# Accepted Manuscript


The effect of low-temperature aging on the microstructure and deformation of uranium- 6wt% niobium: An in-situ neutron diffraction study

D.W. Brown, M.A.M. Bourke, A.J. Clarke, R.D. Field, R.E. Hackenberg, W.L. Hults, D.J. Thoma

PII: S0022-3115(16)30717-6

DOI: 10.1016/j.jnucmat.2016.09.004

Reference: NUMA 49913

To appear in: *Journal of Nuclear Materials*

Received Date: 31 March 2016

Revised Date: 1 September 2016

Accepted Date: 6 September 2016

Please cite this article as: D.W. Brown, M.A.M. Bourke, A.J. Clarke, R.D. Field, R.E. Hackenberg, W.L. Hults, D.J. Thoma, The effect of low-temperature aging on the microstructure and deformation of uranium- 6wt% niobium: An in-situ neutron diffraction study, *Journal of Nuclear Materials* (2016), doi: 10.1016/j.jnucmat.2016.09.004.

Draft Feb. 2016

# The Effect of Low-Temperature Aging on the Microstructure and Deformation of Uranium- 6wt% Niobium: An In-Situ Neutron Diffraction Study

D.W. Brown[1], M.A.M. Bourke[1], A.J. Clarke[2], R.D. Field[1], R.E. Hackenberg[1], W.L. Hults[1], D.J. Thoma[3]

[1]Material Science and Technology Division, Los Alamos National Laboratory, Los Alamos, NM, 87545

[2] Department of Metallurgical and Materials Engineering, Colorado School of Mines, 1500 Illinois Street, Golden, CO 80401

[3] Department of Materials Science and Engineering, University of Wisconsin Madison, Madison WI 53706

ABSTRACT

The mechanical properties of uranium-niobium alloys evolve with aging at relatively low temperatures due to subtle microstructural changes. *In-situ* neutron diffraction measurements during aging of a monoclinic U-6Nb alloy at temperatures to 573 K were performed to monitor these changes. Further, *in-situ* neutron diffraction studies during deformation of U-6Nb in the as-quenched state and after aging for two and eight hours at 473 K were completed to assess the influence of microstructural evolution on mechanical properties. With heating, large anisotropic changes in lattice parameter were observed followed by relaxation with time at the aging temperature. The lattice parameters return to nearly their initial values with cooling. The active plastic deformation mechanisms including, in order of occurrence, shape-memory de-twinning, mechanical twinning, and slip-mediated deformation do not change with prior aging. However, the resistance to motion of the as-quenched martensitic twin boundaries increases following aging, resulting in the observed increase in initial yield strength.