A Comparative Study of Double-Grid Niobium [^{18}O]H_2O Target and Titanium Foil Welded [^{18}O]H_2O Target for [^{18}F]Fluoride Production

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1. Introduction

The 30 MeV cyclotron of Cyclone-30 was installed and in operation at KIRAMS in 2002 from IBA. Since installation, we have routinely produced F-18 on a daily basis and Tl-201, Ga-67 and I-123 on a weekly basis. Recently, we renovated the F-18 targetry with double-grid target sealed with synthetic plastic (LDPE or HDPE) to increase beam current on target. In this study, we would like to describe the F-18 production yield increasing and pressure development depending on beam current.

2. Design and experiment

2.1 New Target Design

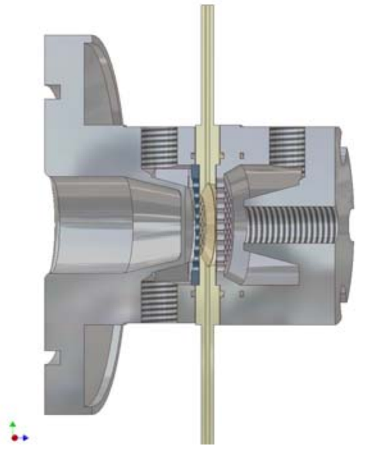
The target was fabricated as shown in Fig. 1. The target body material used was titanium and foils were niobium. The total volume of cavity was 1.1 mL. Both open sides of cavity are blocked with 50 μm niobium foils without welding and PE was used for sealing material other than conventional O-ring. Two aluminium grids are placed outside of each foil. Both sides of target were cooled directly by water flow. Grids were adapted to cool foils and prevent their thermal expansion under high pressure during bombardment. And the thicker Al foil used, this one has no He cooling system.

The bombarding energy on target water was 16 MeV calculated using SRIM 2003 code. Approximately 80% of the incident beam current was bombarded on the target due to Al grid screening. Table 1 and Fig. 2 are the energy absorption data at each material along the proton beam path.

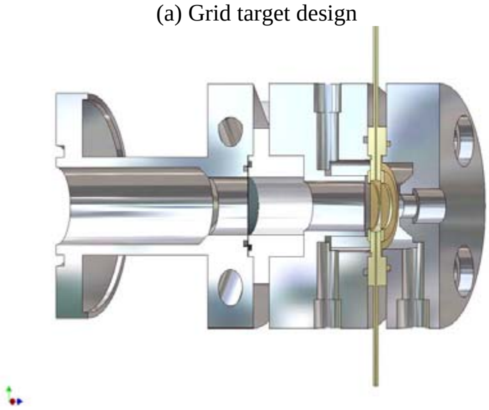
2.2 Experiment and Results

The irradiation beam current was increased to 45 μA starting from 5μA on grid target.

The pressure developed was plotted in Fig. 3. As shown in Fig. 3., the pressure was gradually developed and no burst until 45 μA. And also, the pressure does not exceed 25% of conventional welded targets at the same irradiation current.



(a) Grid target design



(b) Conventional foil welded target

Figure 1. Compare the assembly drawing of target

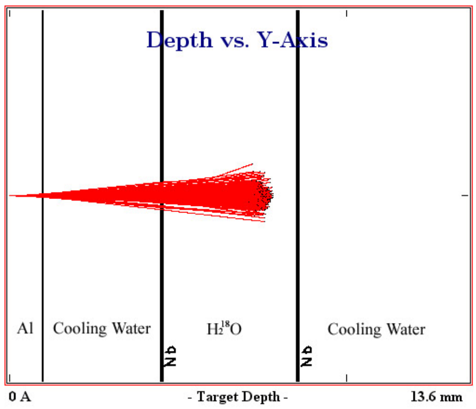


Figure 2. Simulation results using SRIM2003 code

F-18 production yield were 3.6±0.2 Ci after 120 min irradiation at 40μA. In this case, real beam current for (p,n) reaction is 32μA. Production yield versus irradiation time was plotted in Fig. 4. As shown in Fig. 4., grid target is more stable than the other case.

At the routine production, use 35μA proton beam, there is no trouble in 30 times irradiation and earned sufficient fluoride at one time.

3. Conclusion

This results show that the cooling performance of double-grid niobium target is better compare to conventional foil welded target and this target can be used for routine production of $[^{18}F]$fluoride in high yield.

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Table 1 Energy absorption data

Material	Thickness (mm)	Incident Energy (MeV)	Energy absorption (MeV)	Final Energy (MeV)
Al	1	30	**4.1**	25.9
Cooling Water	3.50	25.9	**8.8**	17.1
Nb	0.050	17.1	**1.0**	16.1
$H_2{}^{18}O$	4	16.1	**16.1**	0
Nb	0.050	0	**0**	0

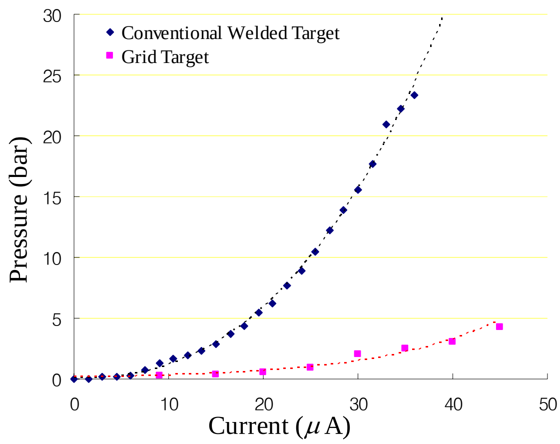

Figure 3. Target pressure vs. irradiation beam current.

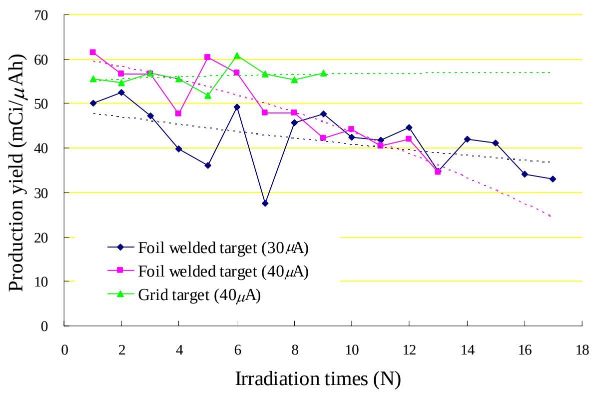

Figure 4. Production yield vs. irradiation times.