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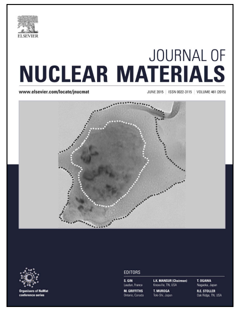

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Modeling the Impact of Radiation-Enhanced Diffusion on Implanted Ion Profiles

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Abstract. Ion irradiations are a valuable research tool for exploring radiation effects in materials. However, it is well recognized that the implanted ions can artificially modify the radiation damage evolution, e.g., enhancing amorphization processes at low irradiation temperatures and suppressing void swelling at elevated temperatures. Therefore, the implanted ion region should be avoided for most studies of ion irradiated materials. Due to increased interest in high damage, high temperature ion irradiations studying radiation effects in materials for proposed high dose Generation IV fission and fusion energy applications, it is crucial to quantify the extent of diffusional broadening of the implanted ion profile for a variety of temperatures, irradiation fluxes, and sink strengths. The present study summarizes computational analyses of thermal and depth-dependent radiation enhanced diffusion (RED) on diffusion broadening of the implanted ion profiles in Fe and Ni for a variety of irradiation conditions. For a low assumed RED coefficient (10^{-20}-10^{-19} m^2/s and 10^{-4} and 10^{-3} peak dpa/s, respectively) or high flux, broadening of the as-implanted ion profile is very small and a suitable artifact-free midrange region for analysis exists for ion energies above 5-6 MeV at 100 peak dpa. At high RED coefficients (10^{-19}-10^{-18} m^2/s and 10^{-4} and 10^{-3} peak dpa/s, respectively) broadening is much more significant, and no valid region for investigation exists below 6-8 MeV ion energies at any damage level >50 dpa. While increasing flux decreases irradiation time, it also increases the RED coefficient; these effects mostly offset except under recombination-dominant conditions. For typical high dose irradiation studies of void swelling that exceed ~100 displacement per atom (dpa), ion energies > 6-8 MeV must be employed in order to achieve suitable artifact-free