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The Origin of Giant Electrostriction in Gd-Doped Ceria as Studied by Modulation Excitation X-ray Absorption Spectroscopy ALYSSA LERNER, YUANYUAN LI, ANATOLY FRENKEL, Yeshiva University, ROMAN KOROBKO, IGOR LUBOMIRSKY, Weizmann Institute of Science — Electromechanical materials, such as piezoelectrics and electrostrictors, are ubiquitous. Recently, an unusually large electrostriction effect, which exceeds that of most common electrostrictors, was found in gadolinium-doped ceria thin films. It is likely to be explained by the dynamic response of oxygen vacancies to external electric field. Verifying this hypothesis is very challenging, as it is required to detect local atomic rearrangement at the 0.01 Å scale. Conventional structural methods have neither elemental specificity nor spatial sensitivity to such structural changes. We applied Quick Extended X-Ray Absorption Fine Structure used in the Modulation Excitation mode to directly observe the dynamic response of the Ce and Gd local environments to the electric field. While using periodic stimulation of the films by electric field in situ, we detected X-ray absorption spectra at the Ce and Gd absorption edges, thus enhancing the sensitivity to electro-active species. Our model of electromechanical activity in this system attributes it to a relatively small population of Ce ions with anomalously short Ce-O bonds formed near the oxygen vacancies. This finding suggests that other oxides with a large concentration of vacancies may exhibit even larger electrostriction.

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