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1. Feasibility Study for ^{10}Be Targets

^{10}Be is a β^-- emitter with E_{max} = 0.6 MeV and a half-life of $1.6{\cdot}10^6$ years. Its theoretical specific activity is 22.4 μCi/mg. A limited quantity of this isotope was produced at ORNL by calutron-separation using feed containing 700 ppm of ^{10}Be, which was obtained by long-term neutron irradiation of the Be-moderator in the Materials Testing Reactor at ARCO, Idaho. The ^{10}Be enrichment of this isotopic material is 61.4 at%, its radiochemical purity 99

In view of a current target request a feasibility study was performed on the basis of a maximum consumption of 1 mg of ^{10}Be isotopic material. A 35 weight% solution of $^9Be(NO_3)_2$ in water[1] was used for this study. Because of its high thermal and chemical stability, BeO is the most suitable compound for such an exotic Be target. In contrary to the actinide nitrates, however, $Be(NO_3)_2$ can not be converted in situ nto BeO during evaporation. This is because it is very volatile and partly sublimes in vacuo before the conversion is completed. Therefore the conversion was performed in air: an aliquot part of the $Be(NO_3)_2$ solution (typically 10–20 μl) was poured into a vitreous carbon crucible and carefully dried at 80 °C in a small muffle furnace. Then the temperature was slowly raised to 500 °C, until the $Be(NO_3)_2{\cdot}xH_2O$ was completely converted to BeO.

Our standard micro-evaporation module [1] was used to condense thin BeO-films of 3 mm diam. on carbon backings of about 40 μg cm^{-2} thickness. In this setup, heating is performed by low-tension electron bombardment. A power of 450 W was required to heat the Re crucible to a temperature of about 2200 °C. Re was chosen as a crucible material, because this metal proved to be most inert against BeO at elevated temperatures. A typical load of 300 μg BeO (corresponding to about 1 0 μg of Be) resulted in a thin film of 200 μg cm^{-2} average thickness, referring to Be. A contamination of approximately 2.5 at% Re, resulting from the crucible, is present in the BeO film, as found by ERDA analytical techniques [2]. Due to the very high evaporation temperature required to sublime the refractory BeO this comparatively low contamination can not be avoided.

Due to the very close geometry of the micro-evaporation module the targets have to be produced individually piece by piece. Thus several targets in the thickness range of 100–300 μg cm^{-2} can be provided from 1 mg of ^{10}Be.

According to this successful study the production of ^{10}Be targets has been scheduled for spring 2001.

2. Gold-Mercury Alloys

In Au parts used in a reactor environment, ^{198}Hg is formed by thermal neutron capture via the reaction ^{197}Au(n,γ)^{198}Au and subsequent β^- decay. On a long term scale an appreciable amount of ^{198}Hg will be accumulated in the Au matrix, which may cause corrosion in continguous Al components, particularly in the presence of humidity. In order to perform relevant corrosion tests, Au-amalgam samples with different Hg-contents up to 20 wt.% have to be provi ed. Since the preparation of Au-amalgam of homogenous structure by melting down aliquot parts of Au and Hg is technically difficult and requires annealing times of several weeks [3], the more promising approach of electroamalgamation [4] was utilized. Accordingly, Hg was electrolytically deposited on Au wires of 1 mm diam. and 40 mm length. The setup is shown in fig. 1.

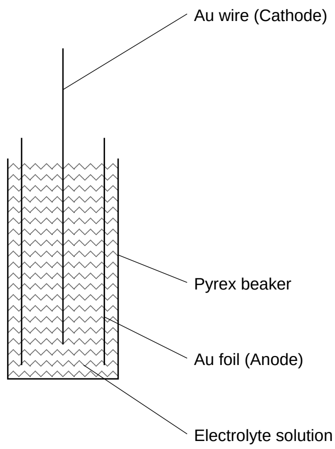

Fig. 1: Electrolysis setup for Au wire amalgamation

The electrolyte was prepared by dissolving 30 mg of HgO in 0.5 ml of concentrated (65%) HNO_3 and subsequent addition of 7 ml of H_2O. Hg-deposition was conducted at a constant current of 2 mA, requiring a voltage of about 2 V. Saturation was achieved after 60 min, resulting in a deposited mass of 10 mg Hg at the surface, which corresponds to an average concentration of approx. 1.5 wt.%. The formation of Au-amalgam was completed by a 24 h heat treatment at 200 °C in an r atmosphere at a pressure of 1670 mbar. X-ray diffraction analysis gives indication of the constitution of the intermediate phase Au_3Hg close to the surface [5], corresponding to a Hg content of approximately 25 wt.%. These samples were used for preliminary corrosion tests. The present study is continued aiming towards the production of Au wire containg 10–20% of homogeneously distributed Hg.

References

[1] H. J. Maier *et al.*, Nucl. Instr. Meth. **A397** (1997) 110
[2] W. Assmann, F. Grüner, MLL Garching, private communication
[3] E.A. Owen, E.A.O. Roberts, J. Inst. Met. **71** (1945) 213
[4] N. Parravano, P. Jovanovich, Gazz. Chim. Ital. **49** (1919) 1
[5] H. Boysen, Kristallogr. Inst., LMU, private communication

[1] supplied by Aldrich Chemie GmbH, D-82024 Taufkirchen