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Ahsanul Kabir[1], Vincenzo Esposito[1]*

[1]Department of Energy Conversation and Storage, Technical University of Denmark (DTU), Frederiksborgvej 399, Roskilde 4000, Denmark

E-mail: ahsk@dtu.dk

Abstract

In recent times, non-classical giant electromechanical properties are reported in both defective cerium oxide ($Ce_1M_{1-x}O_{2-\delta}$) thin films and bulks, which are even superior to current lead-based electrostrictors *e.g.* lead magnesium niobate (PMN). The electrostrictive properties of such material mainly functioned by oxygen vacancy concentration, with strict dependency on their configuration at the blocking barriers. In this work, we investigate the effect of oxygen defects configuration on electro-chemo-mechanical properties of bulk ceria. This is accomplished by tuning the oxygen defects blocking barrier density in following methodologies:

(1) Changing blocking barrier density by consolidating nano-metric gadolinium doped ceria (GDC) powders of fixed doping concentration in different conditions, including field assisted spark plasma sintering (SPS), fast firing and conventional method at high temperatures.
(2) Changing blocking barrier properties by consolidating calcium doped ceria (CDC) powders with different dopant concentration in conventional method at high temperatures.

By correlating both results with electro-chemo-mechanical properties, we finally demonstrate that solute drag effect drives the oxygen vacancy distribution in the materials, which plays a key role in ceria electrostriction, overcoming expected contributions from grain size and nominal dopant concentration.

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