CERIA PROCESSING IN SUPERCRITICAL FLUIDS: FROM NANOCRYSTALS TO THIN FILMS

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ABSTRACT

Ceria is a key material for numerous application including three-way catalysis [1], optical and electronic devices [2] and intermediate temperature solid oxide fuel cells (IT-SOFC) [3].
Significant improvement of the material physical properties, in particular surface exchange rate and conductivity [4], are anticipated with nanostructured materials. Regarding the application as a buffer layer for IT-SOFC, ceria nanopowders can be processed as porous films via screen printing involving an intermediate step with ink fabrication. Another route is to deposit ceria thin films directly on the yttria-stabilized zirconia (YSZ) electrolyte.

In this communication we propose to investigate of these both ways. First, this work is focused on the continuous synthesis of ceria nanocrystals in supercritical water, ethanol and ethanol/water mixtures. Highly crystalline ceria nanoparticles (NPs) are obtained at moderate temperatures (250-300°C) with short reaction times (1 min.). The characteristics of the particles, in particular size and morphology, highly depend on the nature of the precursor (acetate, nitrate) as well as the nature of the supercritical fluid. This route does not involve high temperature calcinations to obtain pure crystalline ceria NPs with high specific surface areas. Ceria film deposition from these nanostructures is discussed.
Second pure ceria thin films have been deposited on YSZ substrates from the decomposition of β-diketonate precursor in supercritical CO_2 at 300 °C in a cold wall reactor. Film thickness is controlled by reaction time and water content [5] whereas the film morphology depends on the substrate nature.
Electrochemical measurements show that these pure ceria thin films exhibit much improved conductivity, matching the performance of doped-ceria thin films.

References

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