Compositional Complexity Effectively Modifies Defect Migration Barriers

Scientific Achievement

Studies of irradiated materials show that defect clusters in NiCo and NiFe migrate much slower and less deeply than in pure Ni, demonstrating that compositional complexity leads to different migration rates of defects.

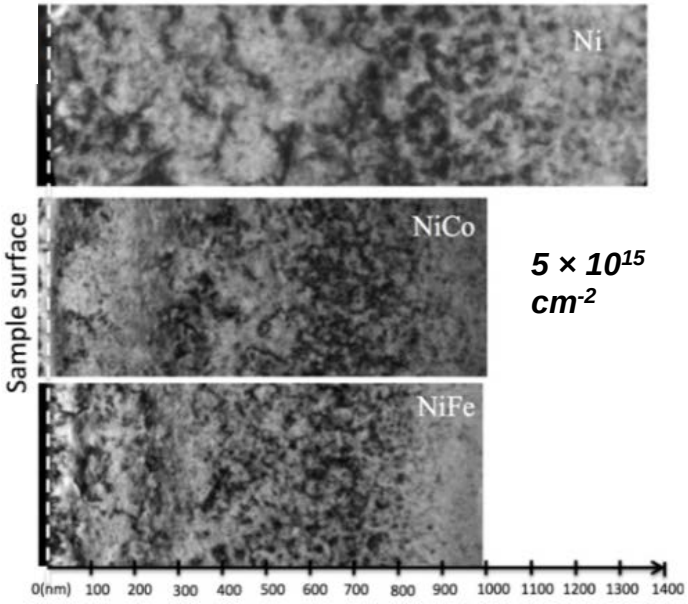
Significance and Impact

Tuning compositional complexity can localize defects to a more confined region in the alloys than in pure nickel, which promotes defect recombination and leads to an improved radiation tolerance.

Research Details

– Transmission electron microscopy images show that defect clusters migrate faster in pure Ni than in the alloys.

– Microstructural observations and molecular dynamic simulations show that the damage in Ni and Ni-alloys are vacancy-type stacking fault tetrahedra and interstitial-type dislocation loops.



Cross-sectional transmission electron microscopy images of Ni, NiCo and NiFe showing irradiation-induced damage is much deeper in Ni, as compared with the two binaries.

C. Lu, K. Jin, L. K. Beland, F. Zhang, T. Yang, L. Qiao, Y. Zhang, H. Bei, H. M. Christen, R. E. Stoller, L. Wang, "Direct Observation of Defect Range and Evolution in Ion-Irradiated Single Crystalline Ni and Ni Binary Alloys," *Sci. Rep.* **6**, 19994; doi: 10.1038/srep19994 (2016).