Steady Non-classical Giant Electrostriction in Calcium Doped Cerium Oxide

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ABSTRACT BODY:

Abstract Body: In recent times, rare-earth-doped cerium oxides, e.g. Gd-doped ceria have shown giant electrostriction that are orders of magnitude higher than known inorganic electrostrictors. This non-classical electrostriction is fundamentally independent of Newnham″s scaling law and is functioned with the existence of oxygen vacancies (Vo) in the host lattice, associated with Ce-Vo pairs. Here, electro-chemo-mechanical properties of highly defective calcium doped ceria (CDC) ceramics, with variously doping levels ($Ce_{0.9}Ca_xO_{2-x}$, x = 0.025-0.15) are investigated. As expected, CDC samples display rather different electrochemical properties depending on a vacancy concentration and microstructure. They reveal primary creep at room temperature, emphasizing an unexpected anelasticity in ceria. The electrostrictive effect describes being independent of either the nominal vacancy concentration or the related blocking effects at the grain boundary, exhibiting a high electrostriction coefficient (M_{33}) in order of ≈ 10^{-18} m^2 V^{-2} in a wide range of frequency. Remarkably, electrostriction show neither strain saturation nor relaxation with field amplitude and frequencies, respectively. These key findings unveil a new form of electromechanical response in ceria that is independent of composition fluctuations and dominated by strong columbic and elastic energy of Ca^{2+}- Vo pairs.

KEYWORDS: Giant Electrostriction, Oxygen defects, Blocking barrier, anelasticity.

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PROFESSIONAL/ACADEMIC STATUS:

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