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Irradiation-induced Nanocluster Evolution

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ABSTRACT

Oxide dispersion strengthened steel (ODS) and commercial ferritic-martensitic (F-M) alloys are widely accepted candidate structural materials for designing advanced nuclear reactors. Nanoclusters embedded in the steel matrix are key microstructural features of both alloy types. Irradiation from nuclear fusion and fission affects the morphology of these nanoparticles, altering the performance of the alloys and potentially decreasing their usable lifetime. Thus, it is important to understand the effect of irradiation on these nanoparticles in order to predict long-term nuclear reactor performance. It was found that the evolution of nanoclusters in each material is different depending on the experimental irradiation parameters. The Nelson-Hudson-Mazey (NHM) model has been refined based on previous experimental work, and has been shown to be an effective model to simulate irradiation-induced nanocluster evolution in ODS and F-M steels. In this work, an NHM simulation tool was developed for nanoHUB, with a simplified user interface that enables rapid prediction of the effect of irradiation on the size of nanoclusters in a variety of Fe-based steels.

KEYWORDS

Nuclear energy, Nanotechnology, Nanocluster evolution