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Point defects and anelasticity in pure and Gd-doped ceria

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Gd-doped ceria (GDC), one of the most well-studied oxygen ion conductors, exhibits a number of unusual mechanical and electro-mechanical effects, including pronounced room-temperature anelasticity and non-classical electrostriction, the origins of which still require explanation. Although the XRD structure of 10mol% GDC displays fluorite symmetry, differential EXAFS measurements, performed with electric field modulation, reveal the presence of a small population of Ce-O bonds that are at least 4.6% shorter than the average. 3D-reconstruction of these local distortions, obtained *via* high-energy resolution fluorescence detection, indicated that the short bonds are randomly oriented and that their lengths show ≤10% variability. These results suggest that the strong elastic dipoles (E > 1 eV), formed by oxygen – vacancy- induced lattice distortions, can nevertheless reorient and, most unusually, are energetically labile. Although such behavior has not been observed previously, it appears to provide a satisfactory explanation for a range of anelastic effects in GDC.