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Thermo-Mechanical Analysis of ISIS TS2 Spallation Target

Tuesday, 20 May 2014 15:30 (25 minutes)

A detailed thermal and mechanical analysis was carried out for the spallation target of the ISIS 2nd target station (TS2). The objective was to develop a better understanding of operating conditions in the target and to identify factors limiting target lifetime.
The TS2 target consists of a solid tungsten rod, with tantalum cladding to improve corrosion resistance. The cladding is bonded to the tungsten using the Hot Isostatic Press (HIP) process. FEA modelling was used to investigate the residual stress generated by HIPing. The simulated residual stress was large enough to cause yielding of the tantalum cladding. An experiment to measure the residual stress state in a HIPed plate has been carried out on the ISIS instrument ENGIN-X, and will be used to validate these models.
Steady-state and periodic components of beam induced stress were calculated using a transient FEA model. A bilinear material model with kinematic hardening was used to investigate the effects of periodic loading on the yielded cladding. Two different periodic load cases were considered: stress cycling due to beam pulses, and accident cases where the beam is tripped for several seconds or more. Fatigue life calculations were performed to assess the relative importance of the two cases.

Summary

A detailed thermal and mechanical analysis was carried out for the spallation target of the ISIS 2nd target station (TS2). Factors considered include fatigue lifetime and residual stress due to hot isostatic pressing.

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