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Zircaloy-4 for Low-Temperature Use with Hydrogen and Neutron Exposure

L. M. Garrison and C. Silva*
Materials Science and Technology Division
Oak Ridge National Laboratory, One Bethel Valley Road, Oak Ridge, TN 37831 – USA
*Current affiliation TerraPower 330 120th Avenue NE, Suite 100 Bellevue, WA 98005 – USA

ABSTRACT

Zircaloy-4 has been used in the nuclear industry for many applications. Now it is being considered for a low temperature application as the vessel material of a liquid uranium solution for Mo-99 production. In this application, it will be exposed to neutrons and hydrogen, both causing degradation. Samples of Zircaloy-4 base metal and tungsten-inert-gas (TIG) welded samples were hydrided to 250 and 500 ppm H to determine the changes to the microstructure and mechanical properties caused by the hydride formation. A range of times and temperatures for heat-treating the TIG welded samples were evaluated. The most promising post-weld heat treatment was a 1 h hold at 800°C. Microhardness and tensile tests are being conducted to determine the effects of the weld and hydriding on the mechanical properties. Samples are being prepared for neutron irradiation at temperatures of 60 and 100°C and fluences of 1×10^{20} and 1×10^{21} n/cm^2 (E>0.1 MeV).

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