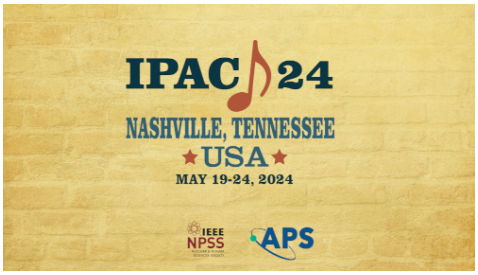

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Diffusion bonding of zircaloy-vanadium and vanadium-tungsten using vacuum hot pressing for the development of a low decay heat cladding solution for solid tungsten spallation targets

Thursday, 23 May 2024 16:00 (2 hours)

Tantalum has been used as cladding material for water-cooled solid tungsten targets at many leading spallation neutron production facilities thanks to its high neutron yield, manageable radiation damage behavior, and excellent corrosion/erosion resistance in radiation environments. However, thermal neutron capture of tantalum in spallation environment causes a high specific decay heat in the target volume, which often becomes a limiting factor in increasing the beam power on the target from a safety hazard perspective. In this paper, we have developed vacuum hot processing (VHP) parameters to diffusion bond zircaloy to tungsten to explore the feasibility of using zircaloy as an alternative cladding material to tantalum. Zircaloy has long been used as cladding material for non-tungsten solid targets, and nuclear fuel rods. It causes significantly lower decay heat with shorter decay time in the target compared to tantalum in spallation environments. The hot isostatic pressing (HIP) of zirconium and tungsten is known to produce limited bonding quality due to the formation of brittle ZrW2 intermetallic layer. To overcome this problem, placing vanadium interlayer between tungsten and zircaloy has been proposed. The zircaloy-vanadium and vanadium-tungsten under the same VHP conditions, 850℃ at 120 MPa for 4 hours showed good diffusion bonding qualities, which demonstrates the feasibility of a single step HIP process to make the zircaloy clad tungsten spallation volume.

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Primary author: LEE, Yong Joong (Oak Ridge National Laboratory)

Co-authors: MONTROSS, Joel (Los Alamos National Laboratory); MACH, Justin (Oak Ridge National Laboratory); MUTH, Thomas (Oak Ridge National Laboratory)

Presenter: LEE, Yong Joong (Oak Ridge National Laboratory)

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