Comparative study of survived displacement damage defects in iron irradiated in IFMIF and Fusion Power Reactors

S.P. Simakov, U. Fischer and V. Heinzel
Forschungszentrum Karlsruhe, Zimer 203, Gebaeude 451, Abteilung HVT-TL, Postfach 3640, D-76021 Karlsruhe, Germany
simakov@irs.fzk.de

The mission of International Fusion Material Irradiation Facility (IFMIF) is to provide the neutron source to test samples of candidate materials for fusion power reactors (FPR). The most challenge goal is to achieve an annual radiation dose in the High Flux Test Module (HFTM) up to 20 displacements per atom for the low activation steel to predict its radiation behaviour in the first wall (FW) of a FPR.

Many efforts have been already applied to evaluate the expected damage rate and show that IFMIF will represent radiation materials properties for fusion technology. All these assessments relied on the model of the Norgett, Robinson and Torrens (NRT), which predicts only the number of primary displaced atoms produced in neutron induced reactions and atomatom collisions. Recent new theoretical considerations based on molecular dynamics model (MD) analyses have shown that during the cascades evolution many primary vacancies and interstitials will recombine. The survival ratio (number of survived defects to NRT predictions) depends on the energy of primary knock-on atom (PKA) and rapidly decreases form 1 to 0.25 as the PKA energy increases. Thus the number of survived displacements averaged over the neutron spectrum will essentially decrease and will be different for irradiations in IFMIF and FPR, since their neutron spectra are different in shape and extend to the different highest energies 55 MeV and 15 MeV, correspondingly.

In the present work the absolute number of survived radiation defects will be assessed for iron irradiated in the HFTM/IFMIF in comparison with FW/FPR. This is done by calculating the PKA spectra in the different irradiation environments and applying the defect survival ratios based on MD simulations. This procedure allows to assess the radiation induced displacement damage on the basis of the advanced knowledge of the defect formation mechanisms.

Number of words in abstract: 293
Keywords:
Technical area: 11. Multiscale modeling for fusion materials and structure
Special session: Not specified
Presentation: No preference
Special equipment: No special equipment