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Mechanical Properties of a Neutron Irradiated Nano-structured Ferritic Alloy

D. Mcclintock\(^a\), D. Hoelzer\(^b\), M. Sokolov\(^c\), R.K. Nanstad\(^b\) and R. Stoller\(^d\)

\(^a\)Materials Science and Technology Division, ORNL - Oak Ridge National Laboratory, P.O. Box 2008, Bldg 4500S - MS 6151, Oak Ridge, TN 37831-6151, United States of America
\(^b\)Oak Ridge Noational Laboratory, PO 2008, MS 6138, Oak Rdge, TN 37931-6138, United States of America
\(^c\)Materials Science and Technology Division, Oak Ridge National Laboratory, 1 Bethel Valley Rd., P.O. Box 2008, Oak Ridge, TN 37831-6138, United States of America
\(^d\)Materials Science and Technology Division, ORNL - Oak Ridge National Laboratory, P.O. Box 2008, Bldg 4500S - MS 6151, Oak Rdge, AK TN 37831-6151, United States of America
d6m@ornl.gov

Advanced nano-structured ferritic alloys (NFAs) containing a high density of ultra-fine (2-5 nm) nanoclusters enriched in Y, Ti, and O are considered promising candidates for structural components in future nuclear systems. The microstructure of a NFA is composed of nanometer sized regions rich in Y, Ti, and O uniformly distributed in a ferritic matrix. The high number density of nanoclusters in NFAs are responsible for their superior tensile strengths compared to conventional ODS ferritic alloys and may provide effective trapping centers for point defects and transmutation products produced during neutron irradiation. This paper summarizes irradiated and unirradiated mechanical properties of an advanced NFA, designated 14YWT, currently being developed at Oak Ridge National Laboratory. In addition to the superior tensile properties, recent experimental results have also indicated 14YWT has very unique and favorable fracture toughness properties down to liquid nitrogen temperatures. For this study an identical alloy to 14YWT, designated 14WT, was produced without nanocluster dispersions in order to quantify the effect of the nanoclusters on mechanical properties and microstructure. Mechanical properties characterization, including unirradiated and irradiated tensile, fracture toughness, and hardness data, will be presented for each alloy along with preliminary microstructure characterization results.

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