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RESULTS OF RECENT MULTISCALE RESEARCH ON THE BEHAVIOR OF HELIUM IN METALS*

R. E. Stoller, T. Seletskaia, S. I. Golubov and Yu. N. Osetskiy
Oak Ridge National Laboratory, PO Box 2008, MS-6138, Oak Ridge, TN 37831-6138
rkn@ornl.gov

Continuing advances in computational hardware and algorithms permits much more detailed simulations of material performance to be carried out. A prominent example is the behavior of helium in irradiated metals, which has remained an unresolved problem in the fusion materials community. Helium is produced by nuclear transmutation reactions in materials exposed to high energy neutrons. Most relevant experimental data has been obtained from materials irradiated in fission reactors, where the neutron energy spectrum includes relatively few neutrons above 1 to 2 MeV. In contrast, DT fusion neutrons are born at 14.1 MeV and the high energy portion of the neutron spectrum in fusion reactor will be substantially different than that in a fission reactor. Since the threshold for (n,α) reactions in many materials is in the range of 2 to 5 MeV, helium production levels in fusion reactor materials will be much higher. Modeling and simulation of the impact of helium on material behavior provides the opportunity to bridge the gap between the fission and fusion reactor environments. Recent work to be discussed includes *ab initio* calculations of fundamental helium defect properties in iron, the development and application of an iron-helium interatomic potential for larger-scale atomistic simulations of the evolution of small helium-vacancy clusters, and the use of advanced cluster dynamics models to predict helium bubble evolution at longer times.

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