RaDIATE 2018 Collaboration Meeting

Monday 17 December 2018 - Friday 21 December 2018

CERN

Book of Abstracts

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Advanced micromechanical testing techniques of irradiated materials and the ability to predict the bulk mechanical properties from small scale experiments

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Advanced micromechanical testing techniques of irradiated materials and the ability to predict the bulk mechanical properties from small scale experiments

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Capabilities of the Brookhaven Linear Isotope production Facility for Irradiation Damage Studies

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BLIP's energetic proton beams can be used to explore the effects of radiation on
novel materials under consideration for next generation nuclear reactors and high-power particle accelerators. By studying how proton irradiation affects materials (including different grades of beryllium and graphite, carbon fibers
and silicon-carbon fiber composites, and super alloys and steels), and assessing the damage using the bright x-ray beams at Brookhaven Lab's National Synchrotron Light Source II,scientists can determine the crucial properties

and ideal materials needed to withstand the extreme environments of next-generation reactors and accelerators. BLIP can also generate fluxes of fast neutrons for similar materials science studies relevant to the design of fusion and fast neutron reactors. Talk will highlight the capabilities available.

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Computational modeling of materials properties under irradiation

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Materials exposed to radiation can undergo undesirable changes, including radiation-induced swelling and creep, hardening, amorphization, phase segregation, and radiation-enhanced corrosion. At the fundamental level these changes are driven by defects that can aggregate into clusters and dislocations and segregate to interfaces, such as grain boundaries. The nature and dynamics of these defects are often difficult to resolve in experiments, particularly over long times, making predictions of materials performance challenging. I will discuss how we address this issue through development of multiscale models capable of simulating long-term evolution of defects in irradiated ceramics, using silicon carbide as an example. With this approach we identified stable defect clusters in irradiated SiC, as well as their dynamics and contributions to experimentally observed swelling. I will also discuss the role and evolution of interfaces in irradiated materials. While it is known that interfaces can act as sinks for defects, much less is understood about how the interfaces themselves evolve to absorb non-equilibrium flux of defects. In particular, I will share our recent discovery of radiation-induced segregation of elemental species in SiC to grain boundaries, a phenomenon previously only known for metals. Radiation-induced segregation can lead to significant changes in the grain boundary stoichiometry, an effect particularly surprising given that SiC is a line compound. Finally, I will give a brief overview of our computational studies of mechanisms underlying materials degradation due to corrosion and mechanical stresses.

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Current state of the art of the post-mortem irradiation examination (PIE) of one spent AD-Target

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Antiprotons are produced by colliding a pulsed 1.5*1013 proton per pulse proton beam of 26 GeV/c momentum from CERN Proton Synchrotron (PS) with a fixed target made of a dense and high-Z material: iridium. In the framework of the Extra Low Energy Antiproton Ring (ELENA) project, in order to address specific requirements for the new designs and operational procedures, a deep understanding of the target system and its behaviour with time has to be carried out. Part of this scope is achieved by the retrieve an iridium core rod (and optionally the Ti Gr5 window) inside one spent AD-target that was previously in function in the PS. This offer a unique occasion to investigate the long-term radiation damage induced by the impact of a high energetic proton beam with matter. The current state of the art of the post-mortem irradiation examination (PIE) through

mechanical and metallurgical characterisation of the target is presented here. Due to the high dose rate and contamination risks of the target, PIEs are conduced together with Framatome GmbH in Erlangen.

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DPA cross-section measurements and potential for HiRadMat

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Development, characterisation and testing of advanced materials through ARIES collaboration

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Discussion & working meetings

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Electron Beam Materials Irradiation Station for Evaluating Thermal Shock, Fatigue, and Radiation Damage in High Power Targetry Materials (REMOTE)

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It is proposed to develop a more efficient method to evaluate radiation damage effects on fatigue life and mechanical/physical properties of future target materials using an existing 9 MeV electron beam machine at Fermilab's IARC facility. This method is unique in that it replicates the prototypic thermal shock environment of high energy proton target facilities while simultaneously accumulating the displacement damage from interactions with electron beam without activating specimen. Here we will attempt to change electron beam parameters (spot size, flux etc.) in order to create comparable radiation damage and thermal stress waves in material as in case of intense proton beam in accelerator. We will also include instrumentation to measure high frequency micrometer scale surface oscillations for fatigue studies. This would give us unique opportunity to estimate fatigue life under simultaneous radiation damage which is more realistic of service conditions of targets in accelerators.

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Facility for Rare Isotope Beams Status

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Overview of the status of the Facility for Rare isotope Beam (FRIB)

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Further analysis of the ISIS Target Station 2 Proton Beam Window Failure. Service conditions, Design Analysis and Irradiation Effects

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Analysis of the conditions on the window while in-service.
Mechanical analysis of the window.
Possible irradiation effects contributing to the window failure.
Upcoming physical testing of the irradiated and un-irradiated window material.

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Future RaDIATE-related experiments at HiRadMat

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HRMT48 PROTAD experiment and relevance for BIDs

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HRMT48-PROTAD Experiment and Relevance for BIDs

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For antiproton production at CERN, high energy (26 GeV/c), intense, and fast extracted proton beams are impacted into the AD-Target, whose core consists in a small rod made of a dense metal. Temperature rises in the order of 2000 ℃ and subsequent dynamic stresses of several gigapascals are induced in this rod every time is impacted by the primary proton beam. Several R&D activities have been launched during the last years with the goal of proposing and manufacturing a new design of such device. A summary of these activities is presented, including the last design stage which involves the manufacturing and testing of six real scale prototypes in the HiRadMat facility within the HRMT-48 experiment. These targets prototypes (named PROTAD) consist in air-cooled Ti-4V-5Al assemblies filled by matrices made of isostatic graphite or expanded graphite (EG), containing target cores made of small rods with different diameters (from 2 mm to 10 mm) of multiple grades of Ta, Ta2.5W, W-TiC and Ir. The outcomes of this experiment will be relevant for all the BIDs –in addition to antiproton production- exposed to extreme dynamic loading, in which the beam intercepting material is inevitably subjected to stresses above its yield strength. In addition, possibilities of application of pre-compressed EG as BID component material is also discussed.

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HiRadMat facility experience and perspectives for post LS2

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Introduction to the workshop

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Ion Irradiation Facilities

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A summary of ion irradiation facilities will be provided, including the UK National Ion Beam Centre. Facilities from around Europe and the USA will be summarised. Indication will be given on the facilities available at example facilities and where possible (within time and space constraints) some examples will be provided. According to the IAEA Accelerator Knowledge Portal There are over 200 research ion beam accelerators operating across 49 countries so it will not be possible to mention all of them.

A new EU project (RADIATE) which will provide Trans National Access (TNA) to a selection of irradiation facilities across Europe will be starting at the beginning of 2019 for a four year period. Preliminary information on this and how access is envisaged to work will be given.

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Ion Irradiation facilities survey

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Irradiation damage in structural materials of fission and fusion reactors: effects of dose, dose rate, temperature, neutron versus ion beam irradiation, analysis techniques.

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Understanding and predicting the effects of irradiation on complex alloys such as structural "ferritic" steels used in fission and fusion reactors is a tremendous and complex challenge. Irradiations performed in experimental irradiation facilities always deviate to some extend from the irradiation conditions existing in nuclear reactors. For instance, the neutron spectrum can be different but even more importantly is the damage rate that is significantly higher in experimental neutron irradiation facilities. It is now well known that such effects affect the accumulation of defects in the microstructures, which in turn influences the evolution of the mechanical properties. Furthermore, the fission neutron irradiation facilities are quite limited, and no intense source of fusion neutrons of 14 MeV is available to produce by transmutation the expected helium and hydrogen contents in the first wall and blanket of the future thermonuclear reactors. Therefore, the nuclear material community has often to rely on alternative irradiations to neutron irradiations, such as ion beam implantations or neutron spallation irradiations. In this presentation, we will make first a short overview the irradiation effects on materials and discuss the advantages and limitations of the various techniques used as surrogate to neutron irradiations. We will outline the fact that extracting information on mechanical properties from irradiated specimens requires the use of small specimens test techniques. This is especially true for ion beam irradiations that, for the usual ion energies, result in a thin irradiated surface layer of several microns, with an associated strong gradients of dose The need to use small specimens has also fostered a science-based approach to their development, which pertains to ad-hoc modeling activities. An overview of the work already done in the context of small specimens test techniques will be presented as well as the challenges and future opportunities to build methods to obtain reliable information from non-conventional tests. The emphasis will be put on the plastic flow and fracture properties.

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Irradiation of coated low-Z absorbing materials for the Target Dump Internal (TDI) and SiC-SiC irradiation in the HiRadMat-35 experiment

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Irradiation of coated low-Z absorbing materials for the Target Dump Internal (TDI) and SiC-SiC irradiation in the HiRadMat-35 experiment

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Abstract

The Large Hadron Collider (LHC) collimator system is one of the main contributors to the total impedance budget of the LHC machine. The Target Dump Internal (TDI) is a Beam-Intercepting Device (BID) considered as a mix between a collimator and a dump. A TDI is located at each of the two injection points of the LHC ring and its function, among others, is to protect the downstream devices from a potential misfiring of the injection kickers. The upstream absorbing core of the TDI is made out of **Graphite (SGL R7550)** blocks sputtered with a copper coating of 2um-3um thickness. The coating is crucial in order to reduce the RF wall impedance of the device and its integrity must be ensured during all the service lifetime. Encouraged by the LHC committee, the behavior of these coated blocks was tested in the HiRadMat installation under the most unfavorable irradiation conditions that the TDI could experience.

In addition, different coatings configurations and other low-Z materials subtracts, such as **Carbon Fiber Composite (CFC) and Silicon Carbide (SiC-SiC)**, were also tested with the objective to extract information for future BIDs such as collimators and absorbers. The performance of the coatings and the structural integrity of the substrates are being evaluated through a Post Irradiation Experiment (PIE) campaign including metrology, coating adhesion tests, dynamic modulus measurements, tomography, SEM and RF impedance measurements.

Special attention will be given to the **SiC-SiC** sample for which the PIE campaign is finished.

The scope of this presentation will be to summarize the energy deposition studies, explain the final experimental set up and performance, indicate the first visual inspections after irradiation and inform about the current status of the PIE performed up to this date.

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New partners presentation

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Next meeting & adjourn

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Operational Status and Upgrade of the J-PARC Neutrino Experimental Facility

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In this presentation I will introduce operational status of the J-PARC Neutrino Experimental Facility and upgrade plan of the facility to 1.3MW for Hyper-Kamiokande project.

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Operational Status and Upgrade of the Spallation Neutron Source at Oak Ridge National Laboratory (REMOTE)

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This presentation will highlight Spallation Neutron Source (SNS) achievements, difficulties and upgrade plans over the past two years. Six mercury target modules were operated without a leak or target related interruption to the neutron science user program. Sustained design improvement, improved fabrication oversight, disciplined target management and – most recently gas bubble injection – are all contributing to reliable target operation at MW power levels. Commissioning target gas injection at the end of 2017 was a major achievement. Measured reductions in mercury vessel pulse fatigue stress have exceeded expectations, and PIE assessments confirm that cavitation damage is significantly reduced. Increasing the gas flow rate to further extend target operating power and lifetime is planned over the next several years. Sustained operation at 1.4 MW has started with the presently running target, T20.
There were difficulties with neutron source operations during this period. Water began leaking inside the monolith core vessel that surrounds the target, neutron moderators and reflector assemblies in September of 2016. Three water loops serve equipment within this volume. The inner reflector plug (IRP) was the main leak source which worsened over time. While neutron production could continue, the IRP was not replaced until early 2018 due to fabrication delays. During the installation process an inspection camera viewed the aluminum neutron and proton beam windows. The proton beam window – replaced in early 2017 – clearly suffered some corrosion. Nevertheless, it remains in service.
Conversion to heavy water in cooling loop #4 is now providing a boost in neutronic performance. An upgrade project to the facility has been approved to double the power capacity of the accelerator which will enable operation of the planned Second Target Station. Part of the approved upgrade project provides for 2.0 MW operation of the First Target Station.

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Overview of HRMT-43 samples preparation

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Overview of HRMT24 & HRMT43 experiment

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Overview of RaDIATE-organised BLIP irradiations

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Overview of RaDIATE-organized activities

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Overview of some CERN High Radiation to Materials experiments and focus on Post Irradiation Examinations

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This talk will present recent High Radiation to Materials experiments run at CERN, and describe their motivations. A focus on the PIE, and the related outputs useful for beam intercepting devices will be given.

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PNNL activities overview and scheduling for PIE tests

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Perspectives for radiation damage studies at TRIUMF

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Present Status of NITE-SiC/SiC Composites R&D as proton accelerator target material

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The development of new target materials toward the increase of the beam intensity of high power proton accelerators has been progressed. Polycrystalline graphite is a principal target material for high power proton accelerator. Graphite has extremely high performance for these applications due to its thermal properties, mechanical properties, and chemical stability. However, graphite is easily oxidized at high temperature. In addition, since a smaller spatial volume of the source of the secondary particles is beneficial to more efficient transport to downstream experiments, the density of the target material should be higher. So, developing a replacement material for the graphite that is denser and more resistant to oxidation is desired. Silicon carbide (SiC) is one of the options as the new proton target materials because it has the excellent thermal properties, oxidation resistance, and higher density than graphite. Because SiC is a brittle ceramics material, SiC fiber reinforced SiC matrix composites (SiC/SiC composites) which has a quasi-ductility is utilized as structural material.
A Nano-Infiltration and Transient Eutectic-phase (NITE) process is advantageous to manufacture dense and large products compared with other fabrication processes. In Organization of Advanced Sustainability Initiative for Energy System/Materials (OASIS), Muroran Institute of Technology, R & D of SiC/SiC composites for fusion/fission energy systems has been carried out with emphasis on NITE process. The joint research between OASIS and High Energy Accelerator Research Organization (KEK) is on-going for R & D of SiC/SiC composites as proton accelerator target.
In order to investigate the applicability as proton target material, it is necessary to evaluate thermal shock resistance by high power proton beam. Moreover, since there are few irradiation damage effects study on SiC materials by high power proton beam irradiation, the high power proton beam irradiation test is expected to obtain the new knowledge to the irradiation effects on SiC materials. The thermal shock test of the NITE-SiC/SiC composite was conducted in the HiRadMat at CERN under RaDIATE collaboration. The post-irradiation examination (PIE) of this sample is planned to conduct at CERN. Furthermore, the possibility to conduct the PIE at Institute for Materials Research (IMR), Tohoku University at Oarai (Oarai Center) is explored. The OASIS has been started the joint research with the Oarai center, which is one of the important PIE facilities in Japan
In this presentation, overview of study for NITE-SiC/SiC composites as target material will be provided. Also, the PIE activities of neutron irradiated NITE-SiC/SiC composites by nuclear reactor at Oarai Center will be presented.

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Proton irradiation effects on superconducting properties of Nb3Sn

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In order to predict the irradiation effects in the MQXF quadrupoles in view of HL-LHC at CERN during operation up to a luminosity of 4'000 fb-1, an irradiation program was carried out on industrial, Ta and Ti added Nb3Sn wires. Wire samples from the same batch were irradiated with high energy protons (65 MeV and 24 GeV, up to 1.4 × 1021 p/m2) and neutrons (1 MeV, up to 1.8 × 1022 n/m2). The values of Tc and Jc were reported as a function of particle fluence. After replacing the fluence by the number of displacements per atom, dpa, determined using the FLUKA code, it was found that the variation of Tc in Nb3Sn wires as a function of the dpa value for both, proton and neutron irradiation, falls on the same curve, reflecting an universal behavior. This result reflects the fact that the variation of Tc is uniquely governed by the change in atomic ordering, S. Both the measured value, Tc, and the calculated one, dpa, depend essentially on the number of Frenkel defects. With the new relationship between Tc and dpa for both, protons and neutrons, the decrease of Tc in the quadrupoles at the maximum luminosity can be estimated to ~ 0.3 K. The variation of Jc vs. dpa shows some similarities between proton and neutron irradiation, too, but the analysis is more complex, the observed enhancement of Jc with irradiation being due to enhanced point pinning caused by the radiation induced defect clusters.

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RADIATION DAMAGE STUDIES ON TITANIUM ALLOYS AS HIGH INTENSITY PROTON ACCERELATOR BEAM WINDOW MATERIALS

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Titanium alloys are used as beam windows in several high-intensity proton accelerator facilities. Although there are wide variety of Titanium alloys, knowledge on the radiation damage effects on different alloys are quite limited.
At the BLIP irradiation during 2017 to 2018, wide variety of the titanium alloy specimens were provided. Accumulated radiation damage was reached to about 1.5 DPA (NRT) at maximum, which is much more than existing data (0.2~0.3DPA) and close to the value for future MW facility beam window operation in a year. The Post-Irradiation Examinations, both macro-scale tensile tests and micro-scale examinations, are being conducted at PNNL. In this presentation, progress and plan of radiation damage studies on these Titanium alloys are reported.

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RaDIATE Collaboration Perspectives

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RaDIATE collaboration welcome and meeting objectives

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Radiation damage in beryllium

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Radiation-induced displacement damage in FLUKA (a very general introduction)

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Recent Post-Irradiation Examination and Testing Results for Proton-Irradiated Ti-Base Alloys

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Three capsules containing Ti-base alloys were irradiated as part of the proton irradiation experiment organized by the RaDIATE Collaboration at the Brookhaven Linac Isotope Producer (BLIP). The downstream Ti-1 capsule was opened at PNNL in spring 2018, the upstream Ti capsule was opened at PNNL in fall 2018, and the downstream Ti-2 capsule will be shipped to PNNL from BNL in spring 2019. Samples of four different alloy grades (Grade 5, Grade 23, Grade 23-forged and Grade 9) from the DS Ti-1 capsule were subjected to tensile tests at room temperature and 200℃. There were notable differences in the effects of temperature and irradiation dose between the Ti-3Al-2.5V (Grade 9) alloys and the Ti-6Al-4V (Grades 5, 23 and 23-forged) alloys. The presentation will review the tensile data and will include scanning and transmission electron microscopy characterization (including electron backscatter diffraction analysis) of the unirradiated and irradiated (as available) microstructures. The presentation will also review the opening of the US Ti capsule that failed during irradiation. Sample recovery efforts will be highlighted along with efforts to characterize the proton beam location and dose profile using Gafchromic film dosimetry. Finally, the presentation will review plans for Ti-base alloy testing during 2019 including US Ti and DS Ti-2 tensile testing, microscopy, and nanohardness measurements.

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Recent developments and benchmarking of MARS15 and DPA model (REMOTE)

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Recommended Best Practices Derived from Test Reactor Irradiation Experiments

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Staff members at PNNL have conducted numerous neutron irradiation experiments at research and test reactors in the US and overseas. Many of these experiments were conducted in support of programs that are subject to commercial nuclear quality assurance requirements (NQA-1 or 10 CFR 50 Appendix B). While this degree of quality assurance rigor may not be appropriate for proton irradiation experiments supporting high power targetry, a graded approach to quality may be worth considering for future studies. The presentation will describe aspects of nuclear quality assurance that may be relevant to future irradiation experiments contemplated by the RaDIATE Collaboration. Recommendations for best practices will be offered based on past experience with reactor experiments.

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Status Report: Research of Materials in Target Environment at European Spallation Source

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At the European Spallation Source (ESS), a number of research projects on irradiated materials are undergoing in collaboration with other leading accelerator labs. The research program includes post irradiation examination (PIE) of tungsten as spallation material, in-beam characterization of chromium doped alumina as luminescent coating material, chemical kinetics of selected catalyzers for ortho-to-para hydrogen conversion, and PIE of radiation resistant elastomer and lubricants. Planned activities in 2019 are the PIE of chosen proton beam window materials in collaboration with PSI, and the works on characterization of beryllium as reflector material in collaboration with UKAEA and SNS. In this presentation, current status and future prospect of the materials research activities at ESS is reported.

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Status and prospective of STIP Irradiation Experiments and Ti-, Mo-,W-alloys irradiated in STIP

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STIP irradiation experiments have been conducted in the targets of SINQ (the Swiss Spallation Neutron Source) since 1996, which been the unique irradiation experiment in spallation target irradiation environments in the world. Seven irradiation experiments were performed during 1996 and 2014 and more than 8000 specimens from several tens kinds of materials were irradiated to doses as high as 30 dpa (in Fe). The eighth irradiation experiment (STIP-8) is being conducted in the present target. Due to the neutron and proton spectra change in a large range in the SINQ targets, different irradiation conditions desired for different purposes as such for fusion, fission and spallation materials research could be obtained. The results of STIP irradiation experiments have widely applied to the R&D and safety studies of high power spallation targets in the world, and to materials research of fission and fusion reactors as well.

Although the main focus of the STIP irradiated is on steels, specimens of other materials such as Ti-, Mo- and W-alloys and also pure Ta are of great scientific and technical interests. They were included in different STIP irradiation experiments. In this presentation, the status and prospective of STIP irradiation experiments will be introduced and some inform about specimens of the Ti-, Mo- and W-alloys and pure Ta will be provided.

Collaboration status and activities / 36

Status of LBNF Project

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Advanced materials and applications / 31

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

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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 (3420ºC). 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.

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Update on Post Irradiation Examination Techniques Employed at the Spallation Neutron Source (REMOTE)

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During operation, the mechanical properties of the 316L stainless steel target module at the Spallation Neutron Source (SNS) are altered, and the vessel surfaces are damaged by cavitation-induced erosion. The mechanical properties of other high-dose components, such as the proton beam window, are also affected by radiation during operation, which limit their useful lifetimes. A robust post irradiation examination (PIE) program is maintained at the SNS to inspect and characterize samples from high-dose components after removal from service. Several specialized remote inspection techniques were developed and implemented to perform PIE at the SNS, including: high-resolution photography, remote sampling, tensile testing digital image correlation, remote inspection via videoprobe, and laser line scanning. During this talk a general overview of the SNS PIE program will be presented, including descriptions of PIE characterization techniques and important findings from the SNS targets and PBWs examined to date.

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Update on the post-irradiation examinations on high Z materials from HRMT-27 and HRMT-42 experiments

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In the framework of the Extra Low Energy Antiproton Ring (ELENA) project, a new upgrade of the CERN AD facility is planned, including the replacement of the actual AD-target. Dynamic stresses take place in target materials as a consequence of the sudden increase of temperature after each pulse,

leading to their potential failure. In this context, the two HRMT-27 and HRMT-42 experiments have been conducted to study these effects, for future target material candidates.
HRMT-27 experiment aimed at impacting 440 GeV proton beams onto thin rods (8 mm diameter – 140 mm length) of high-Z materials such as Ir, W, Ta and Mo among others, with the objective of reaching equivalent conditions of temperature and dynamic stresses to those found in the AD-target. All materials expect from Ta suffered from internal damage hence it was considered as next candidate material for the AD-Target. A further step within the R&D activities was achieved with the HRMT-42 experiment. A first scaled target prototype, constituted of a sliced core made of ten Ta rods -8 mm diameter, 16 mm length- embedded in a compressed expanded graphite (EG) matrix was tested with the same beam parameters.
Extensive post irradiation examination is on-going for all the materials from HRMT-27 and HRMT-42. It comprises non-destructive examinations (ultrasonic testing and neutron tomography), specimen preparation and destructive examinations (microstructural analysis and miniaturized mechanical testing). In a first place, a general overview of the different steps from the extraction of the rods to the on-going examinations will be given. In a second place, an insight will be dedicated to the first results of the microstructural analysis by means of optical and electron microscopy.

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Updates on post irradiation examination at SNS

1

Visit: Patek Philippe Museum

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Welcome address

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Working meeting - Collaboration by-laws and Future MOU considerations / 63

Working Meeting - Future HiRadMat Planning Satellite meeting

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Proton Thermal Shock / 61

Working Meeting - Future HiRadMat Planning Satellite meeting

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Working meeting - Collaboration by-laws and Future MOU considerations / 62

Working meeting - Collaboration by-laws and Future MOU considerations

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Working meeting - Collaboration by-laws and Future MOU considerations

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Working meetings - RaDIATE related PIE prioritization & shipping planning

Author: Patrick Hurh[None]

Concluding session / 52

Workshop summary

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