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Tungsten Alloy Development as Advanced Target Materials For High Power Proton Accelerators (REMOTE)

Thursday 20 December 2018 11:00 (25 minutes)

This presentation will introduce the current status on advanced materials development activities for neutron- and muon-production target applications in MLF (Material and Life Science Facility) 2nd Target Station at J-PARC (Japan Proton Accelerator Research Complex) which will be submitted as a next master plan to Science Council of Japan.
Tungsten (W) is a principle candidate as target material because of its high density (19.3 g/cm3) and extremely high melting point (3420°C). The use of W leads to provide 10 times higher brightness of muons and neutrons than that of the current target materials. Actually, a W target is considered to be used in the upcoming projects such as COMET Phase 2 and MLF 2nd Target Station at J-PARC, Mu2e at Fermilab, SNS 2nd Target Station at ORNL, and neutron target at ESS [2]. However, W is known to exhibit significant embrittlement by recrystallization (recrystallization embrittlement) and by irradiation (irradiation embrittlement). Extensive efforts have been made to develop W materials that exhibit enhanced resistances to these types of embrittlement and TFGR (Toughened, Fine Grained, Recrystallized) W-1.1%TiC has been considered as a realized solution to the embrittlement problems. TFGR W-1.1%TiC exhibits grain boundary reinforced nanostructures containing a high density of effective sinks for irradiation-induced point defects, a DBTT (Ductile-to-Brittle Transition Temperature) down to around RT and enhanced resistances against surface damages by thermal shock/fatigue in the recrystallized state. The material is fabricated via a power metallurgical route consisting of MA (Mechanical Alloying), HIP and GSMM (Grain boundary Sliding based Microstructural Modifications), with the currently available size of about 30 mm x 30 mm x 10mm. We initiated to fabricate TFGR W-1.1%TiC and/or more improved W materials with sufficient dimensions for the target applications and investigate their feasibility as the target materials in 2016. While applying for budget acquisition to embody and integrate the W alloy fabrication processes, we are in the stage of producing TFGR W-1.1%TiC samples with the size of about 20 mm in diameter and about 3 mm in thickness.
The manufactured specimens were supplied and were successfully irradiated at CERN-HiRadMat, HRT48 PROTAD on September 28th of 2018.
The presentation will address our methodology to surmount the shortcomings of the conventional W materials and focus on prospective outcomes from the applications of the TFGR W alloys to proton targets.

Primary authors: Mr MAKIMURA, Shunsuke (J-PARC, KEK); Prof. KURISHITA, Hiroaki (KEK); Mr NIIKURA, Koichi (Metal Technology Co., LTD); Dr JUNG, Hun-Chea (Metal Technology Co., LTD); Dr ONOI, Masahiro (Metal Technology Co., LTD); Mr NAGASAWA, Yutaka (Metal Technology Co., LTD)

Presenter: Mr MAKIMURA, Shunsuke (J-PARC, KEK)

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