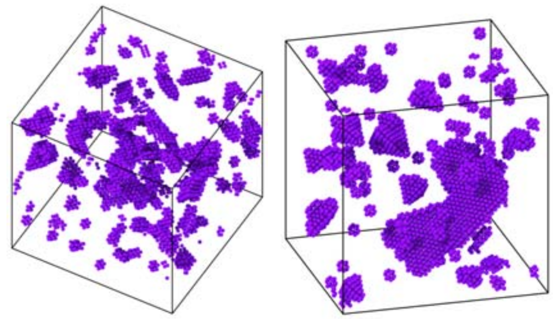
# Mechanism of Reduced Radiation Damage Identified in Complex Alloys

An integrated experimental and modeling study reveals that randomly arranged elemental species in NiFe and NiCoCr alloys lead to a substantial reduction of damage accumulation under prolonged irradiation, compared to elemental Ni. The radiation damage reduction is attributed to reduced dislocation mobility, which leads to slower growth of large dislocation loops. Understanding alloying effects on modified energy landscapes in chemically disordered single-phase alloys will allow prediction of radiation-tolerant alloys for next-generation nuclear reactors and other high-radiation environments.



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

In equiatomic multicomponent single-phase alloys, the random arrangement of multiple elemental species on a crystalline lattice results in unique site–to–site lattice distortions. Suppressed damage accumulation under ion irradiation is observed in Ni, NiFe and NiCoCr,[1] in the same trend as the increasing chemical complexity. The analysis reveals that alloying effects on reduction of dislocation mobility are not specific to the current materials studied or number of elements in the system. The large improvement from NiFe to NiCoCr demonstrates that damage reduction will depend on material choice. With a practically limitless number of elemental combinations, opportunities abound to exploit chemical complexity to create better alloys.

[1] 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.* 1**16**, 135504 (2016). DOI: 10.1103/PhysRevLett.116.135504.