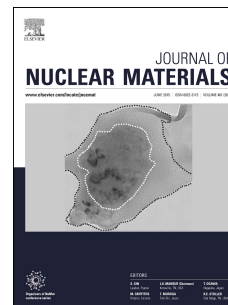


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# Stress Levels and Failure Modes of Tantalum-Clad Tungsten Targets at ISIS

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## Abstract

The ISIS spallation neutron source operates two tantalum-clad targets. Efforts to understand the operating conditions and lifetime limiting factors of these targets are ongoing, driven in part by premature failures of several recent TS2 targets. The Hot Isostatic Press (HIP) process used in target manufacturing is thought to introduce large residual stresses, particularly in the tantalum cladding. In addition, the pre-stressed target materials are subjected to cyclic proton beam heating and irradiation damage during operation. Manufacturing and beam-induced stresses were simulated using finite element analysis. The residual stress simulation results appear largely consistent with the findings from recent neutron diffraction measurements on an ISIS target plate. Simulations of the beam induced cyclic stress in the target, together with the available tantalum fatigue data, indicate that there is a large safety margin on the material fatigue limit and that a fatigue failure in the ISIS target cladding is therefore unlikely.

## Keywords

Spallation, Target, Tantalum, Tungsten, Simulation, Residual Stress, Hot Isostatic Press, Cyclic Loading, Fatigue Life, Radiation Damage

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