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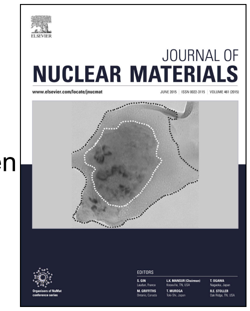

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Effects of interstitial defects on stress-driven grain boundary migration in bcc tungsten

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Abstract

We demonstrate via atomistic simulations that the addition of interstitial defects, either self-interstitials or helium can induce jog formation at grain boundary dislocations in bcc tungsten. For the two typical GBs with distinct dislocation structures, we show that the critical stress for stress-driven grain boundary migration is governed by the competition between the impeding effect of vacancy/helium and the facilitating effect of jogs depending on the grain boundary character, thus yielding different response of critical stress to defect concentrations. Specifically, for self-interstitials, the impeding effect of nucleated vacancies dominates in the ∑85 GB, while the facilitating effect of jogs dominates in the ∑13 GB; for helium, the impeding effect of helium plays a dominant role in both GBs. Moreover, we reveal a transition from coupled migration to pure sliding at high helium concentrations.

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