

Radiation Damage Materials Study for the Radiation Damage in Accelerator Target Environments (RaDIATE) R&D Program

Roles and Responsibilities of Participants

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Introduction

The RaDIATE collaborative program is initiating an experimental R&D work to study and characterize the radiation damage effects in various accelerator component materials. The materials of interest will be proton-irradiated at the Brookhaven's Linac Isotope Production (BLIP) facility at Brookhaven National Laboratory (BNL), where multiple specimen layers enclosed in a target box will be positioned upstream of the medical isotope targets. The Linac proton energy will be increased accordingly in order to compensate for the energy loss through the target box and deliver the required energy to the medical isotope target. This document outlines the roles and responsibilities of BNL and each of the participating RaDIATE institutions during the design, development, and execution of this BNL BLIP material irradiation experiment. Post-Irradiation-Examination activities subsequent to the specimen irradiation are not covered by this document and will be under separate arrangement of each user.

Duration of activities

The design and development of the experiment is expected to be carried out over a period of three months, starting in April 2016. This will include the final design of the material specimens and the corresponding capsules, capsule holders, and target basket that will be inserted in the target drive box. The next five months will involve the procurement and fabrication of the specimens and the associated target box components that will be completed by the end of November 2016. The following two months will comprise of specimen capsules welding, shipment and final assembly of the target box at BNL prior to the irradiation run in February 2017.

Roles and Responsibilities

The RaDIATE participating institutions in this experiment include Brookhaven National Laboratory (BNL), Fermi National Accelerator Laboratory (FNAL), European Organization for Nuclear Research (CERN), Michigan State University – Facility for Rare Isotope Beams (MSU-FRIB), High Energy Accelerator Research Organization (KEK), and the European Spallation Source (ESS). The roles and responsibilities between the participating institutions (users) and BNL, and within the users are detailed in the following two sections.

I. Interface between BNL and users

The responsibilities of the *users* are to

- Perform initial thermal analyses and design the specimens and corresponding six specimen capsules to be included in this experiment
- Provide BNL 3D models of all specimen and specimen capsules for review, before procurement and fabrication
- Procure and fabricate specimens and specimen capsules. This includes welding and leak checking of each specimen capsule
- Shipment of all specimen capsules to BNL in time for assembly into target box
 - FNAL responsible for delivery of Ti and Be capsules. Graphite specimens and capsule will also be shipped to BNL for assembly and welding at EB industries.
 - CERN responsible for delivery of heavy capsule (Ir, TZM) and Si capsule
 - ESS responsible for delivery of Al capsule

The responsibilities of *BNL* are to

- Perform detailed thermal and FLUKA analysis of the target box containing all specimen capsules
- Draft and finalize safety documentation to be presented to the BLIP safety review board
- Provide guidance to users and review all drawings and designs prior to specimen and specimen capsule procurement and fabrication
- BNL will coordinate activities with EB industries to assemble and weld FNAL graphite capsule.
- Design and fabricate capsule holders for each specimen capsule (6 in total)
 - Be, C, Ti, Al, Si, TZM/Iridium capsules
- Design and fabricate vacuum degrader (or degraders depending on TZM/Iridium capsule swap with other material capsule)
- Design and fabricate target basket
- Provide target drive box
- Build and maintain CAD assembly of the target box, capsule holders, specimen capsules and any necessary degraders
- Repeat leak checking of specimen capsules upon receipt from users
- Assemble all specimen capsules, holders, and target basket into the drive box
- Run and monitor the experiment

II. Interface between users

FNAL, MSU-FRIB and KEK will coordinate activities for the **Ti** capsule

- FNAL:
 - Design, procure and fabricate specimen capsule
 - Assemble specimens, weld specimen capsule and leak checking

- Ship capsule to BNL
- MSU-FRIB
 - Coordinate with FNAL and KEK to design and perform thermal analysis of specimens and specimen capsule.
 - Procure and fabricate MSU-FRIB specimens and fillers (3 microstructures)
 - Shipment of specimens to FNAL
- KEK
 - Coordinate with MSU-FRIB to design specimen capsule
 - Procure and fabricate specimens and fillers (2 grades)
 - Shipment of specimens to FNAL

CERN and KEK will coordinate activities for the Si capsule

- CERN
 - Coordinate with KEK on the SiC coated graphite layer in the capsule
 - Design and perform thermal analysis of specimens and specimen capsule
 - Procure and fabricate poly crystal Si specimens
 - Procure, fabricate, weld specimen capsule and leak checking
 - Shipment of specimen capsule to BNL
- KEK
 - Coordinate with CERN on the specimen design and layout
 - Procure and fabricate SiC coated graphite specimens and filler pieces
 - Ship SiC coated graphite specimens to CERN