IN SITU NANOCOMPRESSION TESTS IN AN ENVIRONMENTAL TEM TO STUDY PLASTICITY OF CERIUM OXIDES

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Cerium oxide plays an important role in several fields, among which catalysis, gas detection or fuel cells [1]. Cerium oxide nanoparticles are also used as superior abrasive particles in chemical mechanical planarization (CMP), which is a key process in semiconductor device fabrication [2]. Most of the current research focus on the synthesis of cerium oxide to optimize CMP, but analysing its deformation mechanisms is also a promising research direction [3].

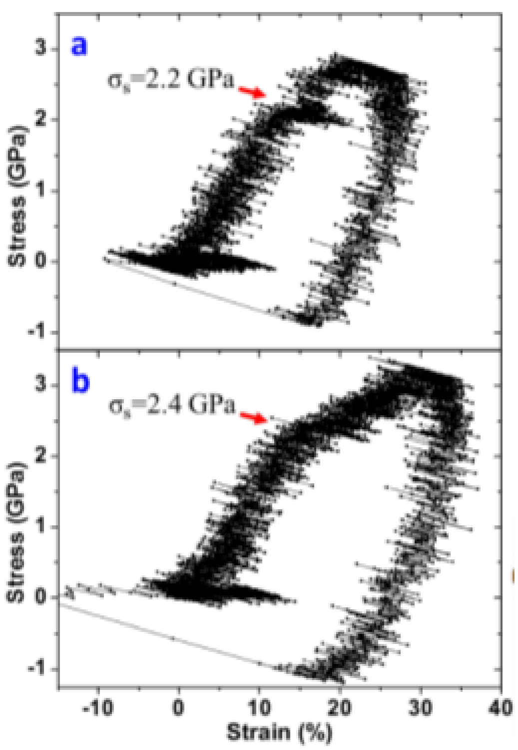

Figure 1 – Strain-stress curve: (a) Dislocation dominated plastic deformation and (b) grain boundary-dislocation dominated plastic deformation.

In this study, we will investigate the plastic behavior of cerium oxide nanocubes of different oxygen contents, using an *in situ* nanocompression Hysitron sample holder in a TITAN environmental transmission electron microscope (ETEM) operating either under vacuum or with a partial pressure of air. The stress-strain curves obtained during the test exhibit small bursts when dislocations dominate the deformation (fig. 1a), but the curves are continuous when grain boundaries exist in the particle (fig. 1b). We will study in detail structural evolutions during deformation. Moreover, we will discuss the observed behavior and the yield stress values in light of published predictions provided by simulations [4]. These findings are helpful for a better understanding of the mechanical properties of cerium oxide.

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