4.3 NEUTRON ENERGY SPECTRUM INFLUENCE ON IRRADIATION HARDENING AND MICROSTRUCTURAL DEVELOPMENT OF TUNGSTEN — Makoto Fukuda[1], N.A.P. Kiran Kumar[2], Takaaki Koyanagi[2], Lauren M. Garrison[2], Lance L. Snead[3], Yutai Katoh[2], Akira Hasegawa[1], 1- Tohoku University, 2- Oak Ridge National Laboratory, 3- Massachusetts Institute of Technology

This is the abstract of a paper submitted to The Journal of Nuclear Materials.

Neutron irradiation to single crystal pure tungsten was performed in the mixed neutron spectrum High Flux Isotope Reactor (HFIR). To investigate the neutron energy spectrum influence, the microstructure development and irradiation hardening was compared to previous data obtained by irradiation in the mixed neutron spectrum Japan Material Testing Reactor (JMTR) and the fast neutron spectrum Joyo reactor. The irradiation temperatures were in the range of ~90 to ~800°C and neutron fluences of 0.02 to 9.00 x 10^{25} n/m^2 (E > 0.1 MeV). Post irradiation evaluation included Vickers hardness measurements and TEM observation. Hardness and microstructure changes exhibited a clear dependence on the neutron spectrum. Hardness appeared to increase with increasing thermal neutron dose >1 x 10^{25} n/m^2 (E>0.1 MeV). Irradiation induced precipitates of χ- and σ-phase were observed in these samples, which were pronounced at high dose and due to the very high thermal neutron flux of HFIR. The result of the precipitates was additional and significant measured hardening of tungsten.