Fabrication of a Strong Mixed Oxide-Ion and Carbonate-Ion Conductor with Porous Solid Oxide Skeleton

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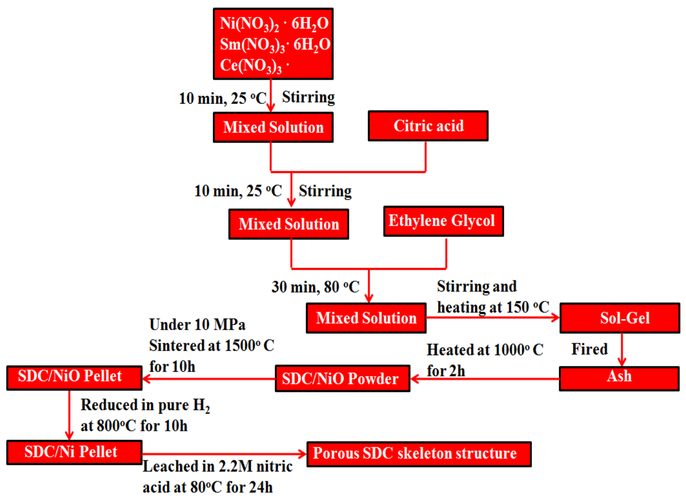
Introduction

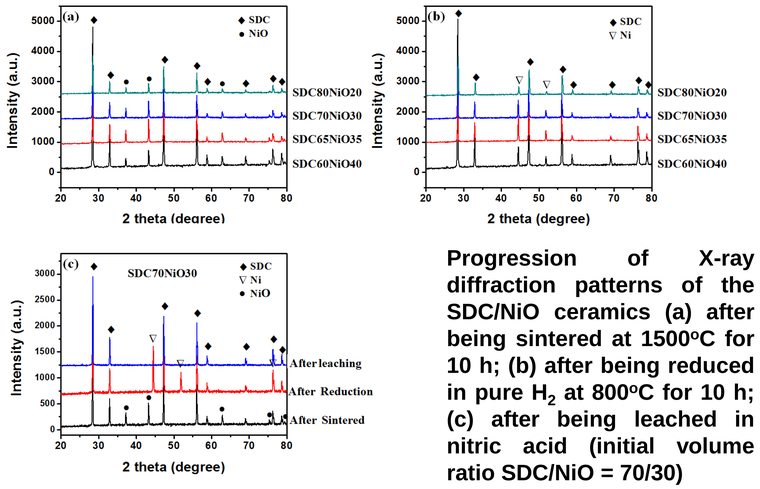
A novel intermediate-temperature two-phase mixed oxide-ion and carbonate-ion conductor (MOCC) has recently been developed in USC for potential applications in IT-SOFCs and CO_2 separation membranes. Excellent electrical performance has been demonstrated with MOCC-SOFCs in the temperature range (500-650°C). Remarkable effective ionic conductivity has been achieved and can be well predicted by the Effective Medium Percolation Theory (EMPT). However, the MOCCs fabricated by conventional mixing-pressing ceramic technique often have low mechanical strength and low oxide-ion conductivity due to a low sintering temperature. An effective way to overcome this obstacle is to prefabricate a strong porous solid oxide skeleton, into which the molten carbonate phase is infiltrated. This presentation summarizes the initial efforts towards this goal.

Porous Skeleton Fabrication

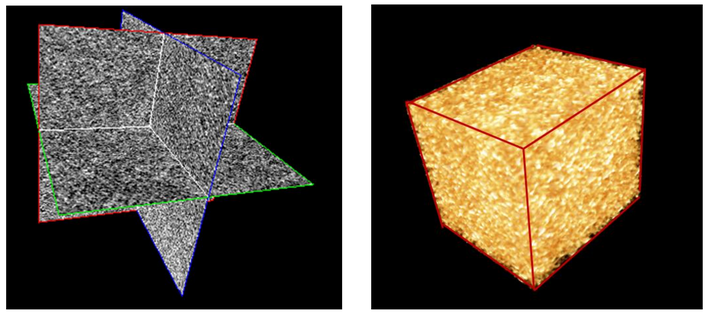


Flow diagram showing fabrication steps of porous SDC skeleton structure

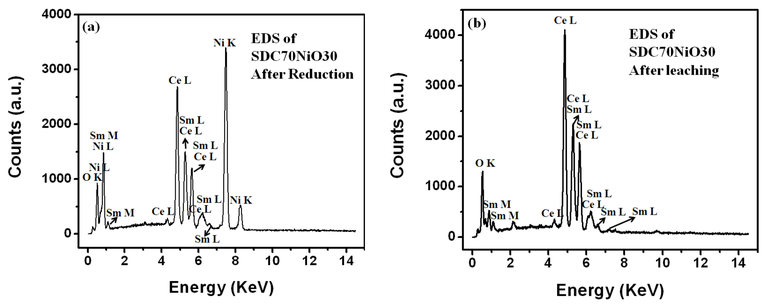
Characterization



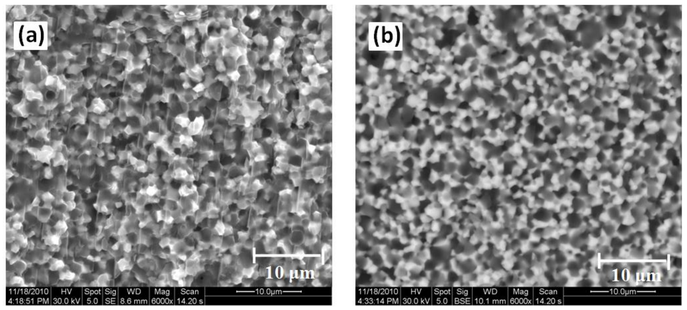
Progression of X-ray diffraction patterns of the SDC/NiO ceramics (a) after being sintered at 1500°C for 10 h; (b) after being reduced in pure H_2 at 800°C for 10 h; (c) after being leached in nitric acid (initial volume ratio SDC/NiO = 70/30)



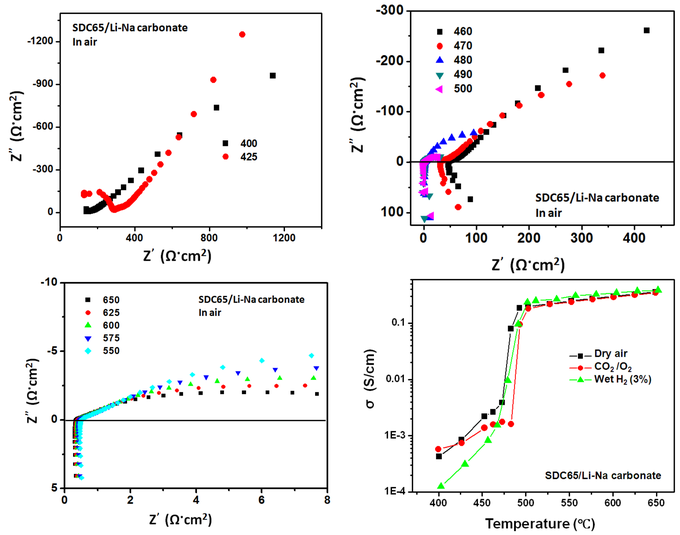
3-D X-ray image showing internal structure of an SDC porous ceramic with an initial volume ratio SDC/NiO = 65/35



SEM/EDS analysis further confirms the XRD results



SEM (a) and BSE (b) images of an SDC porous structure infiltrated with an Li-Na carbonate salt (initial SDC/NIO volume ratio = 65/35)



AC impedance spectra of an MOCC consisting of SDC65 and Li-Na carbonate

Conclusions

- **A porous SDC structure with uniform pore size and porosity distribution has been fabricated with a "template" technique.**
- **The Li-Na carbonate has been successfully infiltrated into the fabricated SDC porous structure.**
- **The fabricated MOCC has been showed with a high effective ionic conductivity.**

Acknowledgement

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