Development of a Sealed Lithium Target for BNCT in Nagoya University

Shogo HONDA[1], Sachiko YOSHIHASHI[1], Kazuki TSUCHIDA[1], Yoshiaki KIYANAGI[1],

Yukio TSURITA[1], Kenichi WATANABE[1], Atsushi YAMAZAKI[1], Yoshiyuki TSUZI[1],

Tatsuya TSUNEYOSHI[1], Akira URITANI[1]

[1] *Nagoya University., Nagoya, Japan*

E-mail: honnda.shogo@a.mbox.nagoya-u.ac.jp

Introduction

An accelerator-driven neutron source with a Li target and a DC accelerator has been developing in Nagoya University. Lithium is a suitable material to generate lower neutrons than the belilium , because the Li (p, n) Be reaction is more efficient at the proton energy of several MeV than the Be (p, n) B reaction. However, lithium target has some difficulties in the target handling due to the following characteristics; low melting point (180 degrees), high chemical activity and production of the radioisotope Be-7. For resolving those problems, we have developed a sealed Li target with high efficient cooling system, in which the lithium is covered by a thin Ti foil on the target plate and the water flow in the cooling channels is strongly turbulent by a special rib structure. In the preliminary tests by using an electron beam, it was confirmed that the high heat load (> 15 MW / m ^{2}) on the target can be removed with the cooling system [1]. In this study, we will report the experimental results of proton beam irradiation on the sealed Li target for evaluating the heat removal performance and soundness of Ti foil under the practical beam irradiation condition (～7MW/m^2).

Materials and Methods

A compact Li target was set in the water cooling jacket with an aluminum flange and irradiated by the proton beam with the energy of 2.8 MeV and the current of 1.0 mA extracted from the Dynamitron. The beam size was identified from the profile of residual activity on the target surface (2000 mm^2, 1.1 MW/m^2) The temperature of the target was measured by multi thermocouple sensors inserted from the back side of the sealed lithium target. To confirm the soundness of the Ti foil during beam irradiation, Ti and Li vapor in the beam line was monitored by a quadrupole mass spectrometer and the surface condition of Ti foil was checked by a camera after the beam irradiation test.

Results

The target surface temperature was measured to be about 40 degrees at the proton beam current of 0.8mA, and was kept below the melting point of Li (180 degrees). Ti and Li vapors were not found by the quadrupole mass spectrometer. After irradiation of 2.8 MeV and 0.8 mA proton beam during more than 5 hours, we found the intact Ti foil and Li layer on the target. We confirmed that our sealed Li target can be used under the beam power of 1.1 MW/m^2.

References

[1] Daiki Furuzawa, et al., Examination of heat removal method of high heat flux to target, YBNCT, 2017