



Contribution ID: 23

Type: not specified

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

Thursday, 20 December 2018 10:35 (25 minutes)

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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Session Classification: Advanced materials and applications