INL/CON-22-67689-Revision-0

The challenges of ?-uranium: fundamental understanding of a past and future nuclear fuel material.

May 2024

Andrea M Jokisaari, B. Beeler, Y. Wang

Changing the World's Energy Future

Idaho National Laboratory

INL is a U.S. Department of Energy National Laboratory operated by Battelle Energy Alliance, LLC

INL/CON-22-67689-Revision-0

The challenges of ?-uranium: fundamental understanding of a past and future nuclear fuel material.

Andrea M Jokisaari, B. Beeler, Y. Wang

May 2024

Idaho National Laboratory
Idaho Falls, Idaho 83415

http://www.inl.gov

Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517

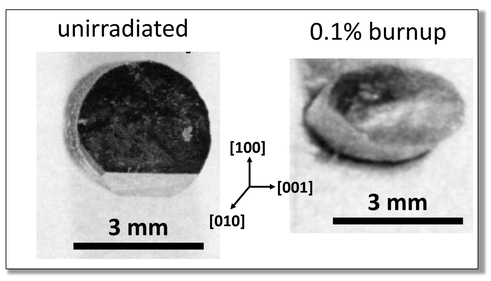
The challenges of α-uranium

Fundamental understanding of a past and future nuclear fuel material

A. Jokisaari[1], B. Beeler[2], K. Mahbuba[2], Y. Wang[3]

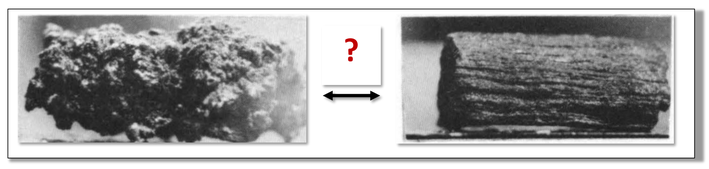
1. Idaho National Laboratory, 2. North Carolina State University, 3. University of Michigan

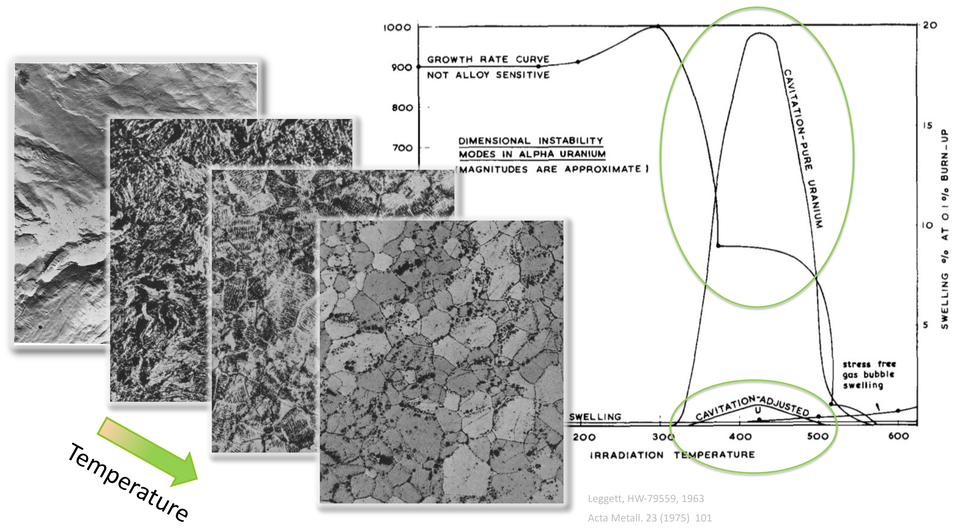
A modern study of α-U benefits metallic fuels and basic science



Paine, ANL-5676, 1958

Leggett, HW-79559, 1963





Leggett, HW-79559, 1963

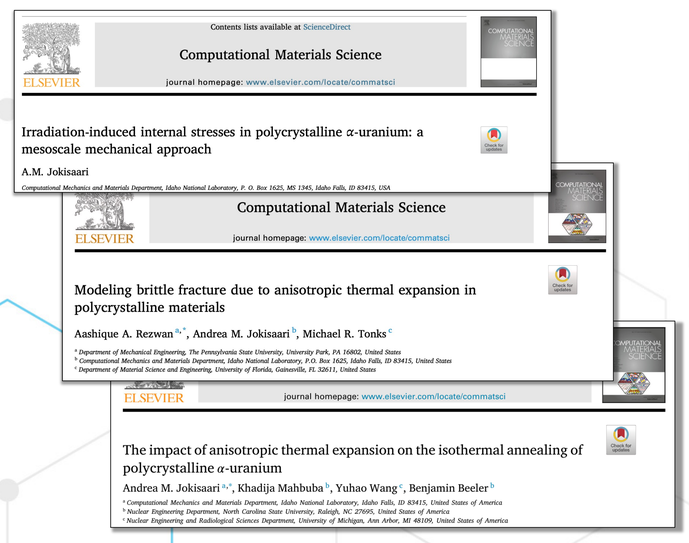
Acta Metall. 23 (1975) 101

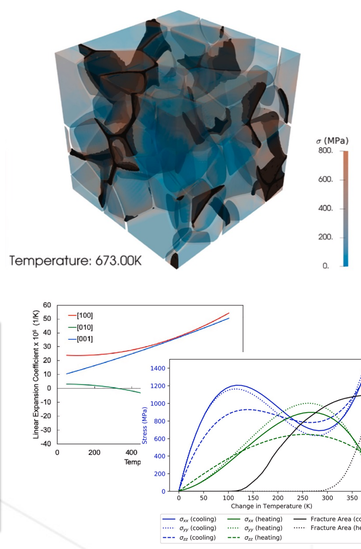
α-U is orthorhombic and its physical properties are extremely anisotropic and temperature-dependent

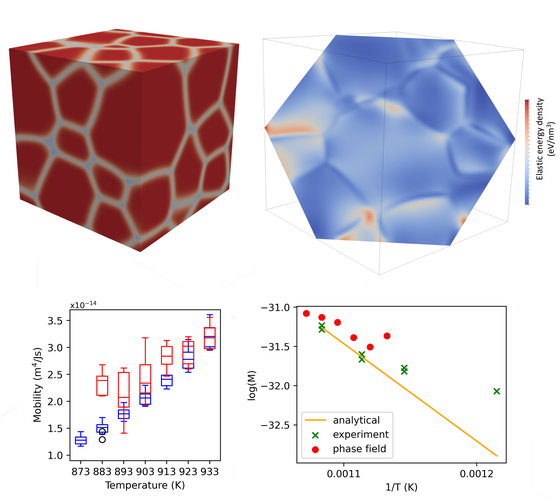
α-U is found in several metallic fuels

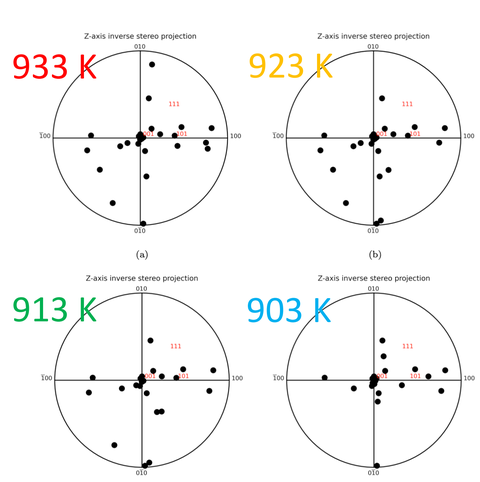
Fundamental behaviors of α-U have been mostly ignored since the 1970s

Mesoscale studies shed light on complex polycrystalline behaviors

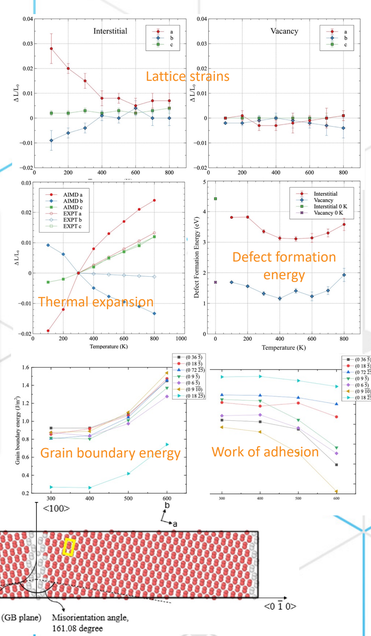


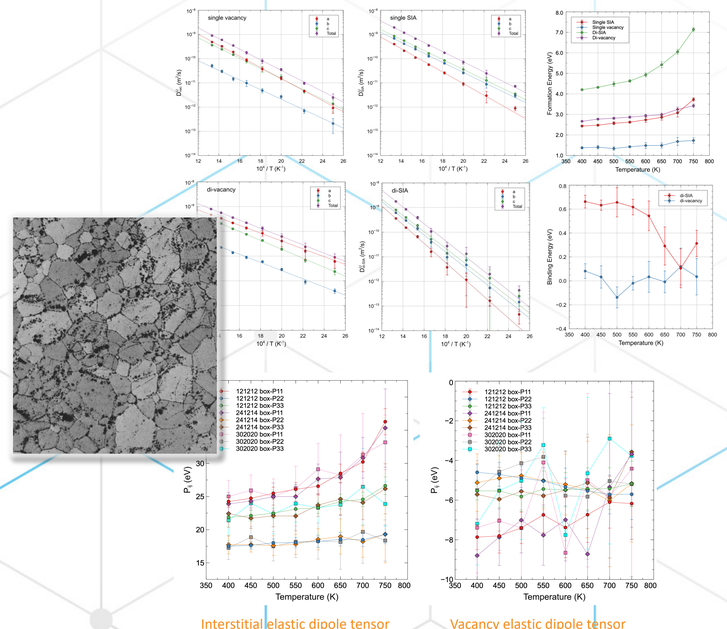






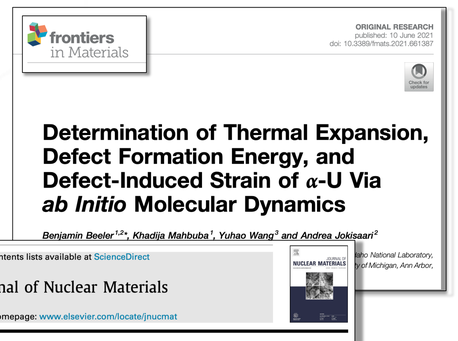
Atomistic investigations suggest several mechanisms for irradiation behavior

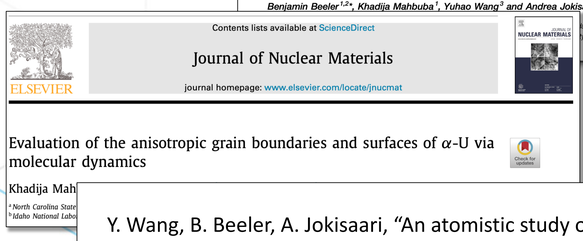




Interstitial elastic dipole tensor

Vacancy elastic dipole tensor





Y. Wang, B. Beeler, A. Jokisaari, "An atomistic study of fundamental bulk and defect thermodynamic properties in α-uranium," under review, Journal of Nuclear Materials

Gaining physical insights

www.inl.gov

Idaho National Laboratory