Design of multi target for F-18 and C-11 production

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1. Introduction

Generally, gas and liquid target system have been used for PET RI production. These two types of RI can not be produced with one time bombardment. This kind of separated production system makes research activities tardy and time consuming. The aim of this research is to design a multi target for simultaneous C-11 and F-18 production with one beam line and bombardment.

2. Methods and Results

2.1 Energy selection

Fig. 1 and 2 are nuclear reaction cross section for C-11 and F-18 nuclear reaction. Effective energy band for C-11 production is 3~15MeV and over 2 MeV for F-18. At low energy band (0~7 MeV), the cross section of C-11 is small, while the cross section for F-18 is higher than that of C-11. Therefore, the formation of two targets was decided that gas target was in the first place followed by liquid target. The thickness of materials was calculated using Williamson's stopping power equation. Table 1 is the energy absorption data at each material along the proton beam path.

2.2 Target design

Multi target is composed three parts; energy degrader, gas target for C-11 and liquid target for F-18. The incident irradiation energy for multi target was 30 MeV and degraded to 13 MeV with energy degrader. Energy band for N_2 gas is 13~8 MeV and for $H_2{}^{18}O$ is 7~0 MeV.

Energy degrader has a cooling water path to reduce heat generated during proton beam irradiation. The shape of gas target chamber was designed conical type considering beam broadening. The liquid target has two thin metal foil (50μm) and two grids. The open area of front grid is over 80%. The cavity diameter of water target is wider than the beam entrance of gas target to make up for beam scattering and high cooling efficiency.

Al-2063 was used for degrader and gas target chamber material and pure titanium was used for liquid target and metal foils.

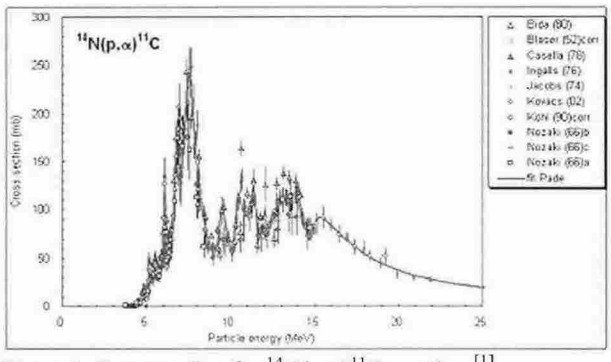

Figure 1. Cross section for $^{14}N(p,\alpha)^{11}C$ reaction [1]

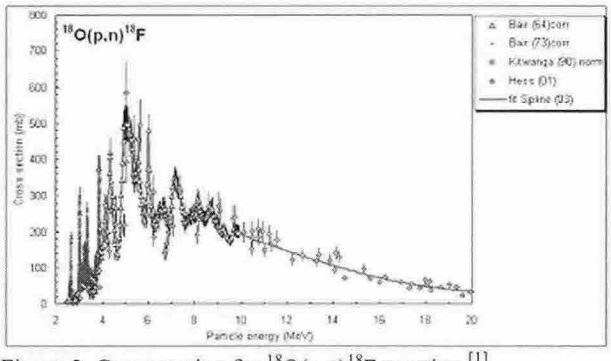

Figure 2. Cross section for $^{18}O(p,n)^{18}F$ reaction [1]

Table 1 Energy absorption at each material

Material	Thickness mm	Incident Energy MeV	Energy absorption MeV	Final Energy MeV
Al	0.75	30	**3.01**	26.99
Cooling Water	3.50	26.99	**8.92**	18.07
Al	0.75	18.07	**4.81**	13.25
N_2+H_2(5%)	100	13.25	**5.10**	8.14
C.P Ti	0.05	8.14	**0.79**	7.35
$H_2{}^{18}O$	3.0	7.35	**7.35**	0

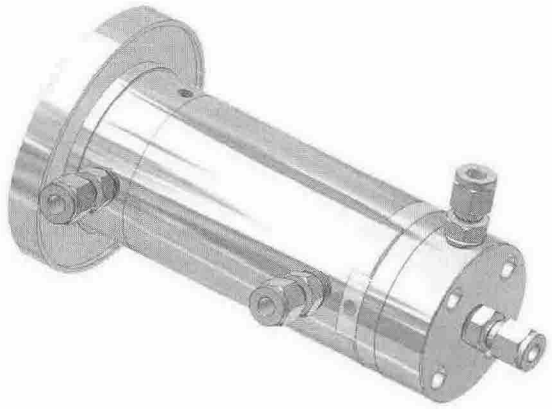

Figure 3. Assembly drawing of multi target

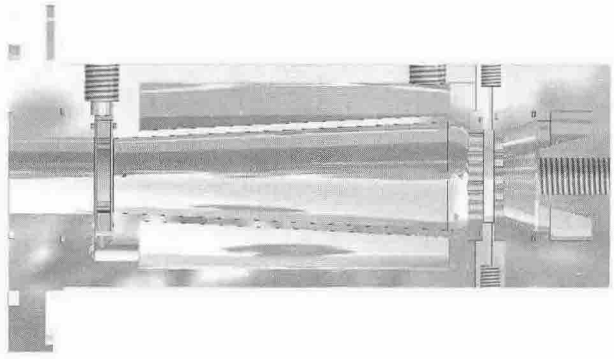

Figure 4. Cross section view of multi target assembly

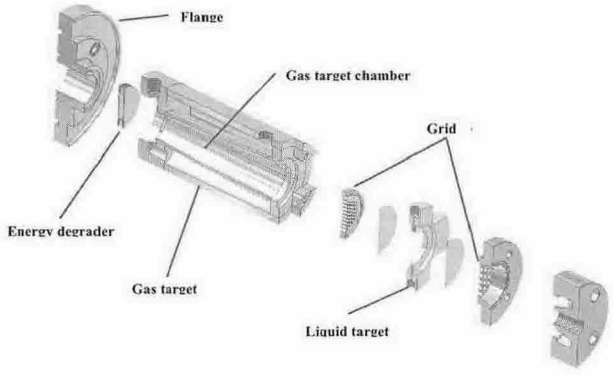

Figure 5. Composition of multi target parts

2.3 Targetry design

Targetry has been constructed with two 6 port-2 position valves and 4 solenoid valves. C-11 will be collected in liquid nitrogen trap.

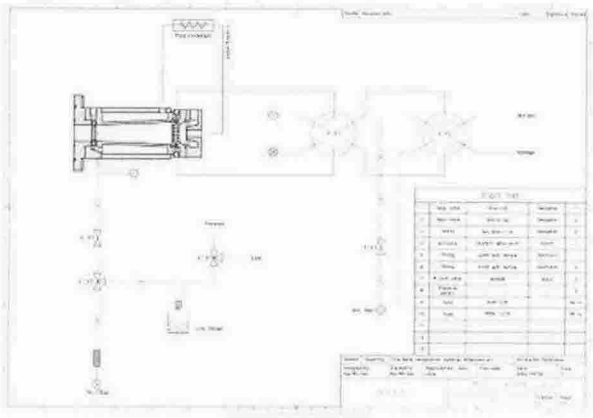

Figure 6. Schematic drawing of targetry

3. Conclusion

In conclusion, we designed multi target for C-11 and F-18. Expected production yield of each isotope is over 350mCi at the 30 MeV, 25μA proton beam irradiation. And now the experiments are in progress.

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