Isotopic Sn Target Fabrication at IUAC

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Introduction

Target development laboratory of IUAC has successfully fabricated Sn Targets of different thicknesses of <0.5 mg/cm^2, <1mg/cm^2 and <2mg/cm^2 for nuclear physics experiments. Targets were fabricated in the form of self supporting foil and with thick Gold backing. Rolling technique, physical vapor evaporation and Ion beam milling were used in target fabrication. Thick targets of thickness of >1mg/cm^2 were prepared in rolling technique and thin targets of thickness of <1mg/cm^2 were prepared by evaporation. Details of different methods employed in Sn target fabrication are discussed.

Fabrication of Sn targets of 0.2mg/cm^2 and 0.6mg/cm^2

Thin targets of Sn were fabricated by vacuum evaporation. A diffusion pump based coating unit was used in this work. A layer of NaCl of 100nm was used as parting agent. Sn and NaCl were deposited by electron beam technique and thermal evaporation technique respectively. Evaporations of Sn and NaCl were performed sequentially without breaking the vacuum in between the evaporations. We also observed that floating of self-supporting films was not successful when evaporation were not done without breaking of vacuum. Cleaned glass slides were mounted in such a way that the vapor from the Sn and NaCl should reach the glass slides without out any obstruction. A shutter was also provided in between the source material and glass slide. The shutter was kept in close-position in the beginning of evaporation. Once the evaporation rate reached at a constant rate, the shutter was opened. A vacuum of $7x10^{-7}$ torr was maintained during the evaporation of Sn. The rate of deposition during the evaporation was 0.1 nm/sec. After the evaporation,the coating unit was left for cooling for 2hours. Sn films were separated from the glass slide by floating them in the deionized water. The floated films were then carefully mounted on an appropriate target holder. In case of targets having backing foil,the Sn is deposited directly on the backing foil by thermal evaporation.

Fig.1 Evaporation set-up

Fig.2 , Ta boats and crucibles

In order to minimize the material loss of expensive isotopic Sn material, special crucibles and boats were used in evaporation. Minimizing the distance between the source to substrate is an another step taken to minimize the material loss. The backing foil mounted on a target frame or glass slides were kept at an optimum distance of ~6cm to maximize the collection of Sn vapor. Available amount of isotopic Sn was only 100mg and it was necessary to ensure the success in one evaporation of isotopes. In order to minimize the possibilities of failure,several trial attempts were made with natural Sn prior to isotopic Sn evaporation. Target laboratory was successful in the fabrication of expensive isotopic targets of ^{116}Sn, ^{118}Sn ^{122}Sn, and ^{124}Sn by evaporation method.

Fabrication of Sn Targets of >1.2 mg/cm^2

Target Development laboratory has successfully fabricated Sn self-supporting targets using rolling. Initially the Sn foil of thickness of ~30mg/cm^2 was placed inside the folded stainless steel sheet. The stainless steel sheet is then fed into the rolls of rolling machine. Sn foils start sticking with the stainless steel sheets when the thickness reaches ~5mg/cm^2. We observed that heating of stainless steel folder up to 300^{0}C was also slightly helpful in the rolling of Sn. For the further reduction of thickness of Sn foil,the Sn foil was carefully shifted into a folder of teflon sheet. And the further rolling is done in the folder of teflon sheet. The thickness of Sn self supporting targets made by using teflon was 1.2mg/cm^2.

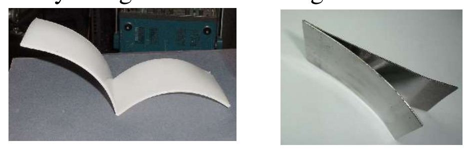

Fig.3 Teflon folder and Stainless steel folder

Sn targets with Au backing were also fabricated by rolling technique. In the fabrication of Sn targets of 1.5mg/cm^2 with a Au backing thickness of 6mg/cm^2 , Sn and Au were rolled separately up to the thickness of ~4mg/cm^2 and ~10mg/cm^2 respectively. After cleaning, both the foils were placed together inside the folded stainless steel sheet and rolled to the required thickness. Nuclear physics experiments using the DSAM technique require targets with no air gap in between the foils. Clean surface of foil and additional care in rolling were more important to ensure no air gap in the target. Target laboratory was successful in the fabrication of thick targets of ^{122}Sn, and ^{124}Sn in rolling method.

Ion beam milling of Sn foil

Due to excess amount of material consumption,evaporation technique was not preferred in the fabrication of Sn target of thickness of ~1mg/cm$^{2..}$. An atom source having 2" diameter beam was used in this method. Initially the Sn foil was thinned down to ~5mg/cm^2 by rolling technique. The 5mg/cm^2 Sn foil was then thinned down to ~1mg/cm^2 by milling.

References

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