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Room-temperature deformation processes of $SrTiO_3$ unmasked by nanoindentation and chemical etching

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In light of the rising topic of dislocation-tuned functionality of oxides, the dislocation-based mechanical behavior, for instance, dislocation plasticity and potentially crack formation is also drawing increasing attention. In order to tackle the great challenge of introducing dislocations with controlled structures into oxides, it is critical to first understand the dislocation-based deformation process in oxides. Here, we report a new method, namely, nanoindentation pop-in stop tests, to investigate: i) the nucleation and multiplication of dislocations; ii) crack formation due to dislocation pileup; iii) dislocation-crack tip interaction. These fundamental processes are evaluated by the post-mortem chemical etching and correlated well with the theoretical analyses. We use single-crystal $SrTiO_3$ as model material for demonstration [1, 2], and further discuss the universal applicability of the finding in other ceramics such as MgO and LiF. This simple approach helps to better understand the dislocation-mediated deformation process in ceramics at room temperature, and paves new road to actively tailor the dislocation plasticity in many ceramics.

Keywords*: nanoindentation pop-in tests; dislocations; ceramics; crack initiation*

References:

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