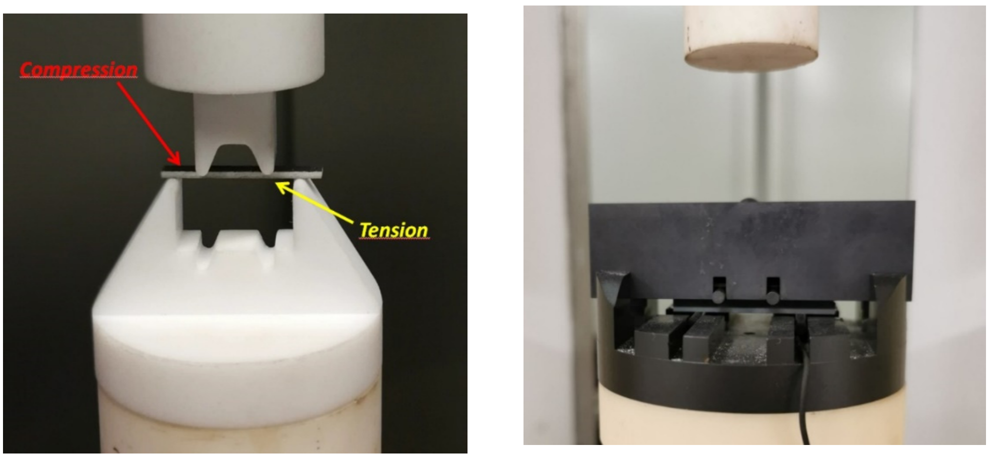


Figure S2. (a) Schematization and (b) picture of an asymmetric green tape, composed by a thin dense membrane underlying a thick porous support. In (a) the doctor blade gaps for casting the different layers are indicated.



(a) (b)

Figure S3. Test setup for the four-point bending tests at (a) room temperature and (b) 950 °C.

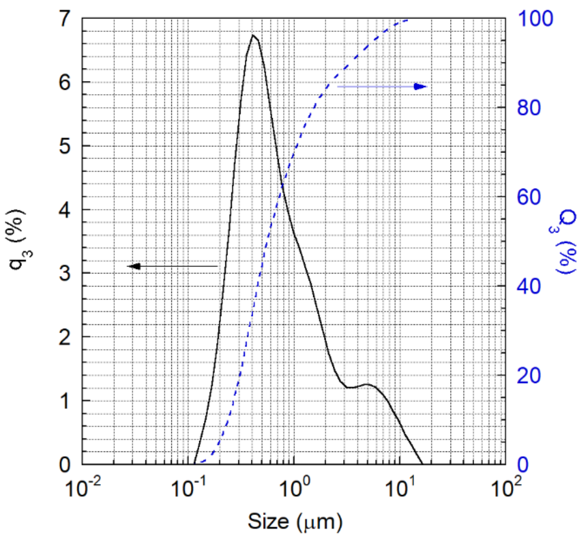


Figure S4: PSD (solid line) and cumulative PSD (dashed line) of the LSCF powder.

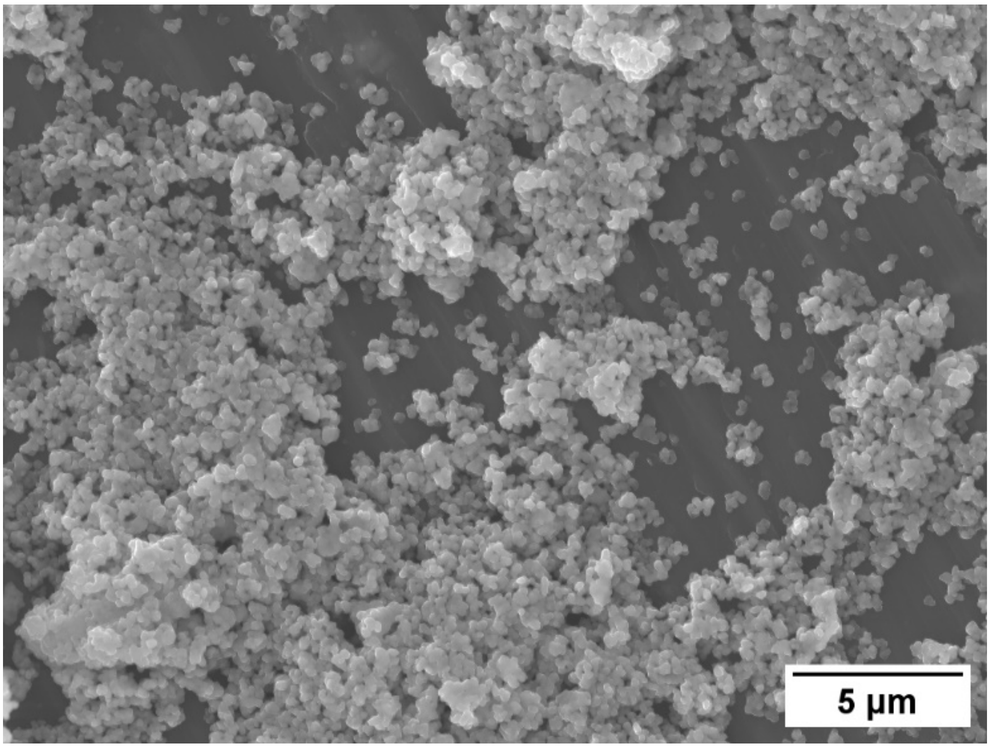


Figure S5. SEM image of the commercially available LSCF powder used for the manufacturing of the membrane components.

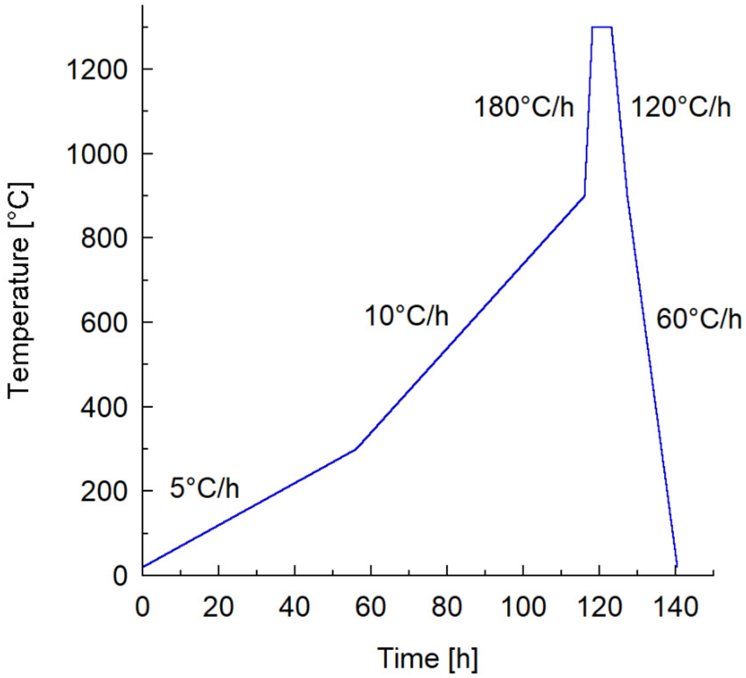


Figure S6. Debinding and sintering program of the membrane half-components.

Oxygen flux estimation

In order to estimate the oxygen flux permeated through the membrane, $J(o_2)_M$, the total oxygen flux, $J(o_2)_{TOT}$, was depurated by the oxygen permeated through the defects, $J(o_2)_D$, according to the following equation:

$$J(o_2)_M = J(o_2)_{TOT} - J(o_2)_D = F(He) * \frac{x(O_2)}{x(He)} - F(N_2)_D * \frac{0.21}{0.79}$$
$$= F(He) * \frac{x(O_2)}{x(He)} - F(He) * \frac{x(N_2)}{x(He)} * \frac{0.21}{0.79} = \frac{F(He)}{x(He)}\left(x(O_2) - x(N_2) * \frac{0.21}{0.79}\right)$$

Where $x(He)$, $x(O_2)$ and $x(N_2)$ are the helium, oxygen and nitrogen concentration, respectively, obtained by microGC measurements, $F(N_2)_D$ is the estimated nitrogen flux which permeates through the defects, $F(He)$ is the sweep gas flow rate, controlled by a mass flow controller, while $\frac{0.21}{0.79}$ is the ratio between oxygen and nitrogen concentration in the feed gas stream.