A simple $^{18}F-F_2$-target for routine use

R. Wagner

Max-Plank-Institut für Neurologische Forschung
Köln, West Germany

The F_2-production system has been in continuous use since 1982.

Target

The target body is machined from copper/beryllium ($CuBe_2$) and chemically nickel plated. The plating thickness is about 50 microns. There was no special treatment of the inner target surface like polishing or honing besides the careful machining. Passivation was achieved by heating the target with a torch to about 200°C, evacuating and filling with 4 bars of 1 % F_2 in Ne. The filled target was heated up again for about 15 min and left to stand overnight. The next day it was evacuated for about 2-4h. Because of the actual setup, the vacuum in the target cannot exceed about 2-10 torr (oil rotary pump, no vacuum monitor at the target, 10 m tubing with 1 mm) between pump and target. The irradiation mixture (Ne/0.2 %F_2) was introduced to a total pressure of 18 bar. The first short irradiations were discarded.

Foils

Havar (Goodfellow) proved very reliable as foil material. For sealing the target foil (50 micron), it is pressed between two standard soft copper rings (Leybold CF16). During compression, a flat sealing surface is formed thus avoiding mechanical stress to the foil. No failures due to bending were encountered, even when a regular evacuation-pressurizing cycle was followed. The 25 micron vacumm foil is sealed with a viton o-ring. Even 7 micron Havar was used for a while and proved rather reliable, but this had to be abandoned because of supply problems. Under normal conditions, the foils could be used for up to 6 months. Foil ruptures had to be atrributed to two main reasons:

- accidental sharp focusing of the beam (a wobbling system is used for defocusing)
- breakdown of the He cooling system due to pump membrane rupture. Pinhole formation was found only once.

Foil cooling

He is pumped in a closed loop at a flow rate of about 100 l/min. A small water cryostat serves to remove the heat developed by the membrane pump.

Target cooling

A simple air jet that blows on the side of the target is used for cooling. A thermocouple is pressed onto the target body and connected to a threshold switch set to 150°C to avoid overheating that could be caused by a failure in the compressed air supply.

Performance and yields

Since the target described here is extensively used for routine production, there was no time for systematic studies of the yield and its dependence on the various parameters, as there are pressure, beam current, target size, total dose, dose rate, target temperature or method of cooling. The target described here proved more reproducible and reliable, after the water cooling system was replaced by the simple air cooling described above. Normally the target temperature read from the thermocouple does not exceed about 100°C. The target pressure during irradiation rises to values up to 26 bars at 25 μA. This pressure rise is a very sensitive indicator of correct beam positioning and is therefore used, together with the readings from a four–sector collimator, to optimize the beam transport parameters. The recovery of labeled fluorine gradually increased during the first runs, reaching about 60 % of theory for a 80 min bombardment with 14 MeV deuterons at a beam current of 25 μA. This value corresponds to a recovered activity of about 350 mCi at EOB. At present, 200 to 250 mCi are produced routinely in a 1 h irradiation at 25 μA.

Materials

Target body:	$CuBe_2$, chemically Ni plated
Target head:	stainless steel
Foils:	Havar (Goodfellow), 25 and 50 micron
Sealing:	Copper rings (Leybold), Viton O–ring
Transmission lines, connectors, manifold:	stainless steel, Swagelok
Valves:	stainless steel bellows (Hoke, Nupro), Ball valves (Whitey)
Pressure transducer:	Piezoresistive, low dead volume type (Keller)
Gases:	Ne/1% F_2 (Matheson), Ne 99.998% (Messer Griesheim)

Cyclotron

At present, irradiations are carried out at the compact cyclotron CV 28 of the Nuclear Research Center in Jülich (KFA GmbH). A baby cyclotron MC 16 is scheduled for delivery to the MPI in Köln for the end of 1986.