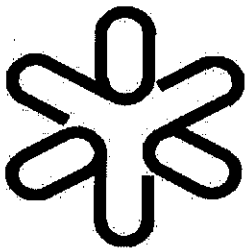

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A Targets of ^{208}Pb on Carbon Backing

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Targets of ^{208}Pb on carbon backing.

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Abstratct: ^{208} Pb was evaporated on 40 μg/cm^2 thick achieved carbon foils on glass substrates. On the ^{208}Pb a thin ~5 μg/cm^2 C layer was subsequently evaporated. The targets were then obtained floating the films in warm water and fishing them onto appropriate thin Al target frames.

More than one hundred ^{208}Pb targets on carbon backing with a thin carbon layer on it were prepared to be used in the recent experiment carried out in Ganil to search the Z=118 super heavy elements using a ^{86}Kr beam of 453 MeV energy.

As Pb is a toxic material in powder and vapour form, special care was taken because of the unusually large quantity of required targets. Special masks with appropriate filters for particulated material, gloves, disposable paper caps and clothes were dressed to avoid undesirable contamination. In addition, flushing of the vacuum system with dry nitrogen or argon was always performed before openning the bell-jar after Pb evaporation.

Joule heating process using Ta boat was chosen to obtain 300 to 400 μg/cm^2 thick film of ^{208}Pb onto 40 μg/cm^2 thick carbon foils deposited on glass substrates. The carbon foils were achieved from the Arizona Carbon Foil Co., for time saving. The Edwards E12 evaporation unit was used in the Pb evaporation, because in this unit it is easier to clean the residual material, washing many pieces as for example the Pirex bell jar. It is known that Pb contamination is hazardous if a very good final vacuum is to be attained in the chamber. A thin layer of C of about 5 μg/cm^2 was deposited on the Pb layer, to avoid target evaporation during the beam exposure in the experiment. This C evaporation was performed in the new Leybold Univex 450 unit.

There is not any rotational substrate holder available in our laboratory. So, to achieve the appropriate uniformity in the whole batch of substrates it was thought that a very large distance from boat to substrates was necessary. As usually done, the preliminary tests were performed using natural Pb material, in metallic form. Distances of 8 and 13 cm were used. Twelve substrates were mounted on a substrate holder with a shape of a section of a sphere. The obtained uniformity was better for the larger distance, as expected, but the efficiency was not acceptable for enriched isotope use. Shorter distance affords a better efficiency, but the thickness distribution was too wide. Many attempts were made using boats of different sizes and shapes as shown in figure 1.

The best configuration should give the acceptable uniformity of the evaporated film examining each glass slide as well as the whole distribution. There could be a sequence of evaporation runs, so that the glass slides with appropriate deposited thickness could be retired and substituted by new substrates. Some other glasses should be left for two or three evaporation runs until the appropriate thickness is attained.

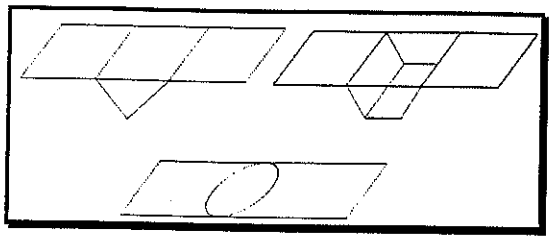

Figure 1 - Ta boats of 0.2mm thick pure Ta sheet, home made by cutting and modelling properly.

Finally it was chosen a distance of 8 cm from boat to the top of the substrate holder and the Ta boat of spherical shape cavity, which was hand made by pressing using a mould with an inox ball of about 1 cm diameter.

The target thickness distribution on the 12 glass slides was carefully determined for this chosen geometry, having in mind the stablishment of a schedule of a systematic loading procedure of the substrates in subsequent evaporation runs, so that by the end of a series of runs all targets would have the appropriate thickness.

As an on line thickness measurement device is not available in the our Edwards evaporation unit, the thicknesses were determined by alpha particle energy loss, after floating the target film onto appropriate thin Al target frames. The effective area of the target was of 1.5 cm x 5 cm and the uniformity of the film Pb deposition along each target of about 10% was also determined for several samples.

To monitor the film thickness deposited in each evaporation run three small thin glass slides (1.5 cm x 1.5cm) were weighed before and after the evaporation of a known amount of mettalic Pb loaded on the boat. One slide was set exactly on the top of the substrate holder and the other two were located aside the carbon slides.

On behalf of the thickness distribution obtained in the test runs it was decided to use 80 mg of material to be fed into the Ta boat for each evaporation run. Only ten of the twelve substrate holders were used, and were named as shown in the figure 2. The two unnamed substrate holders were not used because of the poor uniformity.

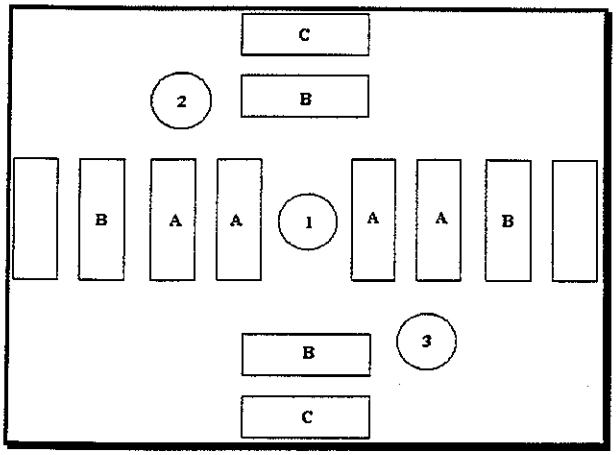

Figure 2 - Schematic view of the substrate holder. The circles numbered 1, 2 and 3 are the sites where the reference glass squares are loaded.

After the first evaporation of 80 mg of Pb the glass slides named A had already the necessary thickness and were therefore removed. New carbon foils and a new amount of Pb on boat were loaded. After the second evaporation run the glass slides named A and B were removed. In the third evaporation run only the slides named A were thick enough. Finally after the fourth evaporation run all slides named A, B and C were removed. Therefore,

after four evaporation runs 26 targets were available using 320 mg of Pb attaining a 55% efficiency, which was considered quite good. The glass slides have 2.5 cm width and 7.5 cm length. Some of the B and C slides were turned 180° between evaporations to attain a final better uniformity. Pb thickness after a complete cycle of four evaporations was of 350 $\mu g/cm^2 \pm 20\%$. It was observed that the control of the heating velocity is very important for a reproducible thickness distribution as well as for the uniformity of the deposition on each substrate.
The heating was performed in 4 to 6 intervals of 20 seconds each, about 3 minutes apart. The maximum applied current has been raised gradually in the subsequent intervals up to the appropriate evaporation current.

When the heating of the Pb was performed at once, only the central glass slides were covered not uniformly and with a very poor efficiency. It seems that Pb is lost through the pumping system. Therefore, the Pb evaporation by Joule heating must be performed very slowly to obtain uniform films and also a reproducible thickness distribution on the batch. The current must be raised very slowly as already described. The mettalic material must be free of colored oxide, which was previously removed using a scalpel. The shape of the Pb piece must also be approximately the same, so that the heating process will not be changed.

On the ^{208}Pb layer a 5 $\mu g/cm^2$ carbon was deposited using the Leybold Univex 450 evaporation unit, where a thickness measurement cristal is installed.

All substrates with deposited Pb films were stored in vacuum. After the thin carbon deposit, the glass slides were stored in dry boxes.

The foils of 40 $\mu g/cm^2$ C + and 350 $\mu g/cm^2$ + 5 $\mu g/cm^2$ C were then floated in 40°C warm distilled water and mounted on thin Al target frames. No zapon was used. As the Pb layer was somewhat thick, the floated foil although perfectly plane and sticked to the frame just after lifting from water, began to roll up when dried. This happened only to the thick Pb layer films (~440 $\mu g/cm^2$). A thin layer of an epoxi mixture (Araldite Ciba) was used on the target frame to glue the foil on the frame during the fishing procedure. This technique demands a good alignment of the floated foil and target frame just in the beginning of the fishing, so that the frame will be entirely covered with the Pb film.

During the fishing procedure with ^{208}Pb isotope, even with the use of the glue, the efficiency was near 100%, almost no loss was verified. For the transportation to France, a little special case was made in Ganil with slots for the fixing of the touchy thin target frames. All targets arrived safely.

The use of the epoxi glue to fix the film to the target frame, although cumbersome during fishing, afforded the necessary mechanical stability to resist the high rotation velocity of the target wheel of 2000 rpm.