Study of B2 and Laves Phase Evolution in a Novel Ferritic Steel under Ion Irradiation

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A novel ferritic steel (Fe-12Cr-3W-3Ni-3Al-1Nb, wt.%) has been computationally designed to contain B2 and Laves phases to both strengthen the alloy and enhance irradiation damage resistance. The stability of the two types of precipitate phases was investigated after Fe^{2+} ion irradiation up to 220 dpa at 475°C using transmission electron microscopy and x-ray energy dispersive spectroscopy. The B2-NiAl precipitates ~13 nm in size remained crystalline and relatively stable after irradiation. Irradiation slightly decreased the B2 precipitate size and increased its density at ~100 dpa. The Laves phase $(Fe,Cr)_2(Nb,W)$ were present in a bimodal size distribution and their radiation response depended on their size. The coarse micron-scale Laves phase precipitates were amorphized with a slight composition change, while the finer Laves phase particles ~100 nm in size were partially disintegrated with a noticeable composition change. Meanwhile, many Nb/Cr-enriched particles ~8 nm in size formed within a few hundreds of nanometers from the disintegrated Laves phase particles.