INTDS NEWSLETTER

International Nuclear Target Development Society

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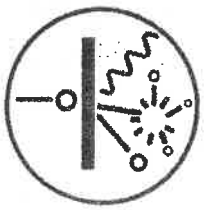

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Cover Photo

A significant revitalization program is well underway at the Oak Ridge National Laboratory which includes some aspects of the Isotope Program. Shown here is a complex of new buildings that have been constructed in the former East Parking Lot at ORNL. The Isotope Program Office and the Isotope Business Office are now located in the new building in the center of the photograph. The stable isotope materials laboratory and inventory are located in the building in the right foreground and the stable isotope chemistry laboratories are located in the left foreground. All were relocated from the Calutron facility at the Y-12 National Security Complex.

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EDITOR'S NOTE

This issue contains the Ballot for INTDS Board of Directors. Please vote for ONLY FOUR and return it to the Nominating Committee at your earliest convenience, thank you.

We again invite any interested members to select distribution of this or future issues of the Newsletter as a ".pdf" file via email. Let us know your wishes. Back issues will soon be posted on the INTDS website for download (minus the Membership Lists), making "reprints" of submitted articles available via the web. Future plans include archived Volumes available on CD-ROM.

I would like to acknowledge the Physics Division of Argonne National Laboratory for their support of our Newsletter and to thank Janelle Neubauer for her wonderful assistance.

John P. Greene
Editor

ANL 2002 INTDS Conference Proceedings

John P. Greene – Conference Chairman
Physics Division, Argonne National Laboratory

The Proceedings

The Proceedings of the ANL 2002 Conference have been distributed to those attending. It is also available online from Elsevier;

Go to http://www.sciencedirect.com/, under '**Search for a title**' type *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, and then click on Volume 521, Issue 1.

There are a limited number of extra copies available to the membership for those wishing to purchase one. Contact me if you would like a copy, our cost per issue is $39 USD. Copies should be available at the 2004 NIST Conference.

John Greene Awarded Outstanding Service Award

Janelle Neubauer, ANL

On June 15, 2004, John Greene was presented with the University of Chicago Outstanding Service Award. Recipients of this prestigious award are nominated by Argonne employees based on their outstanding contributions to the laboratory.

The following excerpt is from the June 1st, 2004 issue of *Argonne News*,

"Four Argonne employees will be honored with University of Chicago Board of Governors for Argonne Outstanding Service Awards, the highest honor the university gives to Argonne employees in support positions. The award was established in 1983 by the University's Board of Governors for Argonne and recognizes those who have furthered the goals and missions of the laboratory through exceptional contributions.

John Greene (PHY) became the target maker for the ATLAS facility almost two decades ago, inheriting a target laboratory largely in disarray. With minimal resources, John proceeded to repair, modify and upgrade the existing equipment while providing targets for the experimental program -- from two to three thousand targets per year. Greene is recognized as one of the best target makers in the United States, producing targets for experiments at ATLAS and other low-energy accelerators around the country. Greene continuously searches for better ways to manufacture targets and to develop new techniques."

To view the entire article, visit http://www.anl.gov/OPA/local/news/an040601.html#story2.

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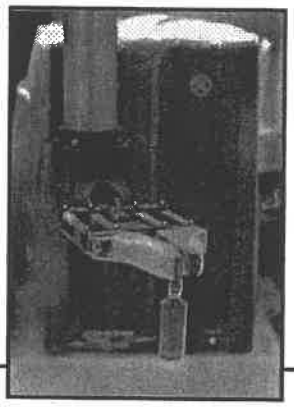
22nd World Conference of the INTDS

Preparation of Nuclear Targets and Samples for Advanced Measurements

U.S. National Institute of Standards and Technology
Gaithersburg, Maryland USA
October 19-22, 2004



TOPICS

- Preparation techniques for thin films- vacuum evaporation/condensation, sputtering, electrochemical deposition, powder distribution and compaction, and roll thinning;
- Separation and chemical processing of stable and radioactive isotopes;
- Preparation and characterization of high-purity and special materials;
- Development of highly material-conservative methods of preparation;
- Effects of contaminants;
- Target and sample encapsulation;
- Radiation and beam heating effects;
- Accelerator targets for radionuclide production;
- Availability of isotopes; and,
- Target and sample thicknesses from gas densities to kg/cm^2.

SCIENTIFIC COMMITTEE

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DEADLINES

Abstracts
July 31, 2004
Pre-Registration
October 5, 2004

Register electronically at:
https://rproxy.nist.gov/CRS/

CAARI 2004 (Denton Conference) will be in Ft. Worth

CAARI 2004: 18th International Conference on the Application of Accelerators in Research & Industry, October 10-15, 2004, Ft Worth, TX, contact Margaret Hall at 940-565-3250 or hall@unt.edu for information.

J. Greene from the INTDS will be organizing an Invited Poster Cluster Session in Targets. Contact J. Greene at 630-252-5364 or greene@anl.gov for information.

The posters in this cluster will be displayed together during the designated poster session. Also, participants will be allowed a few minutes at the end of an appropriate oral session to describe their poster.

The invited poster participants are treated exactly the same as invited oral participants. The official invitation from our office should be sufficient to justify your travel funds to give an invited paper at CAARI. Invited poster papers will be reviewed, and those accepted by the referees will be given five (5) pages in the Proceedings (NIMB), which is the same for invited oral presentations. Please note that the presenter must attend the Conference to have their paper included in the Proceedings.

TECHNICAL CONTRIBUTIONS

Major Changes for the ORNL Isotope Program

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A significant revitalization program is underway at the Oak Ridge National Laboratory (ORNL) to replace or modernize facilities, many of which date back to WWII. This revitalization triggered a number of changes involving the ORNL Isotope Program.

In the early 1990s, as a cost savings measure, all stable isotope operations, the Isotope Business Office and the Isotope Program Office were consolidated in the Calutron Facility at the Y-12 Plant Site. This co-location worked well for many years. However, when the operating contractors for ORNL and Y-12 split and security at the Y-12 National Security Complex (formerly the Y-12 Plant) increased greatly after September 11, 2001, logistics and access to the calutron facility, especially for customers and visitors, became major complications. As a result, selected operations started moving back to the main ORNL site. The Isotope Program Office moved first, followed by the Isotope Business Office. These Offices are now housed in the brand new Research Office Building at ORNL (see cover photo). The ORNL Isotope Business Office now also administers all stable and radioisotope program sales/leases for ORNL, Brookhaven National Laboratory, Los Alamos National Laboratory, BWXT Y-12 National Security Complex, and the Savannah River Site.

More recently, the stable isotope inventory and the materials laboratories relocated to a 15-year-old, thoroughly renovated, laboratory building near the Research Office Building. Currently, the stable isotope chemistry laboratories are being relocated to renovated laboratory space in another nearby building. The calutrons are being maintained in an "operable standby" condition in accordance with Department of Energy guidance. In April 2004, all calutron subsystems were operationally tested and they are under a surveillance and maintenance program to ensure that they will continue to operate if needed.

In addition to a large number of new buildings at ORNL, many of the campus fences came down. Check points were added to the east and west of the ORNL campus, closing the main access road (Bethel Valley Road) to the public. The new security checkpoints greatly enlarged the access-controlled area around ORNL facilities. While the isotope program and particularly stable isotope activities have been anything but stable for about the past 30 years, the recent changes at ORNL have been exciting and it is hoped that improvements will continue.

*Prepared by Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831-6285, managed by UT-Battelle, LLC, for the U.S. Department of Energy under contract DE-AC05-00OR22725.

The Frank Karasek Memorial Scholorship Fund Revisited

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Introduction

The Frank Karasek Memorial Scholarship Fund was established by the International Nuclear Target Development Society (INTDS) in 1996 in recognition of Frank's enormous contributions to the production of thin metal foils by the method of rolling. This fund is designated for the support (travel or conference fee subsidy) of young researchers engaged in target foil rolling.

The establishment of these funds was to further the art of rolling foil targets by instructing young investigators who might not otherwise have the opportunity to experience the techniques employed. The scholarships are normally awarded to researchers from other laboratories involved in target making for nuclear physics research [1]. In this instance it involved a commercial company in the business of providing enriched isotope to the science community, something Frank himself was engaged in outside of Argonne National Laboratory (ANL). And so, not being in the true intent of the scholarship, the INTDS provided only nominal support for a visit to ANL in September of 2003.

Historical Perspective

Frank's prodigious work is well known throughout the world, even to this day [2,3]. The large rolling mills he used are still in use at ANL in the Material Science Division. After his passing, much of his Microfoils Company equipment was acquired by Trace Sciences International in Canada. On an unrelated business trip to Toronto, one of the authors (Greene) was afforded an opportunity to visit Trace Sciences and see this equipment. What a delight it was to roll foils on Frank's actual rolling mill! (Fig. 1) During this visit, foils of gold, nickel as well as isotopic foils of Cd and Sn were prepared by pack rolling using this mill. It was a pleasure to see Frank's rolling mill once again in active use.

Description of ANL Research Activities

In anticipation of Janette coming to Argonne, some thought was given to the scope of work that could be accomplished during her limited stay. This work, of course, should involve rolling and, where the opportunity allows, rolling isotopic metal foils. The following is a short list of some of the interactions afforded during Janette's visit (Fig 2).

1. *Rolling of ^{nat}Ni foils.*

To approximate the isotope, nickel metal powder was consolidated into a bead using an electron beam source, and rolled using a small rolling mill [4].

2. *Rolling of ^{nat}Sn metal foils starting from the oxide.*

The tin oxide was first reduced to metal using a carbon crucible in a hydrogen furnace [5]. In some instances, the metal can be consolidated into a bead by tipping the crucible during heating in the furnace. For this case, the resulting mutable metal beads were pressed into a pellet using a standard laboratory press and then rolled using the technique of pack rolling.

[†]*Trace Sciences International Corp.*

3. *Rolling of isotopic $^{64,68}Zn$ foils for targets.*

Two foils of isotopic Zn were prepared by first consolidating the metal by cold-pressing in a small die. A large area (2 cm x 2 cm) ^{64}Zn foil was rolled to a thickness of 5 mg/cm^2. Next, a fairly large size, 10 μm ^{68}Zn foil was prepared in a similar fashion.

4. *Reduction of ^{nat}MgO and subsequent rolling to produce 1 mg/cm^2 metallic targets.*

To observe another method of reducing metal oxides, metallic magnesium was prepared by the pryo-metallurgical reduction of ^{nat}MgO using Zr as a reducing agent after the method of G. Thomas [6]. The metal was collected on a water-cooled Cu block within the evaporator, obtaining approx. 50% efficiency and rolled directly using our small rolling mill, resulting in a 1.4 mg/cm^2 foil.

5. *Rolling of 10 mg/cm^2 ^{92}Mo foil target.*

Starting with the isotopic powder, it was consolidated into a bead using the electron beam source, and a 6 mg/cm^2 ^{92}Mo foil was prepared by pack rolling in the usual fashion.

Conclusion

In conclusion, the visit to ANL by Janette Campbell was very successful in that it afforded an opportunity for her to interact, observe, and learn different techniques involved in rolling metal foils. This support to young researchers engaged in foil rolling for target preparation should be continued and encouraged wherever and whenever possible.

Acknowledgements

The authors would like to thank the ANL Physics Division and in particular, Dr. Donald Geesaman, Division Director, for the continuing encouragement and support of these efforts. We would also gratefully acknowledge Darren Brown of Trace Sciences International for his gracious support, especially while in Toronto, Canada. Finally, the authors would thank Joanne and Joe Heagney of Micro Matter Company and the INTDS for the establishment and administering the Frank Karasek Memorial Fund.

References

[1] John P. Greene, George E. Thomas and Massimo Loriggiola, INTDS Newsletter Vol. 27, No. 1 (2000) p.3

[2] Frank J. Karasek, Proc. Of the Seminar on the Preparation and Standardisation of Isotopic Targets and Foils, Harwell, England, AERE-R 5097 (1965) p.111

[3] F. J. Karasek, Nucl. Instr. and Meth. 102 (1972) 457-458

[4] John P. Greene and George E. Thomas, Physics Division, Argonne National Laboratory, Argonne, IL, USA, PHY-8557-HI-96 (1997)

[5] J.M. Heagney and J.S. Heagney, Proc. 1976 World Conf. of the INTDS, Los Alamos National Laboratory, Los Alamos, NM, USA, A-6850-C (1977) p.92

[6] G. E. Thomas, Nucl. Instr. and Meth. 200 (1982) 27-31

Figures

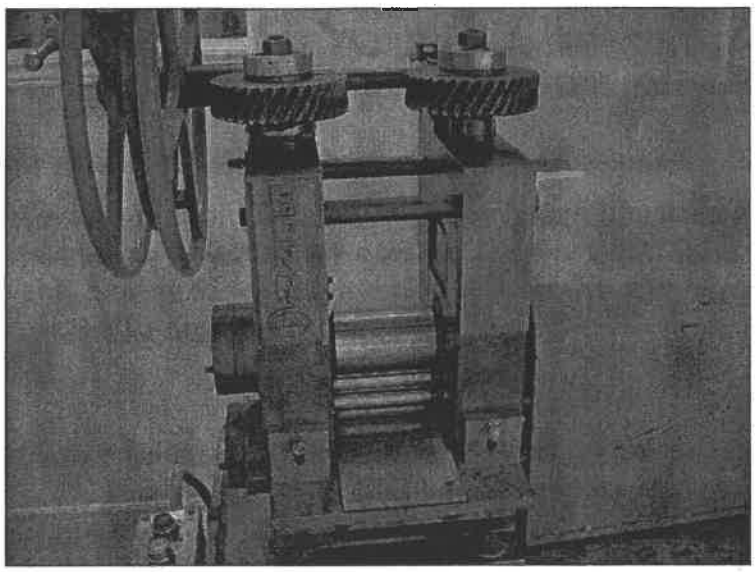

Fig. 1 - Photograph of the Frank Karasek rolling mill obtained by Trace Sciences International.

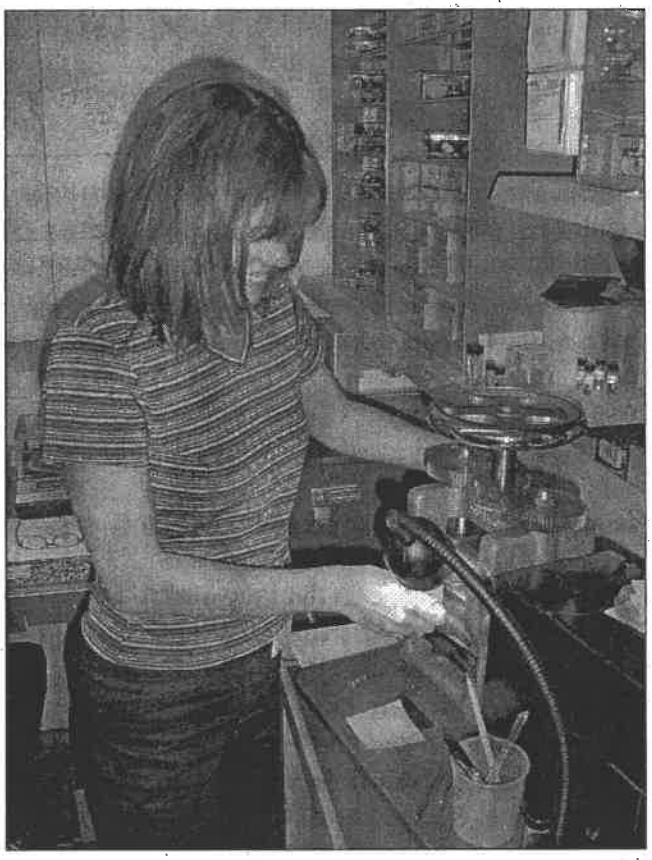

Fig. 2 - Photograph of Janette Campbell rolling foils in the target fabrication facility at Argonne National Laboratory.

Erratum and new delivery problem for Betaine parting agent

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At the INTDS conference in Oak Ridge in 1971 I reported about a so far unknown organic parting agent [1], which is a mixture of seven volume parts of a concentrated solution of Betaine monohydrate with one volume part of a concentrated sucrose solution. Later in the literature this parting agent got the abridged and a little bit misleading name "Betaine". The application is simple: one drop of the mixed solution is wiped with a Kleenex tissue or even with the naked finger on a glass substrate until it dries and forms a milky film. Such a film offers the advantage of a corrugated structure with practically no sharp edges. That is why it is an excellent parting agent especially for very thin foils e.g. carbon stripper foils, because the replica of the corrugated structure on a thin target film results in a high elasticity of the floated foil.

About eight years ago the large chemical companies Merck and Fluka had stopped the production of Betaine monohydrate. When I noticed this, I asked in the INTDS Newsletter Vol.27, No.1 (2000) 11 if someone knew a different supplier. Several members found smaller companies (e.g. Aldrich; Fisher Scientific Co.; Lancaster and VWR Scientific Products). The companies, which are represented in Europe, have depleted their stock meanwhile. Lancaster and Alfa Aesar, however, offer Betaine anhydrous. Both companies get their product from Merck.

I always believed that pure Betaine would be the same compound as Betaine monohydrate only cleaned from crystal water by a drying process. This seems to be not true or the drying process is not reversible.

The compound formula of Betaine monohydrate is:
$(CH_3)_3N(OH)CH_2COOH$
whereas the compound formula of Betaine anhydrous is:
$(CH_3)_3N^+CH_2COO^-$

Comparing both formulas does not explain a big difference for me, I always meant that storing of Betaine in humid environment would automatically convert it into its monohydrate. This is not the case as the following test shows.

We tried to dissolve 147 g Betaine anhydrous in 93 g distilled water, this is equivalent to the 170 g Betaine monohydrate dissolvable in 70 g water as published in the INTDS Newsletter Vol.29, No.2 (2002) 20. In order to speed up the dissolving process a magnetic stirrer was applied. Even after several hours most Betaine anhydrous was still in the solid powder form. Then the mixture was heated to about 340 K, which resulted in a complete solution of the Betaine. At the next morning when the solution had returned to room temperature the Betaine had formed large crystals separated by water. This demonstrated that the solubility in water of Betaine monohydrate is much higher than for pure Betaine.

Searching for a new supplier for Betaine monohydrate I looked in the INTERNET. There is only one producer registered as well for Betaine as for Betaine monohydrate. It is "CHEMICAL LAND 21" in Seoul, Korea. This company explains that both materials belong to life science products and are used for food and cosmetic processing and might act as a provitamin. They synthesize it with high purity of

99.0% minimum (on drying basis), which is the same purity as our last material had which came from Aldrich and probably was produced by Merck. Since the Betaine might be added to cosmetics or even food the Korean company guarantees a maximum heavy metal content of 20 ppm and a maximum impurity of 2 ppm for arsenic. The Merck material had 10 ppm heavy metal impurity, Aldrich presented no heavy metal analysis. The difference in heavy metal impurity is of no meaning for target preparation.

"CHEMICAL LAND 21" claims that as well for Betaine anhydrous as for Betaine monohydrate the losses on drying are 1% maximum. This demonstrates again that the water molecule in Betaine monohydrate is dissociated and not bound as crystal water.

The Korean company does not give a value for the solubility in water for Betaine monohydrate, but they claim that only 64 g of Betaine anhydrous can be solved in 100 g water at room temperature of 298 K. Our experience for Betaine monohydrate is that about 243 g can be dissolved in 100 g water. This demonstrates that a concentrated solution of Betaine anhydrous is too watery with too low viscosity to act as parting agent.

Unfortunately "CHEMICAL LAND 21" sells the Betaine monohydrate only in lots of 25 kg packed in fiber drums. This amount is too much for the use in a target laboratory. That is why I have asked them by e-mail if they might accept also a smaller order or if they could give me the address of a sub contractor. The company did not reply at all. I mean they are only interested in bulk purchaser.

Therefore I have to repeat my question:

Does anyone know a company who still delivers pure Betaine monohydrate?

References

[1] P. Maier-Komor, Nucl. Instr. and Meth. 102 (1972) 485

An Update from GANIL

Christelle Stodel
GANIL
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Since 1997, GANIL, LPC (Caen) and SPhN-DAPNIA (Saclay), supported by CNRS and CEA, took the opportunity to use the velocity filter LISE3 in order to investigate nuclei at the limits of stability such as Super-Heavy Elements (SHE). Technical developments and test experiments have been performed in order to demonstrate the capabilities of the GANIL set-up to pursue this quest of SHE. A round of experiments were performed at GANIL: an attempt to produce the element 118 with the reaction ^{208}Pb(^{86}Kr,1n) ^{293}118 in 1999, then the reactions ^{208}Pb(^{54}Cr, 1,2n) ^{260,261}Sg(Z=106) in 2000 and ^{208}Pb(^{58}Fe, 1n) ^{265}Hs(Z=108). Evaporation residues from the 1 and 2 neutron channels were observed and identified by their decay properties. In 2003, a campaign on transfermium nuclei took place for a few months using the same set-up. It consisted in a first part, to prove the overall set-up to measure cross-sections on the order of picobarn and, in a second part, to search for a new isotope of element Z=114 with the reaction ^{208}Pb(^{76}Ge, 1n) ^{273}114. This experiment was followed by the study of the structure of Mendelevium (Z=101) isotope by spectroscopic means with the reaction ^{209}Bi(^{48}Ca,1n) ^{256}Lr(Z=103). The experimental set-up is similar to that used in other laboratories, such as SHIP at GSI, VASSILISSA at Dubna, or BGS at Berkeley.

The SHE are produced by complete fusion between an incident and a target ion. The beam is produced by the high intensity ECR Ion Sources of GANIL, then accelerated to low energy (4-5.5 MeV/u) in the CSS1 cyclotron and driven through the LISE spectrometer. The beam irradiates a target located in front of the Wien filter. After de-excitation at the target stage, the evaporation residues (ER) are separated from the incident beam using the LISE3 Wien Filter. After implantation in a double-stripped Si-detector, the ER's are identified by their α-decay chains.

In such experiments, the difficulty comes from the very low counting rate and the large use of thin targets with high quality. For the above-mentioned experiments, two wheels, with a diameter of 670mm, bearing 36 or 18 targets were mounted on the same axis to rotate in coincidence at 2000 rpm. Targets (300-400 μg/cm^2) are mounted on the first wheel and carbon foils on the second one. The targets are "sandwiched" between two carbon foils of 40 and 10 μg/cm^2. For the Z=118 experiments, lead targets were produced at Catane, Sao-Paulo and IPN, Orsay. For the Z=106 experiment, lead targets were kindly produced and offered by the GSI target laboratory where we could learn from their experience. For the experiments last year, it was essential to use in-house targets. For this reason, a laboratory was developed in 2003 with the help and fruitful advice of B. Lommel and her group at GSI. The thin layer laboratory is equipped with 2 evaporators, one for carbon layers and one for lead or bismuth targets. Thin self-supporting carbon films are produced through resistance evaporation of a carbon rod under high vacuum. Carbon is deposited on a glass plate according to the method described in Ref 1. These films were used as stripper foils and targets for a detector. Foils with an areal weight of ~10 μg/cm^2 to 40 μg/cm^2 were produced with this method. Such foils of 35 μg/cm^2 were deposited on aluminium frames where enriched isotope of lead and bismuth were evaporated and then a carbon overlayer was evaporated onto it.

For the 2003 experiments, about 200 ^{208}Pb targets and 50 ^{207}Bi targets of 350μg/cm^2 thickness on carbon carrier of 10 and 35 μg/cm^2 were prepared. ^{208}Pb targets rotating at 1500 rpm were irradiated

for nearly 3 weeks with a $^{76}Ge^{10+}$ beam of 5 MeV/u at 0.8 pμA average. The total beam dose was $5*10^{18}$ particles. Targets were replaced every 5 days in order to check their quality.

In the future, we would like to increase the production of thin films of various materials requested as targets or detectors for GANIL experiments. Today, one technician is partially in charge of this laboratory. We would be interested in getting information on the production of thin layers of enriched isotopes for the rare earth elements.

Ref 1 W. Thalheimer et al, Cryst. Res. Technol 34 (1999) – 2 – 175-179

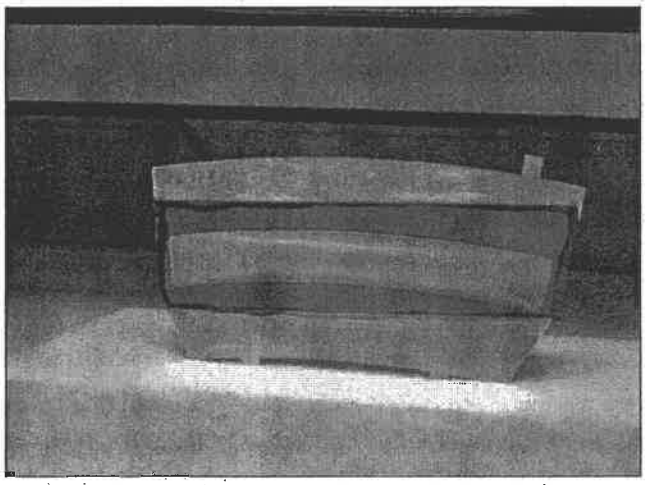

Figure 1: Enriched ^{208}Pb targets, 15 mm height, 100mm long,
C 35μgr/cm^2 + Pb 350μgr/cm^2 + C 10μgr/cm^2

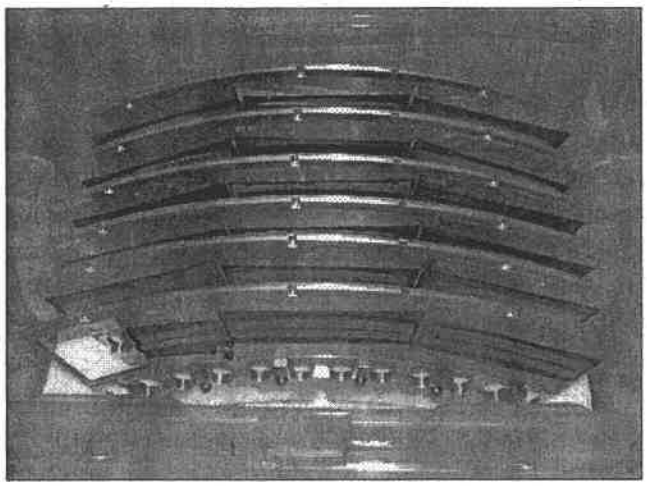

Figure 2: Lead targets after irradiation mounted on partial dials of the wheel.

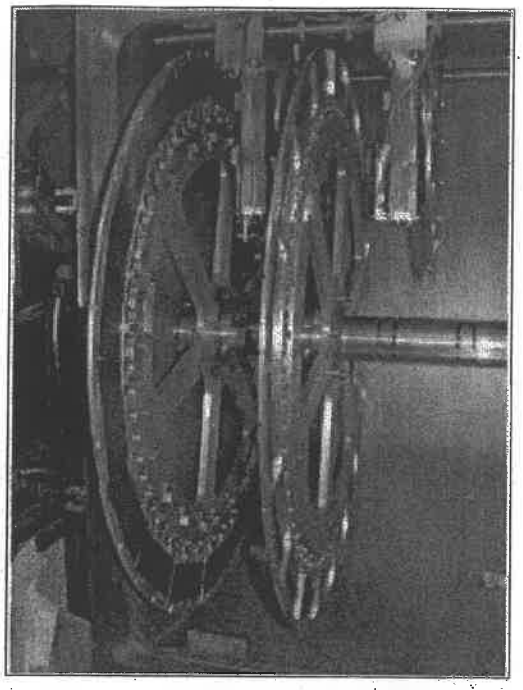

Figure 3: Target chamber with the two wheels bearing Pb/Bi targets and carbon strippers.

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