Fabrication of thin targets of $^{180}WO_3$

S. Sanila[1],* A. M. Vinodkumar[1], B. R. S. Babu[2], S. R. Abhilash[3], S. Ojha[3], G. R. Umapathy[3], and D. Kabiraj[3]
[1]*Department of Physics, University of Calicut, Kerala, India-673635*
[2]*Department of Physics, Sultan Qaboos University, Muscat, Oman*
[3]*Inter University Accelerator Centre, Aruna Asaf Ali Marg, New Delhi 110067, India*

Introduction

Preparation of targets of proper thickness in a nuclear physics experiment is a challenging task. ^{180}W target was prepared for studies on Evaporation Residues using HYRA facility at IUAC. Tungsten having a high melting point and the isotopic abundance of ^{180}W is only 0.12 %. Enriched ^{180}W in the form of WO_3 powder was supplied by Oak Ridge National Laboratory (ORNL) USA. For our experiments, we need a thickness of $\sim 200\mu g/cm^2$ self supporting targets or oxide with small backing of carbon. We have ^{180}W in oxide form, it is a difficult task to prepare self supporting targets of desired thickness.

Lipsky et al, [1] have reported a method to fabricate self supported natural tungsten target of thickness 0.5 - 3.4 mg/cm^2 from tungsten oxide powder. They used evaporation technique to deposit WO_3 over a suitable substrate foil and then selectively etched the substrate in dilute nitric acid solution. Shidling et al, [2] fabricated W target of thickness 210 μg/cm^2 on 100 μg/cm^2 carbon backing using electron gun method. M. Shareef et al, [3] reported the simultaneous fabrication of thin and thick targets of ^{182}W, ^{184}W and ^{186}W isotopes, with relatively thin C backing $\sim$ 30 μg/cm^2. Here we report the fabrication of ^{180}W using the recently installed turbo pump based vacuum coating unit equipped with an 8 KW electron gun at IUAC, New Delhi.

*Electronic address: sanilasathyan90@gmail.com

Fabrication of Carbon backing

In a diffusion pump based vacuum coating facility of IUAC, $BaCl_2$ of 100 nm thickness and carbon of thickness 30 μg/cm^2 were deposited. $BaCl_2$ was used as a releasing agent due to its high melting point, on cleaned glass slides. Carbon was deposited over the parting agent by using the electron beam from the 2 kW electron gun at a constant rate of 0.1 nm/s, without disturbing the vacuum. Graphite pellet of 9 mm diameter was used for this evaporation. The deposited carbon slides were annealed in a tubular furnace at a temperature of 325°C for a period of 1 hr in the environment of Argon gas for relieving the stress developed during the deposition of carbon.

Fabrication of tungsten oxide (WO_3) target

$BaCl_2$ and carbon deposited glass slides were mounted in a newly installed turbo pump based coating unit with a 8 kW electron gun. This facility is capable of achieving vacuum of the order of 10^{-6} Torr. Schematic diagram of turbo molecular pump based vacuum coating unit is shown in Fig. 1. A tungsten pellet of 3 mm diameter was prepared out of 126.1 mg tungsten powder, by using a manually operated hydraulic press. The annealed carbon slides were used as substrates. The substrate was kept at 5 cm height from the source centre. A quartz crystal monitor was kept at a height of 19 cm from the source centre for continuous monitoring of the deposition rate and the thickness of target. In order to achieve good quality films, the current was increased in 2 mA steps for every 5 minutes up to a

maximum of 29 mA. The deposition was completed within an hour using this facility. The material consumed in this process was 27.7 mg. The W deposited slides were floated in hot distilled water to separate out the foils from glass slides. In few cases ^{180}W film was released from the carbon foil itself.

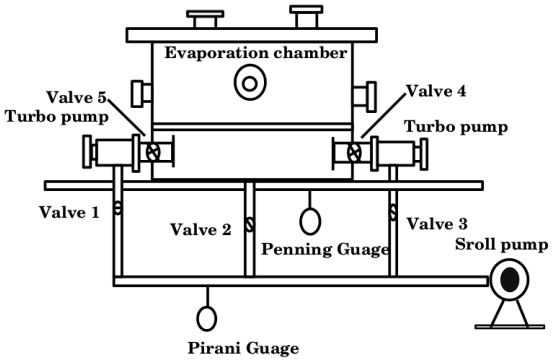

FIG. 1: Schematic of turbo pump based high vacuum coating unit.

Characterization

The fabricated targets were characterized using Rutherford Backscattering Spectrometry (RBS) facility of IUAC. The thickness was measured and the presence of other elements in the target were analyzed. The RBS spectra of fabricated target is shown in Fig. 2. It exhibits three different peaks corresponding to carbon backing, oxygen and tungsten respectively, indicating the absence of any heavy impurity. Using a Gaussian function fitted to this spectrum, we have estimated the thickness of W and carbon backing as $\sim$ 214 μg/cm^2 and $\sim$ 25 μg/cm^2 respectively.

Conclusion

We have successfully fabricated ^{180}W targets of thickness $\sim$ 214 μg/cm^2 using evaporation method.

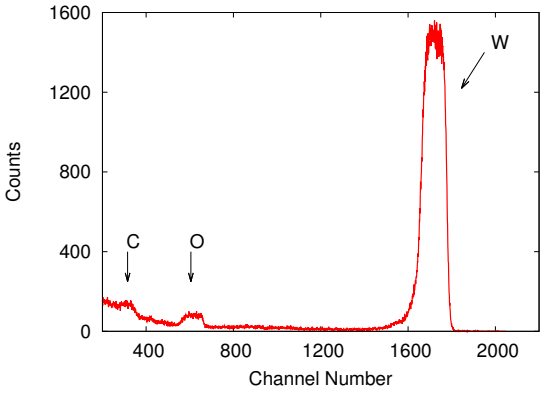

FIG. 2: RBS spectra of WO_3 target.

Acknowledgments

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