

Accepted Manuscript

Modeling the impact of radiation-enhanced diffusion on implanted ion profiles

Peter J. Doyle, Kelsa M. Benensky, Steven J. Zinkle

PII: S0022-3115(17)31721-X

DOI: [10.1016/j.jnucmat.2018.06.042](https://doi.org/10.1016/j.jnucmat.2018.06.042)

Reference: NUMA 51055

To appear in: *Journal of Nuclear Materials*

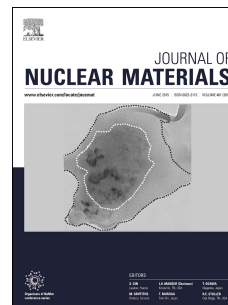
Received Date: 16 December 2017

Revised Date: 21 May 2018

Accepted Date: 26 June 2018

Please cite this article as: P.J. Doyle, K.M. Benensky, S.J. Zinkle, Modeling the impact of radiation-enhanced diffusion on implanted ion profiles, *Journal of Nuclear Materials* (2018), doi: 10.1016/j.jnucmat.2018.06.042.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



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

Peter J. Doyle^{1*}, Kelsa M. Benensky¹, and Steven J. Zinkle^{1,2}

¹*Department of Nuclear Engineering, University of Tennessee, Knoxville, TN 37996 USA*

²*Oak Ridge National Laboratory, Oak Ridge, TN 33831 USA*

* *Corresponding author: pdoyle3@vols.utk.edu*

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} m²/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} m²/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

Download English Version:

<https://daneshyari.com/en/article/7963049>

Download Persian Version:

<https://daneshyari.com/article/7963049>

[Daneshyari.com](https://daneshyari.com)