Preparation of thin ^{122}Sn targets at IUAC

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Introduction

Study of fusion-fission reactions induced by relatively heavy projectile is important in understanding the synthesis of heavy elements [1]. When projectile comes in contact with target then along with evaporation residue (ER) formation there are other processes like fusion-fission, quasi-fission (QF) and fast-fission etc. which hinder the formation of heavy residues. Factors like entrance channel, deformation and shell effect also affects the formation of heavy residues. Both the processes i.e. fusion hindrance and enhancement are present in the interesting energy range near the coulomb barrier for heavy systems. For this kind of study, measurement of ER and fission cross-section is necessary. ERs are normally detected by sophisticated mass separators, where as fission fragments are detected either by large area multi-wire proportional counter or by solid state detectors. For our programme in fusion-fission dynamics we require a thin ^{122}Sn target. In the present work a carbon backed (~ 20 μg/cm^2) ^{122}Sn targets of thicknesses ~ 200 μg/cm^2 has been prepared by using thermal evaporation technique. Prior to this work, Manente et al. [2] and Singh et al. [3] have reported the fabrication of tin target but the focus of study was to prepare self-supported targets of thicknesses ~ 1 mg/cm^2 and gold-backed targets of thicknesses in the range of 0.5-2 mg/cm^2 respectively. In this abstract, we describe the essential steps and precautions required for the successful fabrication of ^{122}Sn targets on thin carbon backing.

Experimental setup

A very thin carbon backing was prepared using an electron gun bombardment technique. Then, enriched ^{122}Sn was evaporated on the carbon foils by using thermal evaporation technique in diffusion pump based coating unit. The schematic diagram of diffusion pump based coating unit is shown in FIG. 1. In the diagram, the manual valve is used to

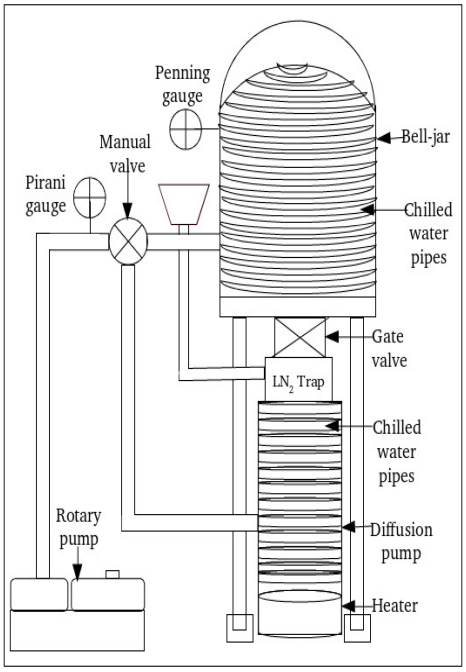

FIG. 1: The schematic diagram of the diffusion pump based coating unit at IUAC.

connect rotary pump to bell jar and diffusion pump for the roughing and backing purposes respectively. This coating unit is equipped with liquid nitrogen (LN_2) trap filled with LN_2 which condensate the boiled oil vapors present in diffusion pump. To maintain the vacuum inside the bell jar, chilled water is circulated in the outer traps of bell jar as well as in the water pipes around the diffusion pump. This chamber is equipped with an electron gun, quartz crystal thickness monitor, thermal

evaporation setup and a water cooled copper crucible.

Carbon backing

For the preparation of carbon backing, clean glass slides were used as a substrate for carbon deposition and $BaCl_2$ was used as the parting reagent to seperate the target from the glass slide. For the evaporation of $BaCl_2$, the pellet of $BaCl_2$ was placed in the molybdenum boat [FIG. 2(a)] and then it was evaporated on the glass slides using resistive heating method. The deposition was monitored and controlled using quartz crystal monitor. After obtaining the desired thickness, source was covered with a manual shutter to avoid over-deposition. Carbon of thickness ~ 20 μg/cm^2 was deposited on a $BaCl_2$ layer by using 2 kW electron-gun. These slides were annealed in a tubular furnace at a temperature of 598K for a period of 60 minutes in the environment of dry inert gas. Some of the glass slides were floated in warm distilled water and used as substrate for the fabrication of ^{122}Sn target. To minimize the heat in the carbon foils, silver paste was applied on the target frame holder.

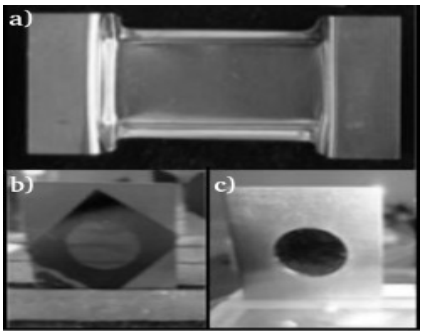

FIG. 2: a) Molybdenum Boat, b) front view and c) back view of the floated ^{122}Sn target.

Preparation of ^{122}Sn targets

Finally, the vacuum evaporation technique was used to prepare thin ^{122}Sn targets. Prior to final evaporation, various trials were performed with natural tin material which was available in the form of shots. All the trials to make carbon backed ^{122}Sn target were successful. In the final deposition, 50 mg of ^{122}Sn material was placed inside the Ta boat. Annealed carbon deposited glass slides and carbon foils were placed at a distance of 7 cm from the Ta boat. After getting the vacuum $\sim 10^{-6}$ torr inside the chamber, the thermal evaporation was started. The current was increased very slowly during the evaporation process. Then, the chamber was vented in air and ^{122}Sn deposited carbon foils were found in good condition and targets were successfully floated [FIG. 2(b), 2(c)] in warm distilled water. Finally, all the targets were kept inside the dessicator in the inert gas environment.

Conclusion

Thin carbon backed ^{122}Sn targets were successfully fabricated by using the resistive heating method in diffusion pump based coating unit. The rough estimate of thickness has been obtained by using the profilometer in the target lab of IUAC. The actual thickness of the targets will be measured via Rutherford Backscattering Spectrometry (RBS) at IUAC.

References

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