Simultaneous production of F-18 and C-11 for PET research

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1. Introduction

C-11 and F-18 are most frequently used positron emitting isotopes for PET. We reported the possibility of the simultaneous production of C-11 and F-18 with cyclotron.[1] We hereby report the current status of tandem target we developed and the real production of C-11 and F-18

2. Methods and Results

2.1 Proton Energy Consideration

Proton energy which can bombard the tandem target has been calculated and simulated using SRIM 2003 code. We set 30 MeV as incident energy and degraded down to 13.88 MeV before entering the target. The entering energy onto each material is given in table 1.

Table 1. Energy and energy absorption calculation

Material	Thickness (mm)	Incident Energy (MeV)	Energy absorption MeV	Final Energy MeV
Al	0.75	30	**3.01**	26.96
Coolant	3.50	26.96	**8.37**	18.59
Al	0.75	18.59	**4.71**	13.88
N_2+H_2(5%)	100	13.88	**5.55**	8.33
Ti	0.05	8.33	**0.79**	7.54
$H_2{}^{18}O$	3.0	7.54	**7.54**	0

The proton of 13.88 MeV bombards the nitrogen target for C-11 and then 7.54 MeV enters the O-18 water target for F-18. This bombarding energy was calculated from the published cross section data.[2,3,4] Effective energy band for C-11 production is 3~13 MeV and 2~18 MeV for F-18. At low energy area (0~8 MeV), the cross section for C-11 production is relatively small, while the cross section for F-18 is larger than that of C-11.

2.2 Target design

The formation of two targets was decided that gas target was placed in the first place followed by liquid target.

Tandem target is composed three parts; energy degrader, gas target for C-11 and liquid target for F-18. Energy degrader has a cooling water path to reduce heat generated during bombarding. The shape of gas target chamber was conical considering beam broadening. The liquid target has two thin titanium 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 to compensate for beam scattering and increase cooling efficiency.

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

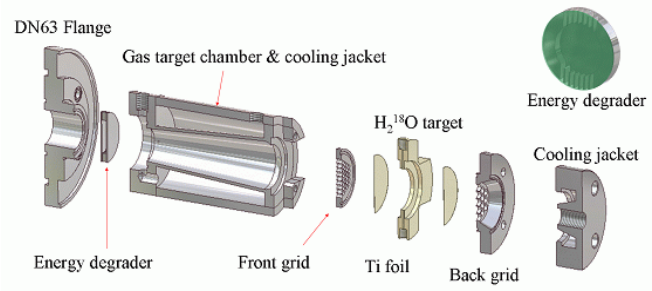

Figure 1. Tandem target drawing in section

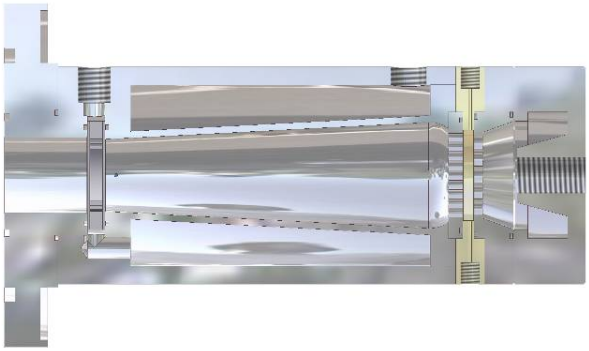

Figure 2. Cross section view of tandem target assembly

Figure 3. Tandem target installed in beam line

2.3 Preliminary experimental results

The pressure developed during irradiation is given in table 2.

Table 2. Pressure development during bombarding (bar)

Beam Current	Loading	5 μA	10 μA	13 μA	15 μA	20 μA
Pressure (C-11)	12.8	14.2	14.8	15.0	15.4	15.8
Pressure (F-18)	10.96	12.04	12.76	13.07	13.28	13.70

As shown in table 2, pressure of both target were increased in a current dependent manner. 300±50 mCi of C-11 and 600±50 mCi of F-18 were simultaneously produced with proton beam current of 20 μA for 1hour.

3. Conclusion

In conclusion, we designed and manufactured the tandem target for C-11 and F-18. Although the radio activity produced were not satisfactory, further research to optimize beam onto target is on going. This first and preliminary research is expected to encourage radiopharmaceutical development.

REFERENCES

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