^{116}Cd Target Fabrication at IUAC

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Introduction

Target fabrication by rolling is very effective way to prepare self supporting foils with a variety of thicknesses. Extremely thin foils can be produced by utilizing modified pack rolling technique. The ultimate thickness to which a metal can be reduced is dependent upon the mechanical properties, purity and chemical stability. It is well known that the rolling technique is preferred for conserving material, especially in the case of expensive and ductile isotopes. For experiments such as gamma-ray spectroscopy, the ultimate required thickness is in the range obtainable with the pack - rolling method; that is, about 1mg/cm^2. The main limitation usually comes from the sticking of the foil to the stainless steel pack.

Fabrication Equipment

The rolling machine at IUAC, New Delhi (Fig.1) is used to prepare thin foils of cadmium by cold rolling method. The material to be rolled is placed between two mirror polished stainless steel plates and rolled through specially hardened rollers (Fig.3). Teflon foils can also be used.

Fig. 1 Rolling machine

The gap between the rollers is reduced gradually to achieve thinner foils. Foils of ductile metals of thickness of the order of 1.0mg/cm^2 can be prepared by this method.

Target Preparation

A stainless steel plate has been folded as shown in Fig 2. At first, natural cadmium has been rolled. At the thickness of about 1.8 mg/cm^2 foil becomes very sticky to stainless steel plate. We used the sharp and clean pieces of paper to remove the foil very carefully from stainless steel plate rather than using forcep.

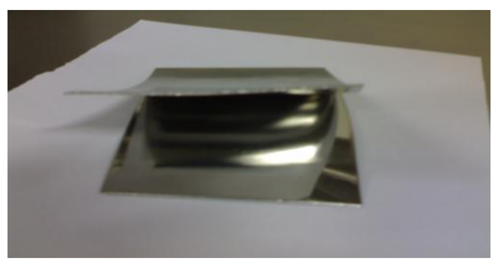

Fig. 2 Stainless steel plate

In order to prevent this strong adhesion, we tried various methods. We insert a very small amount of silicone oil [1] between the metal and not be a success, each time foil get damaged due to excess pressure. Fig.3. displays the rolling technique.

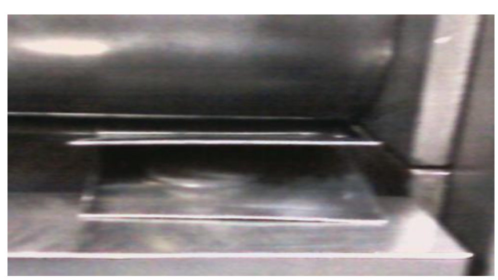

Fig. 3 Rolling of Cadmium foils at IUAC

So, we tried to roll the material with the help of Gold backing. Two foils i.e. natural cadmium as well as Gold were put together and rolled with the help of rolling machine. Pressure is increased very slowly. Procedure is repeated after each fifteen minutes with 5 to 6 rolls. In this way we successfully reached at the thickness of ~ 1.1 mg/cm^2. Thickness is estimated by the expansion in area of foils keeping the weight fixed, i.e. same as weight of foil before putting it on the Gold foil. Now enriched cadmium i.e ^{116}Cd material was provided by IUAC, New Delhi. It was in the form of a bead as shown in Fig.4. Size of granule was around 15.0mm.

Fig. 4 ^{116}Cd in the form of bead

The same procedure was repeated for enriched Cd. We started with 25.0mg/cm^2 of ^{116}Cd. The foil was washed with alcohol to prevent it from dust particles, as the rolling of foil having dust particles on it causes tiny holes in the foil. In this way we are successfully able to make Cd foil of 1.75mg/cm^2 thickness. Fig. 5 displays the foil after rolling.

Fig. 5 ^{116}Cd foil of thickness ~ 3.0mg/cm^2

At this point one must remember to back off on the roll pressure just a little before opening the pack, because it is becoming more and more difficult to avoid sticking, bubbles, blisters or foil breakage. Then it is rolled further with Gold foil of thickness 15.0mg/cm^2. In this way we reached at 0.8 mg/cm^2 of ^{116}Cd supported with 7.0mg/cm^2 Gold foil. When we were not using Gold, we were not able to reduce thickness further. Since the foils were very thin and having heavy Au backing, they get rolled after some time. So it is preferred to mount them on tantalum holder or to keep them between two glass plates. 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. Cadmium foils of thickness of the order of µg/cm^2 can be made by ion beam sputtering or vacuum evaporation techniques. In ion beam sputtering, graphite rod is used as cathode, acceleration voltage is adjusted to 10kV. This results in sublimation of target material. In this way, Cd foils of thickness around 20-3000 µg/cm^2 can be deposited on particular backing.

References

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