**The Yield of F-18 from Different Target Designs
in the $^{18}\text{O}(\text{p},\text{n})^{18}\text{F}$ Reaction on Frozen $[^{18}\text{O}]\text{CO}_2$.**

Mahmoud L. Firouzbakht, David J. Schlyer and Alfred P. Wolf,
Department of Chemistry,
Brookhaven National Laboratory,
Upton, NY 11973. USA.

The shortage of oxygen-18 enriched water has encouraged us to explore alternate methods of production of fluorine-18 where the recovery of the oxygen-18 enriched target material is extremely efficient. We have recently presented the results from a cryogenic target using carbon dioxide ice as the target (1). This is similar in design to a water ice target previously described (2,3). The amount of material required and the maximum beam current which can be put on the target are a function of the particular design. The effects of target cone length and number of cooling fins have been explored in order to optimize the target design.

Three different targets have been used to test these parameters. The three target are shown in Figures 1, 2 and 3. The first was the prototype target with a single heat sink at the rear of the target (Figure 1). The second is a target with several cooling fins and a short cone length which requires less target material (Figure 2). The third is a target with several cooling fins but a longer target length which allows for more efficient cooling of the material. The results from these studies are summarized in Table 1. The target with four cooling fins could be run at a beam current of 18 μA with no perceptible volatilization of the target material while the target with the single cooling block showed volatilization at about 8 μA . The long and short cone targets did not show a difference in the volatilization of the target material at the beam current limit of the 60" cyclotron (18 μA).

The short target did maintain production with a lower amount of gas frozen into the target. The amount of gas frozen into the target in all these runs is two to four times that calculated to be necessary to form an ice layer thick enough to stop the beam in these targets. This is probably due to an uneven carbon dioxide layer on the surface of the cone. Experiments are currently under way to explore both the uniformity of the layer and the optimum angle for the cone.

This cryogenic target gives extremely efficient enriched target material recovery (>99%) and simplicity of material transfer. The production yields are similar to those obtained with the oxygen-18 enriched water target at beam currents up to 18 μA (our cyclotron limit, not necessarily the limit of the target design).

This work was carried out at Brookhaven National Laboratory under contract DE-AC02-76CH00016 with the U.S. Department of Energy, supported by its Office of Health and Environmental Research and grant No. NINDS, NS 15380.

MASTER

References:

1. Firouzbakht, M.L., Schlyer, D.J., Gatley, S.J., and Wolf, A.P. A Cryogenic Solid Target for the Production of $[^{18}\text{F}]\text{Fluoride}$ from Enriched $[^{18}\text{O}]\text{Carbon Dioxide}$ J. Nucl Med. 34 69P (1993).
2. Shefer, R. E. Klinkowstein, R. E., Hughey, B. J., Welch, M. J. Production of PET Radionuclides with a High Current Electrostatic Accelerator. J. Nucl. Med. 32 (1991) 1096.
3. Hughey, B. J., Shefer, R. E., Klinkowstein, R. E., Welch, M. J., Dence, C. S., and Livini, E., A Novel Cryogenic Oxygen-18 Target for the Production of Fluorine-18. J. Nucl. Med. 33:932 (1992).

Table 1.
Production for Various Target Designs

<u>Cone Length</u>	<u>Amount of CO_2 (liters)</u>	<u>Yield at EOB (mCi)</u>	<u>Percent of Theoretical (%)</u>
Long	2.0	56 ± 4	80
Short	2.0	52 ± 3	74
Long	1.2	53 ± 4	76
Short	1.2	50 ± 3	71
Long	1.15	43 ± 2	61
Short	1.15	44 ± 3	63
Long	0.63	12 ± 2	17
Short	0.63	26 ± 4	37

All runs were carried out at $6\mu\text{A}$ for 10 minutes at an energy of 17.4 MeV incident on the carbon dioxide. Percent theoretical is based on the yield from 99% $[^{18}\text{O}]\text{CO}_2$. The dimensions of the long and short cones are given in the figures.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Figure 1. Prototype target design

Figure 2. Short cone target

Figure 3. Long cone target

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.