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ISOTOPIC TELLURIUM TARGETS FOR HEAVY-ION NUCLEAR
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John P. Greene and George E. Thomas

Physics Division, Argonne National Laboratory
9700 S. Cass Ave., Argonne, IL 60439 USA

ABSTRACT

A variety of ^{122}Te targets were prepared by vapor deposition using resistive heating on various substrates. Substrate preparation proved crucial for the production of superior targets. Experimental runs on the Argonne ATLAS Accelerator showed the targets to be of high purity with little contamination. In addition, we have since prepared self-supporting Tellurium using a gold shadowing technique with Teepol as a release agent.

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1. Introduction

The thermal instabilities of Tellurium foils in a heavy ion beam are now well known as reported by Sletten and Hagemann.¹ Because of this tendency for Tellurium to sputter away when subjected to energetic charged particle beams, we prepared foils of ^{122}Te on carbon, lead and gold backings at thicknesses ranging from $900\text{ }\mu\text{g}/\text{cm}^2$ to $1\text{ mg}/\text{cm}^2$ to be used in experiments on Argonne's ATLAS Accelerator. These targets were placed in beams of both ^{32}S and ^{34}S at energies of 165 MeV and performed well, without severe degradation, as reported by the investigators involved. This performance differs substantially from the previously reported¹ properties of these films, as they would fail immediately upon exposure to a 205 MeV beam of ^{48}Ca but were stable in a 80 MeV beam of oxygen. Also, we have recently developed a method to produce self-supporting Tellurium foils of $300\text{-}500\text{ }\mu\text{g}/\text{cm}^2$ thickness using a shadowing technique of 2 to $3\text{ }\mu\text{g}/\text{cm}^2$ thick gold with Teepol as the release agent.

2. Target Preparation

All of the targets were prepared by resistive heating vacuum evaporation using a closed tantalum tube $3/16$ " in diameter with a #64 drill hole midway through the boat. The vacuum was on the order of 3×10^{-6} Torr during the deposition. Natural Tellurium was used for test purposes. It should be noted that we experienced anomalous results when evaporating differing natural Tellurium. We used two different samples (probably a number of years old) which would exhibit different properties after evaporation (i.e. some would float while others didn't). Another aspect we investigated was to use a layer of $2\text{-}3\text{ }\mu\text{g}/\text{cm}^2$ Au on the carbon slides so that the Tellurium would adhere. This didn't seem a problem when using lead substrates. To decrease excessive heat exposure, we fashioned a shield of stainless steel with a $1/4$ " hole clamped directly above the source. We also employed a shutter to be rotated in above the boat to further prevent thermal degradation of the substrates.

A. Supported Targets

These Tellurium films were supported on carbon foils of $\sim 100 \mu\text{g}/\text{cm}^2$ thickness along with $1 \text{ mg}/\text{cm}^2$ thick gold films using Teepol as a release agent. Natural Te was used for practice of these substrates as well as Pb already mounted on target frames. There were a number of obstacles presented to us in the manufacture of this ^{122}Te target. We needed to prepare foils of $1 \text{ mg}/\text{cm}^2$ on various substrates for the experimenter. Having only 100 mg of reduced metal to work with, this meant it was necessary to load all the material into the source boat. We decided to maximize our efficiency by using both mounted carbon and gold foils along with slides of each substrate. The deposition went very slowly. The thermocouple monitor indicated a substrate temperature of $130\text{-}150^\circ\text{F}$, therefore we needed to perform more than one evaporation, taking the current up slowly each time. By keeping the current as low as possible, we hoped to prevent any alloying with the tantalum boat. We eventually produced 10 targets with two blanks of each substrate.

B. Self-Supported Targets

We have just recently prepared self-supporting targets using natural Tellurium by shadowing $2\text{-}3 \mu\text{g}/\text{cm}^2$ thickness of gold onto a slide with a Teepol release agent and then depositing the Tellurium. As before, a closed Ta boat $3/16"$ dia. was used with a #64 drill hole for evaporation. Other release agents, of course, should be investigated (see for instance the papers by Braski² or Ramsey³). Foils of 300 to $500 \mu\text{g}/\text{cm}^2$ thickness have been produced. We hope to use this method for the preparation of ^{125}Te targets.

3. Conclusion

Isotopic Tellurium targets have been manufactured here for heavy-ion beam experimenters at Argonne's ATLAS Accelerator. These foils were produced as self-supporting films along with targets prepared on various substrates.

Investigators who have requested these targets have reported excellent results from their experiments. This work was supported by the U.S. Department of Energy, Nuclear Physics Division, under contract W-31-109-ENG-38.

References

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