4.2 Multiphysics Model of Thermochemical and Helium-Induced Damage of Tungsten Under Plasma Heat Transients —Tamer Crosby (University of California, Los Angeles), Nasr M. Ghoniem (University of California, Los Angeles)

This is the Abstract for an ICFRM-15 paper submitted for publication in the Proceedings.

The combination of transient heating and bombardment by helium and hydrogen atoms has experimentally proved to lead to severe surface and sub-surface damage. Here we present a computational model to determine the relationship between the thermomechanical loading conditions and the onset of damage and failure of tungsten surfaces. The model is based on thermoelasticity fracture damage developed using the phase field method. The distribution of helium bubbles inside the grains and on grain boundaries is simulated with a space-dependent rate theory. The model is also coupled with a transient heat conduction analysis for temperature distributions inside the material. The results have shown the effects of helium bubbles on reducing tungsten surface energy. Further, a temperature gradient in the material that was equal to 10 K/μm, resulted in cracks propagating to deep distances from the tungsten surface.