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To the Editors of the Journal of Nuclear Materials,

Please find enclosed our manuscript entitled “Modeling Injected Interstitial Effects on Void Swelling in Self-Ion Irradiation Experiments,” concerning the specific simulation of the injected interstitial effect on the predicted shape of the void swelling vs. distance curve in the self-ion irradiation of pure iron.

With the closure of more and more neutron irradiation facilities, and the simultaneous need for accelerated, irradiation testing of nuclear materials, remaining cognizant of the neutron-atyipcal effects resulting from ion irradiation is becoming more and more important. One in particular, the injected interstitial effect, arises when the irradiation ions themselves implant in the material as excess interstitials, causing a point defect production imbalance. Even though the relative magnitude of interstitials produced by this method compared to direct cascade production is 3-4 orders of magnitude smaller, their effect on the resultant void swelling profile is remarkable. Recent experiments in pure iron showed an unexpected “double peak” in the void swelling curve, which we have explained using our model in this manuscript as a combination of the injected interstitial and free surface effects causing localized defect imbalances. We do so by implementing the point defect kinetics equations in a spatially varying finite element framework, where the injected interstitials can be “turned off” at will to show their effect on the results.

Our model is admittedly simple, yet its implications are meant to alert the community that there is no “uniform damage” region in terms of resultant radiation effects. This effect is gaining wider acceptance in more recent studies, and yet studies are still performed where researchers mention this uniform damage region, or do not properly account for expected, resultant damage profiles. We also show how this double peak effect is expected to change dramatically with temperature, to the point of disappearing outside a +/- 30C window. This should motivate a confirmatory experimental study to help validate the model.

We are aware that other researchers are working on far more comprehensive and complete models of radiation damage. Even so, we feel that this work merits publication in the Journal of Nuclear Materials, as it is one of the few complete models supplied with an open source, working code which other researchers can use for themselves. Therefore, it could become a quick tool for experimentalists to predict whether a double peak should be expected during self-ion irradiation for other materials, at which dose rates, and at which temperatures.

Sincerely,

