SWIFT HEAVY ION INDUCED MICROSTRUCTURAL CHANGES IN OXIDE DISPERSION STRENGTHENED HIGH-ENTROPY ALLOYS

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High-entropy alloys (HEAs) are promising candidates for Generation IV nuclear reactors due to their enhanced radiation resistance and mechanical properties [1]. The Cantor alloy and its

derivatives serve as ideal model systems for studying fundamental radiation damage mechanisms in concentrated solid solutions. Oxide dispersion strengthening (ODS) is commonly used to improve radiation tolerance by introducing nanoscale oxide particles that act as dislocation barriers and defect sinks. However, the stability of oxide particles under fission fragment irradiation—typically simulated by swift heavy ion (SHI) irradiation—remains insufficiently studied. High electronic energy losses can cause amorphization or phase transformations in oxide inclusions, potentially degrading alloy performance.

In the present work we investigated the radiation response of ODS CoCrFeNi under SHI irradiation. The alloy was synthesized by spark plasma sintering (SPS) at 980°C at the Institute of Materials Science, Vietnam Academy of Science and Technology. Samples exhibited a single-phase FCC structure with dispersed oxide particles ranging from several to tens of nanometers. Microstructural characterization revealed two nanoparticle types: Cr_2O_3 and complex Y-Si-O precipitates.

SHI irradiation was performed using 3.7 MeV/nucleon Xe ions at the U400 cyclotron (FLNR JINR) at room temperature to a fluence of 5×10^{11} cm^{-2}. Microstructural analysis of the near-surface region, where the electronic stopping power was ≈38 keV/nm for the metal matrix, revealed latent track formation in oxide particles with diameters of several nanometers. No significant changes occurred in the FCC matrix structure. The study provides important insights into oxide behavior under severe irradiation and demonstrates the practical value of CoCrFeNi as a representative system for probing radiation effects in multicomponent alloys.

The work was funded by the Russian Science Foundation, The Russian Federation (grant No 25-72-10101, https://rscf.ru/project/25-72-10101/).

References:

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