# Fabrication of thin and thick targets of $^{182,184,186}$W isotopes

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## Introduction

Targets of proper thickness is an indispensable part in nuclear physics research. For example, the measurement of evaporation residue excitation functions and fission fragment mass distribution studies require thinner targets (∼200 $\mu g/cm^2$) to minimise the energy straggling of the interested reaction products. However, neutron multiplicity measurements, on the other hand, need thicker (>0.5 $mg/cm^2$) targets as the neutron yield is proportional to target thickness as well. W element, having different stable isotopes, is one of the best choices in nuclear reaction experiments to study various aspects such as N/Z equilibration, target deformation effects etc., in heavy ion reactions.

Different fabrication methods for tungsten targets have been reported by various groups. A deposition method which relies on the electrostatic acceleration of charged powder between parallel electrodes has been reported in Ref. [1]. A. R. Lipsky *et al.*, [2] fabricated natural tungsten target from tungsten oxide powder. Computer controlled evaporation [3] and sputtering method [4] were also reported for the fabrication of W target. P. D. Shidling *et al.* [5] deposited thin W target on 100 $\mu g/cm^2$ carbon backing using electron gun method. All these methods were limited by the production of either thin or thick W targets alone, or targets with very high backing foils. Here we report the simultaneous fabrication of thin and thick $^{182}$W,$^{184}$W and $^{186}$W targets, with considerably thin C backing (∼30 $\mu g/cm^2$) using the cryo pump based vacuum coating unit at IUAC.

## Experimental Setup

W evaporation was carried out in the cryo pump based vacuum coating unit at IUAC. Vacuum of the order of $10^{-8}$ torr can be achieved in this facility. This high efficiency setup is equipped with a scroll pump, turbo pump and a cryo pump, to achieve and maintain the ultra high vacuum required for better target foil fabrication. A 6 kW electron gun equipped in this chamber is sufficient for evaporating metals having very high melting point. The four pocket copper crucible inside the chamber is continuously cooled by chilled water supply. The schematic of cryo pump based vacuum coating unit is shown in FIG. 1.

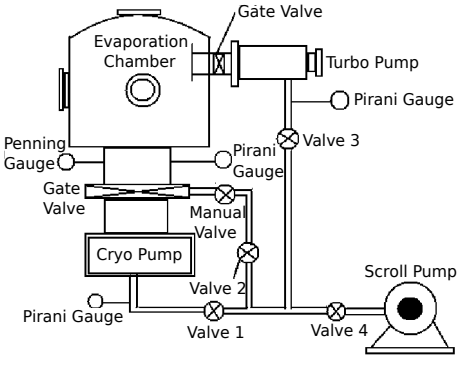


FIG. 1: Schematic of cryo pump based vacuum coating unit.

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## Preparation of Carbon backing

Fabrication of carbon foils for backing purpose are prepared using the diffusion pump based vacuum coating unit [6]. Carbon pellet of 9 mm diameter was used for evaporation. $BaCl_2$ was used as the parting agent. Clean glass slides were used as the substrate. $BaCl_2$ was evaporated using the resistive heating method. This is followed by the deposition of carbon on the same substrate at a constant rate of 0.1 $\mathring{A}$/s, using the electron beam from the 2 kW electron gun.

## Preparation of Tungsten targets

The method of fabrication was first optimised using natural W material. Isotopic material of $^{182}$W was available in the form of metal while $^{184}$W and $^{186}$W were available in the form of powder. Pellets prepared from these materials were used for the target production. As we had to make both thin and thick targets, two sets of substrates were arranged, one kept at 17 cm from the source center and other at 9 cm from the source. In order to achieve good quality films, the current was increased in 5 mA steps in every 5 minutes up to a maximum of 210 mA. The slides were annealed at $325^0$ C under argon environment and later floated using hot distilled water.

## Characterization

The fabricated targets are charecterised using Rutherford Back Scattering (RBS) facility of IUAC. Analysis of RBS spectra explicitly show the quality of the targets prepared. Only two distinct peaks corresponding to carbon backing and tungsten respectively could be seen in the RBS spectra, indicating the absence of heavy impurities. Analysis shows thicker targets have ~700 $\mu g/cm^2$ and the thinner targets have ~200 $\mu g/cm^2$ thickness. The RBS spectra of thick and thin $^{182}$W targets are shown in FIG. 2.

## Conclusion

Established a straight forward method to fabricate thin and thick targets of W isotopes in a single evaporation. Fabricated thin (~200 $\mu g/cm^2$ ) and thick (~700 $\mu g/cm^2$ ) targets of $^{182,184,186}$W isotopes, substantially reducing the material wastage and hence the cost. Evaporations were performed on thinner C foils (~30 $\mu g/cm^2$) and are observed to be perfectly stable. RBS spectra clearly indicates the absence of any heavy impurities testifying the quality of the targets fabricated in this work.

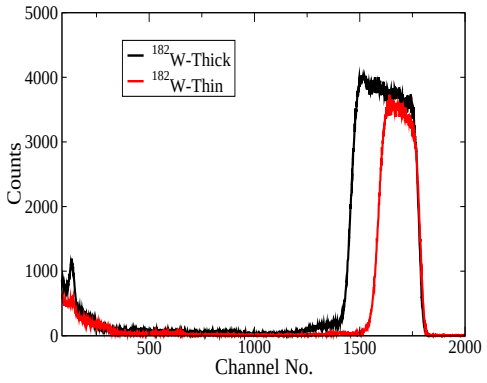


FIG. 2: RBS spectra of thick and thin $^{182}$W targets.

## Acknowledgments

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## References

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