Purpose and Scope

The scope of this project was to achieve a solid target that is capable of dissipating high proton beam intensities for extended periods of time. Ultimately, we intended to demonstrate that technetium can be produced in multi-curie quantities by proton irradiation of $^{100}$Mo-solid targets through the (p,2n) reaction.

Background

Solid molybdenum-100 metal targets for the production of technetium-99m on medical cyclotrons via the $^{100}$Mo(p,2n)$^{99m}$Tc reaction have been developed. The isotopically enriched $^{100}$Mo target material is electro-deposited on a tantalum backing and then sintered [1]. The targets thus produced have been irradiated at power densities of up to 1.1 kW/cm$^2$.

Preprocessing of Powder Received from Manufacturer

The enriched $^{100}$Mo powder that was received from various manufacturers was found to have a large grain size distribution. In order to obtain an adherent molybdenum layer through EPD/sintering, the powder was preprocessed to achieve a smaller and more uniform grain size. This was accomplished through dissolution and oxidation with peroxide, then followed by a carefully controlled hydrogen reduction (Fig. 1 & 2) [2]. Powder characterization was performed with the use of SEM/EDX (Fig. 3).

Target Manufacture

Deposition of the enriched molybdenum onto tantalum was accomplished through electrophoretic deposition (Fig. 4) with a polar solvent, and then sintered at high temperatures (1700°C). This technique afforded both small and large solid targets to be manufactured for high current proton irradiation.

Due to the high cost of highly enriched $^{100}$Mo powder, a recycling process was established to recover as much of the target material as possible. After irradiation and extraction of the pertechnetate ($^{99m}$Tc), an ion exchange was performed to remove the impurities from the enriched molybdate, followed by thermal decomposition to MoO$_3$ and then hydrogen reduction to achieve $^{100}$Mo-metal powder [3]. Greater than 90% of the enriched material can be recycled through this method.

Targets have been irradiated on the GE PETtrace cyclotron at the Lawson Health Research Institute, with 80 µA of 16.5 MeV protons.

References

1. C.P. Gutierrez et al., J. Electrochem. Soc. 109, 923-927 (1962)

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