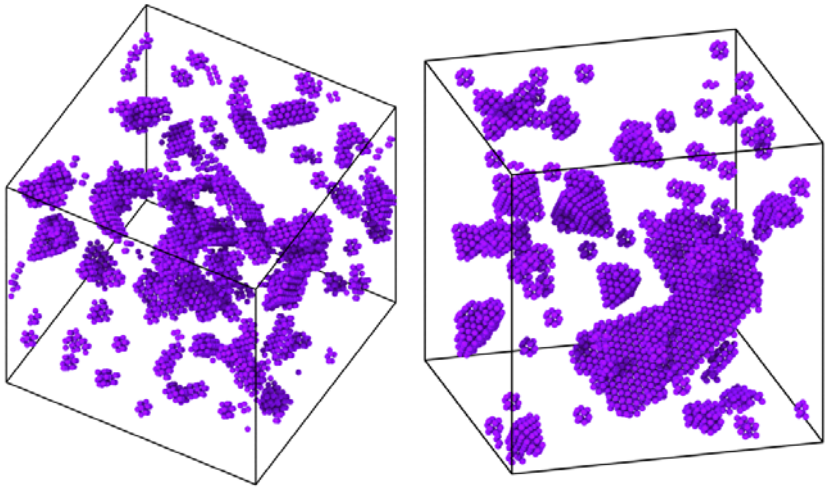
Mechanism of Reduced Radiation Damage Identified in Complex Alloys

Scientific Achievement

Randomly arranged elemental species in NiFe and NiCoCr alloys, compared to elemental Ni, lead to a substantial reduction of damage accumulation under prolonged irradiation, due to reduced defect mobility that leads to slower growth of large dislocation loops.

Significance and Impact

Chemically disordered single-phase alloys with increasing number of principal elements at significant concentrations may be radiation-tolerant alloys.



Randomly distributed Ni and Fe atoms in NiFe (left) leads to reduced dislocation mobility and smaller clusters, as compared to pure Ni (right).

Research Details

- Lower damage level in alloys than in pure Ni is determined from both ion channeling experiments and cross-sectional transmission electron microscopy characterization, with more chemically disordered NiCoCr outperforming NiFe.
- Molecular dynamics simulations reveal that the significantly suppressed dislocation mobility in equiatomic alloys is not specific to the model systems of Ni, NiFe and NiCoCr.

F. Granberg, K. Nordlund, M. W. Ullah, K. Jin, C. Lu, H. Bei, L. Wang, F. Djurabekova, W. J. Weber, and Y. Zhang, "Mechanism of radiation damage reduction in equiatomic multicomponent single phase alloys," *Phys. Rev. Lett.* **116**, 135504 (2016). DOI: 10.1103/PhysRevLett.116.135504.

U.S. DEPARTMENT OF ENERGY | Office of Science
UNIVERSITY OF HELSINKI
THE UNIVERSITY of TENNESSEE KNOXVILLE
UNIVERSITY OF MICHIGAN
OAK RIDGE National Laboratory