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YTTRIUM SEGREGATION IN HIGH PURITY SUPERPLASTIC Y-TZP: SIGNIFICANCE IN TENSILE CREEP

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ABSTRACT

Constant stress tensile creep tests were performed on samples of high purity superplastic yttria-stabilized zirconia (Y-TZP). The results revealed an immediate steady-state condition with a gradual decrease in the creep rate evident after large strains. This decrease became more significant with a decrease of the applied stress. At the lowest testing stress, the appearance of the creep curve resembled a primary creep region. These results were related to a diffusional creep mechanism controlled by interface reaction. Analysis of grain boundary chemistry and morphology were necessary to relate the deformation behavior to interface phenomena in this material. Scanning Transmission Electron Microscopy (STEM) was utilized to inspect and characterize grain boundaries at high magnifications. The probe current was set as 1 nA and the probe size was ~2 nm FWHM. Energy-Dispersive X-ray Spectroscopy used with STEM in these conditions allowed the detection of yttrium enrichment within ~2 nm of the grain boundary. It is possible that the yttrium present at grain boundaries exerts a drag on the grain boundary dislocations and limits their mobility. In this case, the creep rate is proportional to the dislocation mobility. Therefore, a continuous decrease in the mobility of grain boundary dislocations due to yttrium segregation may be the origin of the continuous decrease in creep rate.

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