Preparation of $^{128, 130}$Te targets by evaporation method

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Introduction

In the fabrication of nuclear targets one must take into account several factors which can affect the required precision of data measurements. The appropriate target thickness depends on the experiment where it will be used [1]. Due to the low melting point of tellurium metal of 450^{0}C, self-supporting Te targets degrade quickly when exposed to particle beams [2] and as supported targets they disappear easily by sublimation or evaporation. It is important to optimize the target thickness as thicker targets lead to larger absorption of beam energy creating elevated target temperatures where re-evaporation of the target material can occur. Evaporated metallic and oxide Te targets were prepared at Target Development Laboratory (Inter University Accelerator Centre, New Delhi) by vacuum deposition from a resistively heated source boat. A description of the apparatus and production method will be presented.

Experimental Details

The evaporation was carried out in the diffusion pump based coating unit(high vacuum evaporator) in target laboratory of IUAC,New Delhi. In this evaporator, the target material can be evaporated by resistive heating as well as by the use of a 2 kW electron gun. Since the melting point of Te (450^{0}C) is quite less than the melting point of Ta (3017^{0}C), the resistive heating method was found to be best for the fabrication of Te targets. During the evaporation, the vacuum was achieved and maintained in the order of 10^{-6} mbar. The evaporator is also equipped with a quartz crystal thickness monitor which can give the thickness of deposition as well as the rate of evaporation on the crystal. With low vapour pressure elements such as Te, great care must be taken during the deposition process to prevent loss of material from the source boat [3].

Fig.1. Outer view of High Vacuum Chamber at IUAC

In the proposed experiments, the most appropriate backings to use were gold and terbium foils. For the preparation of the ^{128,130}Te targets, isotopes in the elemental form were available from ISOFLEX USA (P.O. Box 29475, San Francisco, CA 94129, USA). An isotopically enriched 500μg/cm^2 ^{128}Te evaporated on 5.7 mg/cm^2 gold foil was used as a target.

Before the evaporation of isotopic material, a few trials have been made with natural tellurium for optimization of parameters. The gold and terbium foils were pasted onto the glass slides with the help of silver paste. Then these glass slides and crystal monitor were placed above the resistive heating arrangement at a distance of 5 cm and 8 cm respectively. After arranging the glass slides inside the high vacuum chamber, the chamber was evacuated to a pressure 2×10^{-6} mbar. The current was increased slowly from 0 to 85 Ampere after the 5 minutes interval in steps of 5 Ampere. At 85 Ampere current the material started evaporation. After that the current was increased more slowly upto 95 Ampere in intervals of 15 minutes each. The evaporation was kept very slow rate about less than 0.1 nm/sec. After the completion of evaporation of required thickness, the chamber was allowed to cool for 4 hours and later naturally vented very slowly. Target thickness was measured using profilometer also.

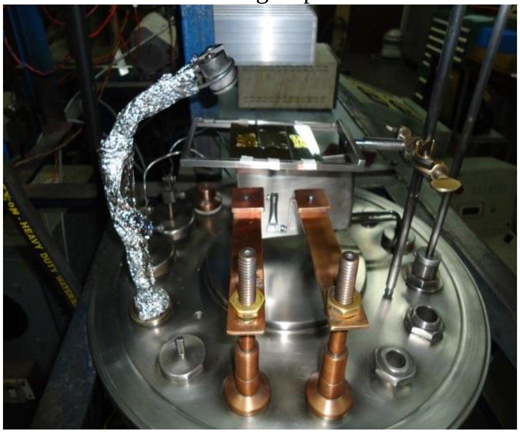

Fig.2. Inside view of High Vacuum Chamber at IUAC

Results and discussion

For these targets, the approximate Te thickness needed was approached during the evaporation process using the quartz crystal deposition monitor, taking into account a correction for the geometry of the set-up. A further refinement to obtain the actual target thickness was accomplished with α-particle energy loss measurements [4]. A summary of all the targets produced and their thicknesses is given in Table 1.

Table 1: Various Te targets produced

Isotope	**Thickness (μg/cm^2)**	**Backing**	**Thickness of backing (mg/cm^2)**
^{128}Te	249.6	Tb	7
^{128}Te	397.4	Tb	7
^{128}Te	156	Au	6.8
^{128}Te	169.7	Au	5.7
^{128}Te	217.46	Au	6.8
^{128}Te	254.9	Au	5
^{128}Te	507	Au	5.7
^{130}Te	189	Tb	5.5
^{130}Te	464.5	Tb	7
^{130}Te	151.9	Au	6
^{130}Te	209	Au	6
^{130}Te	238	Au	6

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References

[1] J.S. Dionisio, Ch. View, J.M. Lagrange, M. Pautrat, J. Vanhorenbeeck, A. Passoja, Nucl. Instr. and Meth.A 282 (1989) 10.
[2] G. Sletten, G.B. Hagemann, Nucl. Instr. and Meth. A 236 (1986) 647.
[3] John P. Greene, George E. Thomas, Nucl. Instr. and Meth. A 282(1989) 71.
[4] G.E. Thomas, J.P. Greene, Nucl. Instr. and Meth. A 362 (1995) 201.