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Effects of He ion irradiation on the microstructures and mechanical properties of t' phase yttria-stabilized zirconia ceramics

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Abstract

The dense ZrO₂-8 wt.% Y₂O₃ ceramics with tetragonal (t') phase were prepared by spark plasma sintering (SPS). The micro-structure modification in poly-crystalline t' phase YSZ ceramics irradiated with 60 KeV He ions over a wide fluence range were studied. It is found that, the t' → t + c phase transformation was detected for the samples irradiated at the fluence above 2×10¹⁷ cm⁻². In addition, a three-step model for damage stages has been proposed and discussed for interpreting the evolution of mechanical properties of t'-YSZ ceramics after irradiated, mainly revealed by the analysis from HRTEM results. Firstly, as the He⁺ fluences range from 0.5×10¹⁷ cm⁻² to 1×10¹⁷ cm⁻², the hardening effects were confirmed in t'-YSZ owing to the irradiation induced defects serve as obstacles to resist slipping of dislocations. As the fluence was increased to 2×10¹⁷ cm⁻², the degradation of mechanical properties was evidenced, which could be ascribed to the deterioration effect of aggregated He bubbles inside t' YSZ grains. While the fluence increased to 10×10¹⁷ cm⁻², a seriously damaged region was approximately located at 250 nm in depth, at which a great

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