DISLOCATION INTERACTIONS WITH VOIDS AND HELIUM BUBBLES IN FCC METALS—J. A. Young (Lawrence Livermore National Laboratory), B. D. Wirth (Department of Nuclear Engineering, University of California Berkeley), J. Robach, and I. M. Robertson (University of Illinois, Urbana-Champaign)

EXTENDED ABSTRACT

The formation of a high number density of helium bubbles in FCC metals irradiated within the fusion energy environment is well established. Yet, the role of helium bubbles in radiation hardening and mechanical property degradation of these steals remains an outstanding issue. In this paper, we present the results of a combined molecular dynamics simulation and in-situ straining transmission electron microscopy study, which investigates the interaction mechanisms between glissile dislocations and nanometer helium bubbles. The molecular dynamics simulations, which directly account for dislocation core effects through semi-empirical interatomic potentials, provide fundamental insight into the effect of helium bubble size and internal gas pressure on dislocation interaction and bypass mechanisms.

The results demonstrate the use of the latest simulation and experimental techniques to probe the underlying mechanisms governing the mechanical properties of irradiated metals. Reasonable agreement between experiments and simulations are found for the critical shear stress of under pressurized He bubbles in FCC metals. The internal pressure of the bubbles influences the critical shear stress as well as the dislocation interaction and bypass mechanism. Low (under-pressurized) pressure He bubbles are bypassed by dislocation annihilation and re-nucleation, as is the case for bare voids, resulting in a shear step of **b** in the bubble. Dislocation interaction with high pressure bubbles, which are greater than the equilibrium He pressure, depends strongly on the defect structure at the bubble matrix interface. Future work will further examine the effect of internal gas pressure, as well as the effect of dislocation morphology and the geometry of the dislocation/obstacle interactions.

Reference

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