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Mock-up Test for Isotope Target Transport and Cooling System

Sang-pil Yoon*, Hyeok-jung Kwon, Han-sung Kim, Yong-sub Cho, Bo-hyun Chung, Kyung-tae Seol, Young-gi Song, Dae-il Kim, Yi-sub Min
KOMAC, Korea Atomic Energy Institute
**Corresponding author: spyun@kaeri.re.kr*

1. Introduction

Korea multi-purpose Accelerator Complex (KOMAC) has a plan to construct the new proton beam irradiation facility for the production of radioisotopes. Sr-82 and Cu-67 were selected as the target isotope in this facility, they are promising isotope for the PET imaging and cancer therapy. To produce Sr-82 by 100-MeV proton irradiation, RbCl were chosen as a target material due to their high melting point and easy separation [1].

For the facility construction, we have designed targetry system which consists of target, target transport system and target cooling system. This paper describes the details of targetry system.

2. Methods and Results

2.1 Isotope Target Fabrication

To design RI target, we have derived the optimum thickness of target materials considering the beam energy loss by the beam window, cooling water and target claddings through SRIM calculation [2].

RbCl pellet was made by first vacuum drying RbCl powder for at least 24 hours and then pressing this powder in a mold with 300 ~ 380 MPa pressure to achieve the theoretical density. This RbCl pellet is encapsulated in stainless steel cladding with o.d. of 60 mm and i.d. of 50 mm with 0.3 mm window. To prevent the leakage of the radioactive species inside target, the cladding is fabricated by laser welding. Figure 1 shows the fabricated RbCl pellet and the welded target cladding.

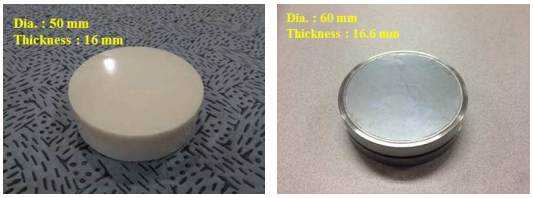

Fig. 1. The fabricated RbCl pellet and target cladding

2.2 Target holder

The RI targets are mounted inside the target holder for their supporting and cooling. Inside of target holder, there is cooling water gap between two targets. And then, the fast water flow can induce vibration of target stack. Thus the fabricated target stacks have to be mounted robustly at the target holder.

This fabrication of target holder is conducted in the processing hot-cell remotely for the radiation safety. Figure 4 shows designed target holder and their fabrication concept.

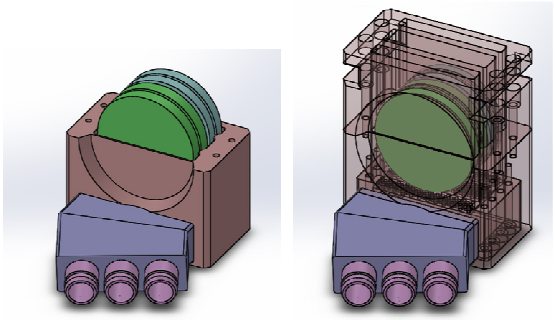

Fig. 2. The fabricated RbCl pellet and target cladding

2.3 Target carrier design

These fabricated target holders are should be transported from Hot-cell to irradiation chamber for the proton beam irradiation. Thus target holder has to be mounted in the target carrier.

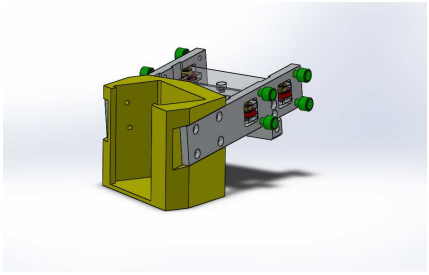

Fig. 4. Target carrier

2.4 Target transport system

Figure 5 and 6 describes the conceptual design of the target transport system. For the transportation of target carrier between the hot-cell and irradiation chamber, target carrier is driven by the motor with chain and sprocket system thorough the target transport pipe. The oscillations of target carrier during its motion are controlled by constraining by two guide rail which

attached inside of transport pipe.(Fig. 5 and 6) All structural materials are stainless steel due to the transport pipe is filled with deionized water.

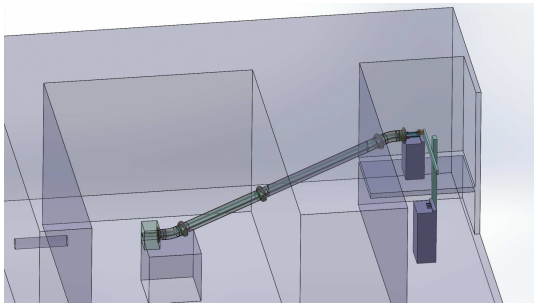

Fig. 5. Configuration of target transport system

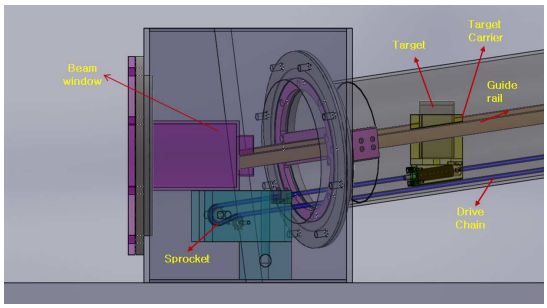

Fig. 6.the detailed view of target transport mechanism

2.5 Cooling system

For the removal of 30 kW heat load, we have prepared independent cooling system. the flow rates of coolant are 85.7 L/min and the coolant was selected the de-ionized water to prevent the corrosion inside target transport system. The cooling system consists of air-cooled chiller, water purification filter and de-ionized water product apparatus and All component are integrated at SKID (Fig. 7, Fig. 8).

The target cooling systems can be remotely monitored and controlled by EPICS IOC.

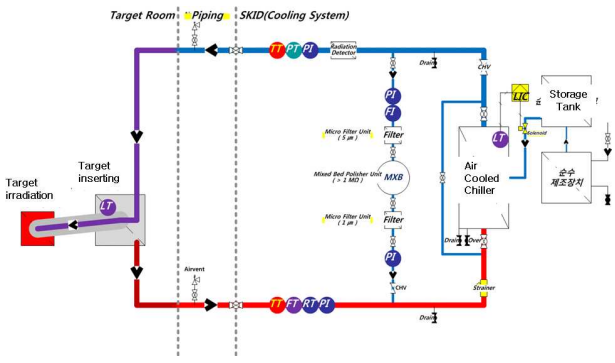

Fig. 7. The P&ID of cooling system

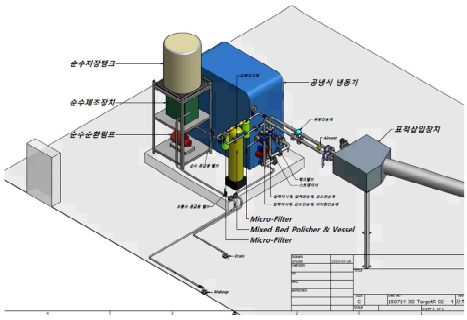

Fig. 8. The Schematic drawing of cooling system

Fig. 9. Test Mock-up of target cooling system

3. Conclusions

In this paper, we described the design and fabrication of the test mock-up of target transport and cooling system for the isotope production by using the 100-MeV proton irradiation. For Sr-82 production, RbCl target and aluminum dummy target was prepared. These targets are contained in the target carrier, which could transported by drive chain and guide rail system.

Acknowledgements

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[2] J. Ziegler, www.srim.org , 1999.