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View Abstract

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CURRENT SYMPOSIUM: S2 - Advanced Electronic Materials: Processing Structures, Properties, and Applications

CURRENT SESSION: Advanced electronic materials, including ferroelectric, piezoelectric, dielectric, electrostrictive, and pyroelectric materials

PRESENTATION TYPE: Contributed (Oral)

TITLE: Tunable Giant Electromechanical Properties in Defective Co-doped Ceria Systems

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ABSTRACT BODY:

Abstract Body: Recent studies demonstrate that highly defective cerium oxide, e.g. Gd-doped ceria, is capable of generating a giant electromechanical effect that is orders of magnitude larger than other ceramic-based electrostrictors, e.g. lead-based piezoelectrics. This is an unconventional response as it does not obey the Newnham's empirical law and it is atomistically explained by the lability of Ce- pairs. In this report, we investigate the electrostrictive properties of defective ceria with 0.25−3.75% oxygen vacancies introduced by a co-doping (Sm, Nd) concept. The codoping strategy leads to a different oxygen vacancy configuration in the lattice than for the single dopant case, delineated by a relatively lower vacancy-dopant association energy. This results in electrostrictive response with high strain coefficient (M_{33} in the 0.1-10 10^{-17} m^2/V^2) as well as in marked, strain saturation effects to the applied field from 0 to 120 kV/m and in a relaxation behavior by increasing the frequency of the applied field (0.1 to 1 kHz). Remarkably, M_{33} follows a strict dependency on oxygen vacancy configuration rather than their nominal concentration. Such outcomes define the hypothesis that electrostriction does occur due to oxygen vacancy concentration but it is firmly tuned by oxygen vacancy

distribution at the blocking barriers.

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