Renovation of a scraper unit of a muon production target at J-PARC

Shiro MATOBA[1, 2], Shunsuke MAKIMURA[1, 2], Naritoshi KAWAMURA[1, 2], Yukihiro MATSUZAWA[2], Masato TABE[2], Yasuo KOBAYASHI[1,2], Ryosuke KADONO[1,2] and Yasuhiro MIYAKE[1,2]

[1]Muon Science Laboratory, High Energy Accelerator Research Organization, Shirakata Tokai, Ibaraki 319-1106,
[2]Muon Science Section, Materials and Life Science Division, J-PARC Center, Shirakata Tokai, Ibaraki 319-1195,

*E-mail: shiro.matoba@kek.jp
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We developed a beam scraper that can handle up to 2 MW proton beams and replaced the conventional scraper with the new one. For the replacement work, Monte Carlo calculation code was carried out to evaluate the protection of induced radiation by 3-GeV proton beam irradiation. New scraper is running smoothly at 0.5 MW operation and can withstand the upgrading of the beam power that is planned in the future.

KEYWORDS: muon production target, proton accelerator

1. Introduction

A variety of materials and life science research has been carried out with the pulsed muon beams of the world's highest intensity, which are generated using the pulsed proton beams from the accelerator (3 GeV, 25Hz, 333 μA) at J-PARC. A rotating target made of an isotropic graphite for muon generation is located in the proton beam line between the 3-GeV Rapid Cycle Synchrotron (RCS) and a neutron target [1]. In the summer maintenance period of 2014, the spent fixed target was replaced with the rotating target [2, 3]. This rotating target is running in full working order with the beam power 0.5 MW.

Two scrapers made of oxygen-free copper for stopping scattered components of the proton beam are placed at the downstream of the muon rotating target in series. The upstream scraper is called No. 1 scraper, hereinafter referred to as SC. The distance of the SC from the muon rotating target is 380 mm. Approximate dimensions of the SC are 300 mm wide, 700 mm height, and 700 mm length in the direction of the beam axis. Circular through-hole of the inlet diameter 74 mm has been drilled in the SC with a beam axis as the center. The radius of the hole is increasing toward the beam downstream. Heat load on the SC due to scattering of the proton beam on the target is about 19 kW in the 1-MW operation of the beam power [4]. This heat is removed with two cooling water lines. The cooling water pipes are embedded in the SC with a hot isostatic press method in order to avoid thermal resistance on the interface of the bonding. K-type thermocouples enclosed in stainless steel sheathes are mounted on the upstream and side surfaces of the SC to