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Title:

Fabrication of $Ba_{0.3}Sr_{0.7}Fe_{0.9}Mo_{0.1}O_3$ perovskite multichannel hollow fiber for oxygen separation and membrane reactor

Authors & affiliations:

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Jinkun Tan[1], Guangru Zhang[1], Wanqin Jin[1]*
[1] State Key Laboratory of Materials-Oriented Chemical Engineering, College of Chemical Engineering, Nanjing Tech University, 30 Puzhu Road(S), Nanjing 211816, P.R. China

Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

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1. The title should be as brief as possible but long enough to indicate clearly the nature of the study. Capitalise the first letter of the first word ONLY (place names excluded). No full stop at the end.
2. Abstracts should state briefly and clearly the purpose, methods, results and conclusions of the work.
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Results: Present your results in a logical sequence in text, tables and illustrations
Discussion: Emphasize new and important aspects of the study and conclusions that are drawn from them

Perovskite type oxide is a type of mixed ionic and electronic conducting (MIEC) material, has shown remarkable promise for separation and catalysis. It can be fabricated into a dense and gas-tight ceramic membrane, through which oxygen ions migrate selectively under a driving force of oxygen chemical potential gradient at elevated temperature. However, the cation segregation in perovskite-type membrane deleteriously affects the membrane performance and durability. This work presents a novel hydrogen-induced annealing approach for reversing the surface cation segregation of $Ba_{0.3}Sr_{0.7}Fe_{0.9}Mo_{0.1}O_3$ multichannel hollow fiber membranes (BSFM HFs). This approach served to trigger outright reverse segregation of massive complex oxide precipitations at grain boundaries and a self-healing of cracks formed during the sintering stage (Fig. 1). A maximum breaking load of 31.6 N is reached for the hydrogen-induced membrane which is approximately 6 times of the as-prepared BSFM membrane.

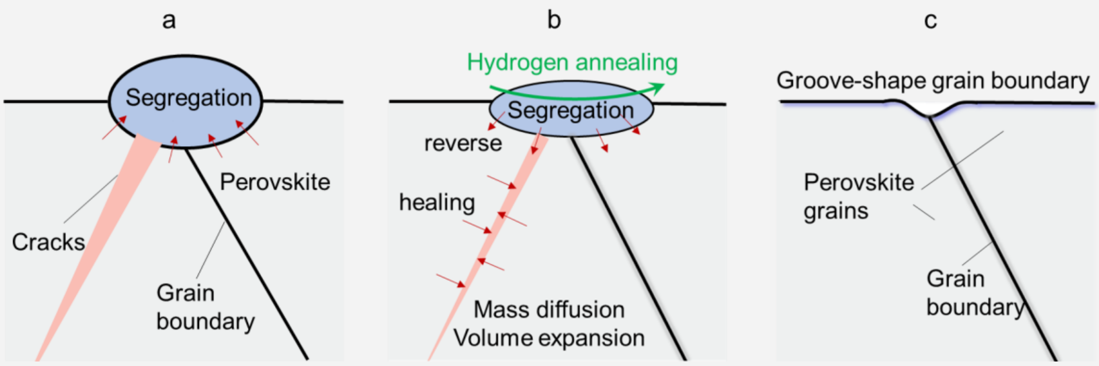

Fig. 1. Schematic representation of the hydrogen-induced reverse segregation and crack self-healing. (a) Segregation and cracks were initially formed at the sintering stage and featured by a convex-shape grain boundary at the surface as-prepared BSFM membrane; (b) It is annealed with hydrogen which is facilitating element migration and crack healing and (c) outright reverse segregation and crack healing achieved and featured by a groove-shape grain boundary.

The hydrogen-induced BSFM HFs possesses high oxygen permeation flux and tolerates to H_2- and CO_2- contained atmosphere. Thus, the hydrogen-induced BSFM HFs were suitable for

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catalytic membrane reactor fabrication. We demonstrated the partial oxidation of methane (POM) catalytic membrane reactor could produce industrial syngas and operate stably for more than 120 h. As the CO_2 splitting reaction was further introduced into the membrane reactor, a higher CO_2 conversion efficiency was obtained. Our results demonstrate the feasibility of hydrogen-induced reverse segregation in the perovskite membrane, suggesting new directions to design the high-performance materials based on perovskite oxides for application in catalysis and separations in the future.

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