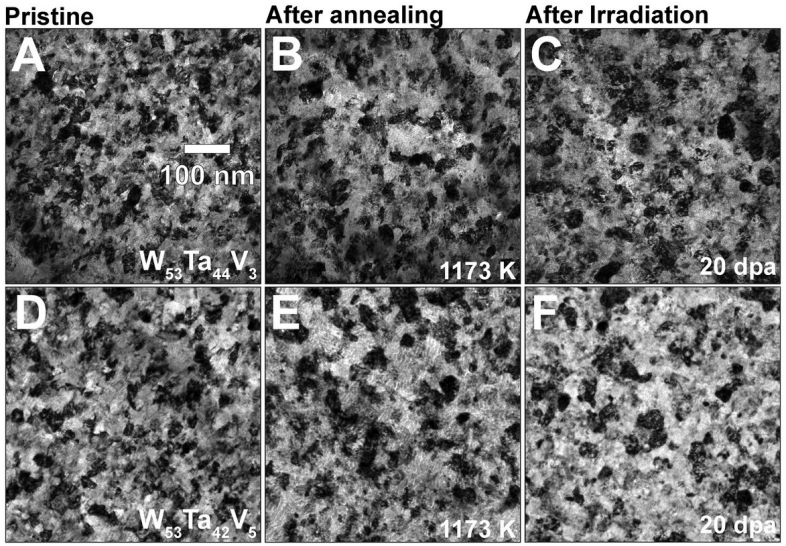
Engineering Radiation Resistant Nanomaterials in Nuclear Fusion Technologies

Scientific Achievement

Demonstration via irradiation-testing and characterization experiments that new HCRAs can be developed, and their radiation response can be tailored as a function of minor modifications in the alloys' chemistry.



Response to annealing and irradiation | BFTEM micrographs taken at pristine condition, after annealing (at 1173 K) and after irradiation (at 1073 K) are shown in (A–C)and (D–F), respectively for the W53Ta44V3 and the W53Ta42V5 HCRAs.

Significance and Impact

The experiments conducted in this study provide preliminary evidence that the HCRA alloys investigated could be viable candidates for further evaluation in materials test reactors (MTRs).

Research Details

- Two new nanocrystalline HCRAs were synthesized and investigated in this work: W53Ta42V5 and W53Ta44V3.
- Atomistic simulations of short-range order in these bcc HCRAs unraveled the significant role of V alloying effects on radiation-induced micro-structural stability and defect formation properties in W–Ta–V via a systematic investigation of dependence in CSRO for the Ta-V in 1NN and those for the W-V in 2NN as a function of V concentration and temperature.

Tunes, M. A.; Parkison, D.; Sun, B.; Willenshofer, P.; Samberger, S.; Frühwirth, C.; Tripathi, S.; Derby, B. K.; Baldwin, J. K.; Fensin, S. J.; Sobieraj, D.; Wróbel, J. S.; Byggmästar, J.; Pogatscher, S.; Martinez, E.; Nguyen-Manh, D.; El-Atwani, O. High Radiation Resistance in the Binary w-TA System through Small V Additions: A New Paradigm for Nuclear Fusion Materials. *Advanced Science* **2025**. DOI:10.1002/advs.202417659.

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