RCNP EXPERIMENT E494

PROPOSAL FOR EXPERIMENT AT RCNP

24 July 2016

TITLE: Investigation of proton-irradiation effect to “silicon carbide composite” material for muon production target

SPOKESPERSON:

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Institution:

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EXPERIMENTAL GROUP:

Full Name	Institution	Title or Position
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Shiro Matoba	KEK	(Assistant Professor)
Kazuhiko Ninomiya	Osaka University	(Assistant Professor)
Tatsushi Shima	Osaka University	(Associate Professor)
Tomokazu Suzuki	Osaka University	(Assistant Professor)
Naritoshi Kawamura	KEK	(Associate Professor)
Koichiro Shimomura	KEK	(Associate Professor)
Satoshi Mihara	KEK	(Professor)
Masaharu Aoki	Osaka University	(Associate Professor)
Takeshi Nakadaira	KEK	(Associate Professor)

RUNNING TIME: Installation time without beam; 1/2 day

Data runs; 1 day

BEAM LINE: Ring : N0 course

BEAM REQUIREMENTS: Type of particle non-polarized p

Beam energy 392 MeV

Beam intensity 1 μA

Other requirements energy resolution _ 200 keV

BUDGET: Experimental expenses 500,000 yen (Movable ladder sample holder for irradiation at N0 line)

SAFETY CONTROLLED ITEMS:

- un-sealed radio-isotopes

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SPOKESPERSON: Shunsuke Makimura

SUMMARY OF THE PROPOSAL

Polycrystalline graphite is a principal target material for muon production under high power proton beam irradiation. The graphite has extremely high performance for these applications due to its thermal properties, mechanical properties, and chemical stability. However, the graphite is easily oxidized at high temperature. In the case where air is unexpectedly introduced into the primary beam line during high power beam operation, a robust closed area is required to enclose the consequent contamination. A smaller spatial volume of the source is beneficial to more efficient transport. The density of the target material should be higher, as long as it can resist the beam loss. Recently, we started to investigate a new target material with higher performance. Silicon carbide (SiC) is an excellent candidate because it has a good heat resistance, high mechanical strength, higher density, and higher oxidation resistance. But a monolithic SiC cannot be used as a structural material under the pulsed heating cycle, because it is brittle. So, NITE-SiC composite material, developed for fusion and fission reactor at OASIS group, Muroran Institute of Technology, is investigated. Brittleness of SiC is improved in this composite material.

We would like to have a proton irradiation of the samples at N0 beam line. The purpose of this proposal is to obtain the information for produced amount and emission of the radionuclides of the SiC composite material through high energy proton irradiation. Some of the produced radionuclides, especially tritium, are emitted into vacuum. The emission rate strongly depends on the temperature. So, after the irradiation, the temperature dependences of the emission are measured with heating of the irradiated samples at a range from room temperature to 1300 Kelvins. Actually-obtained datum of production of the radionuclides by the experiments will be compared with the results through Monte-Carlo code, PHITS. In the simulation, after 1day from the irradiation, the samples can be handled by hands-on maintenance at the radioisotope (RI) building in RCNP. They can be transported with an appropriate packaging from N0 beamline to the RI building. The amount of gamma-ray emitters will be determined by gamma-ray spectroscopy using high-purity germanium detectors. After the gamma-ray measurement, the sample will be set into a vacuum vessel with a heating oven. Then after heating, the residual tritium inside the sample is precisely measured by LS1800; liquid scintillation counter (LSC) system at the RI building. When the material properties of the SiC composite material under the proton beam irradiation are understood, it will be one of the most valuable material to accomplish more stable and safer beam operation.