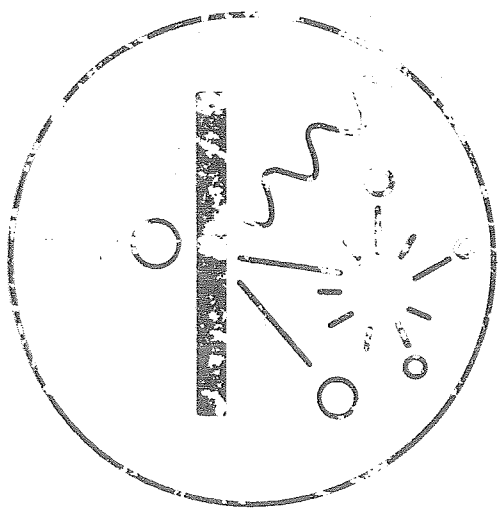
INTERNATIONAL NUCLEAR

TARGET DEVELOPMENT SOCIETY

NEWSLETTER



DECEMBER 1982

I.N.T.D.S. NEWSLETTER

DECEMBER 1982

This Newsletter is an informal method of information exchange between the Members of the International Nuclear Target Development Society.

If sufficient contributions are received the Newsletter is published twice a year.

The following items are of interest :

1. Description of recent work of the Society Members.
2. Requests for advice on, for example : - making specific targets
   - obtaining specific material (e.a. enriched isotopes).

Our thanks are due to the Direction of the Central Bureau for Nuclear Measurements for their support in producing the Newsletter.

Editor

Jan Van Audenhove
Central Bureau for Nuclear Measurements
B - 2440 GEEL (Belgium)

MERRY CHRISTMANS AND HAPPY NEW YEAR !

To the Membership and Friends of INTDS:

The 11th World Conference of INTDS was hosted by the University of Washington in Seattle (USA); summarily, the Conference was a grand success. Our meeting was held concurrently with that of the Society of Northeast Accelerator Personnel (SNEAP) which allowed a broader spectrum of technical presentations to be made available for attendees. In addition to the oral presentations, a show of commercially available equipment for use in target preparation and with accelerators was open to all attendees throughout the meeting--this was a very welcomed and helpful addition to the Conference. The combination of INTDS and SNEAP Conferences allowed for extensive social activities which were most enjoyable. As President of INTDS, I wish to congratulate Jerry Hinn and his staff on hosting the superb Conference, and I would like to thank the staff of the University of Washington in general for their financial and personal support. Finally, I wish to acknowledge the significant contributions of Joanne Heagney (MicroMatter, Inc.) toward the success of the Conference.

In attendance at the World Conference was Dan Riel to whom the Society awarded a citation of recognition for "....continued scientific achievement and devoted support of the Society above and beyond the normal call of duty." As most of the membership is aware, Dan was the first President of the Society and generally the leader in formally organizing target preparation personnel into a working, scientific group of international significance. Congratulations, Dan!

A rather lengthy and productive meeting of the Board of Directors and the INTDS attendees was held during the recent World Conference. Two new Board Members were elected: Harold Adair (Oak Ridge National Laboratory) and Leo Sapir (Weizmann Institute, Israel). Congratulations to these new members of the Board--may their terms of office be productive and enjoyable. Although I offered my resignation as President because of my retirement from Oak Ridge National Laboratory effective August 1, 1982, the Board of Directors requested that I continue as President until my normal term expires (October 1983). As a result, I will continue in this capacity for another year. As recognized in the bylaws, our next President of INTDS will be Jan Van Audenhove who is our current Vice-President--a new Vice-President will be elected by the Board in October 1983 to succeed Jan and who will eventually succeed to President. A more detailed presentation of the significant results of the membership meeting will be given by Bill Lozowski (University of Indiana), our Recording Secretary.

Finally, I would like to extend my personal appreciation to the Conference attendees who presented papers. Not only was the technical content of the oral contributions of significance, but the written papers were submitted to our host, Jerry Hinn, in a timely fashion so that editing and publication of the Proceedings possibly can be accomplished by June or July 1983. In addition, Leo Sapir has agreed to send me the papers from the Israel Conference so that both Conference Proceedings can be included in a single publication of Nuclear Instruments and Methods. In this way publication costs can be minimized and the valuable technical information can reach the membership at an early time.

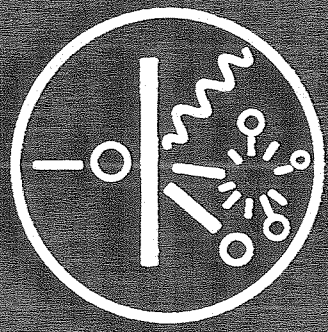
I extend my best regards and wishes to you all and hope your Holiday Season was a happy one and that your New Year will be productive, healthy and pleasurable.

Sincerely,

Ed

E. H. Kobisk, President
International Nuclear Target
Development Society

INTERNATIONAL NUCLEAR TARGET



DEVELOPMENT SOCIETY

TO

DAN RIEL

IN RECOGNITION OF CONTINUED SCIENTIFIC
ACHIEVEMENT AND DEVOTED SUPPORT OF
THE SOCIETY ABOVE AND BEYOND
THE NORMAL CALL OF DUTY

AWARDED AT THE 11TH WORLD CONFERENCE
OF I.N.T.D.S., SEATTLE, WASHINGTON
OCTOBER 6, 7, 8, 1982

Dear Friends,

I can not host a regional INTDS meeting here at Stony Brook in 1982. There are two other meetings already scheduled and the Physics Dept. can not afford another one.
My regrets to the membership.
Please express my thanks to the society for the award they bestowed on me in Seattle and the beautifull plaque I received.
I shall cherish them always.

Dan RIEL
State University of New York
Stony Brook

G. HINN
Nuclear Physics Laboratory
University of Washington
USA - Seattle, WA, 98195

TARGET PREPARATION

The targets and coatings listed in Table 11.11-1 have been prepared in the target laboratory during the past year. Of the 200 targets prepared, only those that involved and non-standard techniques will be described in detail.

Target	Starting Form	Final Form	Method of Prep.	Backing	$\mu g/cm^2$ Thickness
^{150}Nd	oxide	metal	reduction;E-bomb.	S.S.	$500-10^3$
$^{26,nat}Mg$	oxide	metal	reduction;E-bomb.	S.S.	$150x10^3$
$^{9,10}BeO$	metal	metal	10μ exchange, precipitation		$10^3, 5x10^3$
$^{nat}Ta_2O_5$	metal	Ta_2O_5	anodization	200 μg, 0.59 mil Ta	50-60, 10-20
$^{28,30}Si$	oxide	metal	reduction, E-bomb.	S.S.	500
^{11}B	metal	metal	elect. bombardment	S.S.	10^3
^{44}Ca	carbonate	metal	vac. reduction evap.	200 μgC	10^3
^{nat}Lu	metal	metal	reduction, E-bomb.	S.S. collodian	700-800
^{nat}Ag	metal	metal	vac. evaporation	S.S.	200-400
^{58}Ni	metal	metal	vac. evaporation	S.S.	$500-10^3$
^{54}Fe	oxide	metal	H_2 reduction and vac. evaporation	C	3-20 μg
^{nat}Al	metal	metal	vac. evaporation	S.S.	50 μg
^{nat}Au	metal	metal	vac. evaporation	Cu cavity	400-500

S.S.=self supporting

A. Beryllium

The past year has seen a simplification of the beryllium processing for radiometric dating and other applications of accelerator mass spectrometry. Instead of producing beryllium metal sources by reduction evaporation,[1] we have found that a mixture (1:6 to 1:8) of BeO and finely ground silver, compressed into pellets for use in our reflection geometry sputter ion source, produces beams as large (up to 55 nA Be^{+3}, analyzed) as those from beryllium metal samples.[2] We also have been working toward the measurement of ^{10}Be in samples of snow and ice from several locations at extreme southern latitudes. As soon as the snow or ice is melted, 5 mg of beryllium metal is dissolved in 3 cc 3M HCl and added to 10 liters of the melt. This in turn is passed through a Gelman Acrophor 6034 cation exchange filter to concentrate the ^{9}Be and ^{10}Be. Several filters must be used due to the low capacity of the filter (around .05 milliequivalent/filter). Yields are low using this method but the ease of preliminary concentration of the ^{10}Be makes it attractive for processing large volumes of water.

After all the melt is passed through the filter, the filter is allowed to sit in 40 cc of 3M HCl where the ^{10}Be and carrier ^{9}Be are removed from the filter in two hours' time. The filter is then removed and the solution brought to neutrality by slowly adding base.

The ^{10}Be and carrier ^{9}Be both precipitate as $Be(OH)_2$. If natural boron is present in the sample at this point in an amount unacceptable for use in the Van de Graaff mass spectrometry system, it can be removed or at least drastically reduced by the following chemical procedure.

The beryllium hydroxide is removed from solution by passing it through a 2" diameter #42 ashless Whatman filter paper. Then the entire filter paper containing the precipitate is placed in a custom-made 1-mil Pt crucible measuring 2.5 cm x 1 cm x 1 cm and lined with 90% PT, 10% Rh wire mesh, covered with a mesh cover of the same material to prevent spattering during heating. Concentrated HF is added slowly, drop by drop, and evaporated to dryness on a small hot plate in the beryllium glove box system. Then concentrated sulfuric acid is added (drop by drop, also) to the platinum crucible and allowed to evaporate overnight. During this process white fumes are given off and boron is lost to the sample in the white fumes. After white fumes cease to come off, the platinum crucible with the boron-purified BeO is placed in a tube furnance and calcined for 4 hours at 1000°C. It is allowed to cool and then is ready to be mixed (see above) with Specpure silver powder from Johnson Mathey Chemicals, Limited, England.

The need has developed for a sensitive easy-to-use balance for accurately weighing and preparing beryllium samples for $^{10}Be/^{9}Be$ measurements. Therefore, a Sartorius microprocessor-controlled 1207 MP 2 balance is currently being installed in an additional glove box which is being joined to the existing beryllium glove box system.

8. Thick low-oxygen-content ^{nat,26}magnesium

The results of thick target (p,n) and (α,n) yield measurements are relevant to current problems in nuclear astrophysics and/or nuclear reactor operations. The large neutron detection system recently built in our laboratory for these measurements requires that the beam be stopped in the target, necessitating very thick targets. Thirty-nine mg/cm^2 to 100 mg/cm^2 targets of elemental magnesium ($^{nat,26}Mg$) with an oxygen content of less than 7% for ^{26}Mg and less than 1% for ^{nat}Mg have been successfully made by high-vacuum reduction evaporation from their respective oxides onto a water-cooled 2-mil tantalum sheet. Very short duration (5 second) pulsed heating during reduction evaporation insures that the oxide formation remains low. The final desired thickness is produced by pressing the elemental magnesium in a die of the appropriate size. An analysis of the carbon content in the final elemental ^{26}Mg showed it to be 1.4% of the carbon content present in the ^{26}MgO from which it was derived.[3]

C. Silicon-30

Problems associated with the production of ^{30}Si from its respective oxide in a previously described process[4] have been solved as follows. The presence of a large amount of the reducing agent (magnesium oxide) previously present in the final target has been lowered to tolerable levels by allowing the reduced ^{30}Si to sit in 2N HCl for at least 48 hours. This allows for the removal of magnesium; it is considerably longer than the time of 2 hours used previously.

D. Cracked ethylene stripper foils

Cracked slacked ethylene carbon stripper foils have been produced in the target laboratory and inserted in some of the positions of the 40-position stripper foil wheel assembly. No negative results have been experienced so far. The foil wheel assembly was replaced three times this year, with two cracked slacked ethylene foils remaining intact through the year.

References:

1. Nuclear Physics Laboratory Annual Report, University of Washington (1981), p. 192.
2. ibid., p. 145.
3. G.M. Hinn, E.B. Norman, T.E. Chupp, and K.T. Lesko (invited paper) 10th Int. Nucl. Target Development Soc. Conf., Weizman Institute, Rehovot, Israel (to be published).
4. Nuclear Physics Laboratory Annual Report, University of Washington (1981), p. 192.

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For those who are interested, N-15 labelled Melamine can be obtained from the following supplier:

Al Idelson
622 Route 10
Whippany, NJ 07981 U.S.A.
Telephone: (201)884-0128

Al formerly worked for Isomet and now has his own company.

K.O. Zell
Institut für Kernphysik der Universität Köln
Zülpicher Str. 77, D-5000 Köln 41, West Germany

1. Bi backings of 150 mg/cm^2

Good results with Bi backings in γ-spectroscopy with Carbon induced reactions (that means low background, no γ-lines) made us think about to use them also for α-reaction at energies beyond its Coulomb threshhold. The following technique for rolling the Bi was used: Lumps of Bi are molten in vacuum by an electron gun to a large piece of 2g. This is put between stainless steel sheets which are heated by the flame of a bunsen burner to about 200°C. Then this package is pressed in a hydraulic press. The resulting disc of Bi is put between two new sheets heated again and rolled with slight pressure. This process has to be repeated two or three times to get 150 mg/cm^2. As Bi is a bad heat conductor it then is glued to a 100 mg/cm^2 Cu foil with a two component heat conducting epoxy resin. It can stand a 100 (but not a 300) nA 20 MeV α-beam on a 2x2 mm^2 spot. It also showed no signs of deterioration when we connected it to a Cu-block and then evaporated from a 1.5x6 cm Ta boat 0.4 g Ce onto it at a distance of 8 cm resulting in a 1 mg/cm^2 layer.

2. Other targets

Targets made by rolling: La 8mg/cm^2, Tl and Pb 3mg/cm^2 rolled between Teflon sheets, ^{100}Mo 1.5 mg/cm^2 prepared from powder molten by electron gun, and 0.5 mg/cm^2 Cd on a sandwich of 50 mg/cm^2 Bi and 60 mg/cm^2 Cu with 1mg/cm^2 In between the Bi and Cu as glue. As there is a maximum thickness of Bi (~100 mg/cm^2) which can be connected with Cd and a minimum thickness of Cd which can be handled easily (~2mg/cm^2) 3mg/cm^2 Cd and 30 mg/cm^2 Bi were rolled together until Cd had 0.8 mg/cm^2. This sandwich was then rolled with slight pressure onto a ready sandwich of 80 mg/cm^2 Bi and 100 mg/cm^2 Cu. Sn targets were made in the same way.

Targets made by evaporation: Te 2 mg/cm^2 on thick Bi and also 1mg/cm^2 Au backing, Ni 100 μg/cm^2, Ni 400 μg/cm^2 on thick Ta, Zr 0.5 mg/cm^2 on thick Ta by electron gun, Pr and BaO 130 μg/cm^2 on 10 μg/cm^2 C which was rotated by a motor so that it could condense on both sides to avoid stresses which destroy the carbon foil. Other targets made on 10 μg/cm^2 C-foils: Nd 130 μg/cm^2, KJ 0.5 mg/cm^2, BiJ 0.5 mg/cm^2 and Te 0.5 mg/cm^2.

Irith Gilath and Y. Sapir
Soreq Nuclear Research Center
Yavne 70600, Israel

Polystyrene Casting in the Micron Range

There are handling problems when casting polystyrene one one side of a thin aluminum foil, both of which have thickness in the micron range. We solved this problem by using instead the spin coating method usually employed for photo-resist applications in microelectronics.

The fragile thin aluminum foil was attached to a microscope slide (2 x 2cm) using a drop of distilled water. The adhesion and stretching of the foil was very good.

A solution of 10-20% polystyrene in trichloroethane was applied to the top of the aluminum and uniformly spread by spinning. The samples were dried at 90^{o}C for 10 minutes. The coated foils were easily lifted after releasing the ends with a fine blade.

By varying the solution concentration and spinning speed (700-4000 rpm),different polystyrene coating thickness can be achieved.

Vincent L. AVONA
Isotec, Inc.
7542 Mc Ewen Road
USA - CENTERVILLE, Ohio 45459

Isotec, Inc., continues to expand its involvement in the separation, enrichment and distribution of stable isotopes.

Currently, Isotec is constructing a cryogenic distillation facility for the exclusive separation and production of enriched Carbon-13. The C-13 separation facility is expected to be fully operational in March 1983 and capable of producing both 90% and 99% enriched C-13 in a variety of basic chemical forms. The C-13 will be available as amorphous elemental carbon, carbon dioxide, carbon monoxide, methane and barium carbonate. The facility is expected to approximately double the world's commercial production of Carbon-13 and to offer the isotope at competitive prices. Other C-13 labelled chemical forms are also available and can be prepared upon request by contacting Isotope Sales, 7542 McEwen Road, Dayton, Ohio 45459; Phone (513)435-4669; Telex 288278.

11TH WORLD CONFERENCE OF THE INTERNATIONAL NUCLEAR TARGET DEVELOPMENT SOCIETY

SEATTLE, WA, USA • October 6, 7, 8, 1982

ABSTRACTS

Proceedings To Be Published in *Nuclear Instruments and Methods*

NEW CARBON STRIPPER FOILS MUCH LESS SHRINKABLE UNDER HEAVY ION BOMBARDMENT

Suehiro Takeuchi and Shuhei Kanazawa

Japan Atomic Energy Research Institute,
Tokai, Ibaraki, Japan

We have found a new type of long-lived carbon stripper foils which hardly shrink under heavy ion bombardment. The preparation method developed at JAERI in 1978 makes use of d.c. arc discharges between carbon electrodes as the carbon emission source. The new foils were obtained by increasing the diameter of the electrodes from 3 mm to 6 mm and by keeping the temperature of the electrodes as low as possible. The modifications increased the emission of ionized carbon atoms or clusters from 5-20 % to 50-60 %. The new foils are more transparent than the old foils made with 3 mm electrodes. The lifetime measurements of the new foils 10 $\mu g/cm^2$ have been carried out under the bombardment with 2.0 MeV Ar^+ beams of 1 μA in 4 mm diameter. The new foils were relaxed and did not shrink very apparently for at least two hours. On the contrary, the old foils became taut within 30 min because of strong shrinkage of the irradiated area. The new foils had an average lifetime of 4.7 hours. It was improved more than twice compared with the old foils with the average lifetime of 2.1 hours or 50 times compared with commercial foils.

A TECHNIQUE FOR THE PREPARATION OF CARBON-14 TARGETS FOR NUCLEAR PHYSICS EXPERIMENTS

J.L. Gallant and P. Dmytrenko

Nuclear Physics Branch, Chalk River Nuclear Laboratories,
Chalk River, Ontario, KOJ 1JO Canada

A technique has been developed for the preparation of acetylene from barium carbonate (^{14}C). A method of cracking the acetylene to produce high purity carbon-14 films has also been developed.

PREPARATION AND CHARACTERIZATION OF HEAVY ION TARGETS

H.L. Adair and E.H. Kobisk

Oak Ridge National Laboratory, Oak Ridge, TN 37830

Many of the same target preparation techniques used to fabricate samples to be bombarded with light ions (protons, deutrons, $^{4}He^{++}$, etc.) in various nuclear research studies can be and are used in fabricating targets for heavy ion interaction research. However, the experimental data obtained in heavy ion studies are far more sensitive to variations in target parameters than those resulting from light ion interactions. Careful consideration of anticipated results of the research must be given in selecting preparative techniques that can yield the desired target characteristics. Proper interpretation of experimental results demands that the target used is extensively characterized. Effects of specific target parameters, e.g., thickness, nuclidic uniformity, impurity concentration and identification, are reviewed in this paper. Preparation and characterization techniques are critically examined in terms of their effects on experimental results and on target lifetime.

"SANDWICH TARGETS" FOR HEAVY ION EXPERIMENTS*

George E. THOMAS

Argonne National Laboratory, Argonne, IL 60439

Techniques for producing "sandwich targets" such as Sn + Pb will be described. Better contact between the materials is sometimes assured by evaporating one material onto the other rather than by rolling the two together. Experimental data using both types of targets will be shown.

*This research was supported by the U. S. Department of Energy under Contract W-31-109-ENG-38.

ROTATING TARGET-SUBSTRATE FIXTURES FOR THE VAPOR DEPOSITION OF URANIUM AND BISMUTH OR LEAD-208

H. Folger, J. Klemm, and W. Thalheimer

G.S.I., Planckstr. 1, 61 Darmstadt, FRG

The frequent demand for larger amounts of almost equal U-layers of surface densities varying between 0.1 and 2.0 mg/cm^2 initiated the construction of a domed-type rotating substrate holder. It is mounted into a high-vacuum evaporator being equipped with an electron beam gun. 80 targets of 20 x 25 mm can be coated at once at a source-to-substrate distance of 300 mm. A deposition uniformity of better than $\pm$10% was measured. Various U targets were thus prepared on thin backing, and special glasses were coated with U for the use as detectors for multiprong fission events.

A new type of frame is used at GSI on rotating target wheels: the actual target areas of 8.5 cm^2 have the form of a sector of an annulus ($\alpha = 24°$; $r_2/r_1 = 162/148$ mm). In a high-vacuum coater, 13 such frames with thin C backings are fixed to the rim of a disk of 290 mm in diameter. Bi or ^{208}Pb is evaporated from a Ta crucible, only 15 mm away from the continuously rotating C substrates. High deposition yields of up to 80%, and uniform films of 0.5 mg/cm^2 are achieved in one run on large target areas. The targets are fabricated for experiments at the GSI UNILAC accelerator.

VAPOR-DEPOSITED $^{235}UO_2$ LAYERS FOR AN ULTRA-HIGH SENSITIVITY FISSION COUNTER

Oak Ridge National Laboratory
Oak Ridge, Tennessee 37830

H. L. Adair, B. L. Byrum, J. M. Dailey, J. R. Gibson

After evaluating the properties of UO_2 coatings prepared by electrodeposition, painting and physical vapor deposition, the vapor deposition method was selected as being preferable for preparing coatings on aluminum electrodes having a total area of 5 m^2. The electrodes were used in an experimental fission chamber designed at the Oak Ridge National Laboratory for use as a neutron flux monitor for the Clinch River Breeder Reactor. Initial testing of the Ultra-High Sensitivity Fission Counter (UHSFC) indicated that a tenfold increase in sensitivity was achieved as compared to commercially available fission counters. Techniques used in vapor coating and characterizing the $^{235}UO_2$ deposits on the large-area curved substrates will be described.

PREPARATION OF ACTINIDE GAMS TARGETS

Oak Ridge National Laboratory
Oak Ridge, Tennessee 37830

T. C. Quinby

Methods were developed to prepare encapsulated target samples of separated actinide isotopes for use in the GAMS spectrometer systems at the Institut Max von Laue-Paul Langevin in Grenoble, France. These targets contained between 0.1-80.0 mg of the isotope either as pure oxide or as a solid dilution of the isotope in pure Al_2O_3. The objective was to assure distribution of the material in a planar configuration having an edge thickness of 0.1 mm or less, so that prompt gamma rays perpendicular to the target surface would be extremely well collimated as a "line source."

PREPARATION OF ^{237}Np and ^{239}Pu TARGETS FOR EXPERIMENTS IN A HIGH FLUX REACTOR

J. Kwinta

Commissariat A L'Energie Atomique, Centre 3 - Service Tresorerie, Bofte postale 561, 92542 Montrouge Cedex France

The process for preparing ^{237}Np or ^{239}Pu deposits on Ni foils using focussed ion beam sputtering is described. These targets are to be irradiated in the high flux reactors at the I.L.L. GRENOBLE. Consequently, the most important specifications are the adhesion and the temperature behaviour of the deposits between 500°C and 1000°C. ^{237}Np deposits were made starting from the oxide NpO_2. When the ^{239}Pu deposit has been prepared by sputtering metallic plutonium under a 10^{-6} torr pressure, a fast oxydation was observed as confirmed by X-ray photoelectron spectroscopy (X.P.S.). The final result is a thin layer of PuO_2 which fits quite well the required specifications.

THICK ISOTOPIC OSMIUM TARGETS*

Wilfried Reuter, Judith C. Gursky, E. B. Shera,
and M. William Johnson
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

For electron scattering experiments we have prepared osmium targets of 20-40 mg/cm^2 sandwiched in graphite by centrifuging and vacuum hot-pressing. They are strong and withstand beam-induced temperatures of 500°C.

*Supported by US Department of Energy.

A HIGH EFFICIENCY PREPARATION METHOD FOR ^{36}S-TARGETS*

P. Maier-Komor

Physik-Department, Technische Universität München,
D-8046 Garching, FRG

The limited availability of highly enriched ^{36}S (81.1%) requires a target preparation method with excellent reproducibility and high efficiency. The reaction of vacuum condensed metal films with sulfur vapor of a vapor pressure up to 200 Pa in a very small vacuum container was investigated. The sulfur contents of the sulfide targets were determined as a function of reaction temperature. According to these results ^{34}S and ^{36}S targets with compound thicknesses of 50 µg/cm^2 to 5 mg/cm^2 were prepared with an efficiency >90%.

* Supported in part by the BMFT, Bonn, FRG.

ACTINIDE TARGETS PREPARED BY MOLECULAR PLATING PROCEDURES

N. Trautmann, R. Heimann, and D. Gembalies-Datz[1]; and
H. Folger and W. Hartmann[2]

1) Institut für Kerchemie, Universität Mainz, 65 Mainz, FRG
2) GSI, Planckstr.1, 61 Darmstadt, FRG

For nuclear spectroscopy studies in heavy-ion reactions a number of actinide targets were prepared by molecular plating, i.e. electrodeposition from organic solutions. This process guarantees total recovery yields of more than 95% which is of special interest in the handling of rare and highly radioactive actinide isotopes. Depending on the experimental conditions, target layers of about 6 mm in diameter with surface densities varying between 0.1 and 2.0 mg/cm^2 were fabricated of the following actinide isotopes: ^{230}Th, ^{236}U, ^{236}Pu, ^{239}Pu, ^{242}Pu, ^{244}Pu, ^{248}Cm, and ^{252}Cf. In the preparation procedures, nitrates of the actinides were dissolved in isopropyl alcohol and plated at 500V/5mA onto 0.5-2.0 mg/cm^2 thick pin-hole free foils of Be, Ti, Ta, and Pt; the deposits were then converted into the oxides. For all isotopes 'clean-up' columns had to be run prior to the depositions thus removing undesired impurities.

ANODIZING Al FOILS TO PRODUCE Al_2O_3 TARGETS OR TO REMOVE BACKINGS FROM ULTRA THIN FOILS

W.D. Riel

SUNY-Stony Brook, NY

A method of producing strong Al_2O_3 films via anodizing of Al foils is presented along with an extension of this method to gently remove Al backings, resulting in extremely thin self-supporting metallic foils.

THIN FILM ISOTOPIC OXYGEN TARGETS

A.H.F. Muggleton

Department of Nuclear Physics, Australian National University, Canberra, ACT 2600, Australia

Various techniques for preparing thin film isotopic targets are described and the relative merits of each technique are discussed.

Targets to be described are: a) those produced from the chemical reaction between an incandescent tungsten filament and enriched gas; the tungsten oxide formed is then evaporated onto thin, self-supporting carbon backings. b) Self-supporting tantalum pentoxide targets made by the anodic oxidation of thin tantalum foils. c) Self-supporting silicon dioxide targets made by evaporating SiO_2. d) Targets made by the thermal oxidation of thin self-supporting nickel foils in an enriched oxygen atmosphere.

ENERGETIC ION CHARGE STATE DISTRIBUTION DEPENDENCE ON THE METHOD OF TARGET PREPARATION

A.H.F. Muggleton and L. Pender

Department of Nuclear Physics, The Australian National University, Canberra, ACT 2600, Australia

The charge distribution of an energetic ion after passing through a given target thickness is found to be strongly dependent upon how the targets are prepared. This dependence has been correlated with the target surface structure as seen with a Scanning Electron Microscope.

THE USE OF A SADDLE FIELD ION SOURCE FOR THE PREPARATION OF THIN FILMS AND FOILS FOR NUCLEAR STUDIES

R.J. Drinkwater, Ion Tech Ltd., England TW11 OLT.

Thin films for use as particle accelerator targets have been produced by thermal deposition techniques employing resistance heating or electron beam sources. Excessive levels of thermal radiation often occur during deposition, which result in poor yields of source material and film stress related problems. Sputtering as a cool deposition technique has been tried, but problems can occur due to the presence of plasma affecting film structure. Large amounts of source material are also necessary resulting in prohibitive costs for rare materials. Thin films have been deposited by sputtering with fine beams of ions or fast atoms from a saddle field source using very small amounts of source material. These films have a dense fine grain structure (grain size typically 1nm) and have been shown to be of high purity. Targets produced include Pb, Mn, Os, W as well as "easier" materials. Materials with a low "sticking coefficient" such as Cd etc., condense in the target area in contrast to experience with thermal methods. A diffuse beam source fed with a hydrocarbon gas has also been used to produce excellent carbon films by direct deposition at pressures of approximately 10^{-4} torr. The diffuse beam source when used to produce a beam of fast atoms of argon has shown potential as a means of thinning metal foils controllably to predetermined limits without inducing mechanical damage as may be caused by rolling.

Tritium Targets at RTNS-II

D. W. Heikkinen and C. M. Logan
Lawrence Livermore National Laboratory
Livermore CA 94550 U.S.A.

Tritium targets are used at RTNS-II to generate 14-MeV neutrons using the $^{3}H(d,n)^{4}He$ reaction. The neutrons are used for fusion materials damage studies. The targets consist of a titanium-tritide layer of ~3.5 mg/cm^2 thickness. This is deposited on 23 or 50 cm diameter copper substrates which are in the form of a spherical segment (corresponding ^{3}H content of 1.4×10^{13} and 4.4×10^{14} Bq, respectively). The substrates are internally cooled using high-pressure chilled water, and are rotated at ~4000 rpm during operation using an air-levitated, differentially pumped vacuum seal. In addition, the substrates are oscillated slowly to scan the target surface areas of ~300 and 1200 cm^2 for the different size substrates. Over 60 such targets have been used at RTNS-II. During operation, both instantaneous and cumulative neutron production are recorded at frequent intervals as is integrated beam current. We will give examples of typical neutron production parameters and lifetimes for targets used at RTNS-II.

*Work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract Number W-7405-ENG-48.

FURTHER DEVELOPMENT OF A PIEZOELECTRIC DROP JET DEVICE FOR THE PREPARATION OF NUCLEAR TARGETS

L. Coppieters*[1] and J. Van Audenhove[2]

1) State University Ghent, Laboratory for Electronics, B - 9000 Ghent - Belgium and 2) Commission of the European Communities, Central Bureau for Nuclear Measurements B - 2440 Geel - Belgium

At the 9th INTDS Conference in 1980 we reported on the development of a new method for the preparation of deposits using a commercial piezoelectric pulsed jet device conceived for character printing with ink.

This order was very preliminary and there remained several problems to be solved in order to obtain a reliable system for the quantitative preparation of uniform deposits of scarce isotopes.

The present paper is concerned with the development of a more appropriate device.

Details are given concerning the construction and performances of a drop generator, the adaptation of a plotter and the development of an interface card which connect a TRS-80 microcomputer to the plotter. Software was written so that rectangular and circular deposits of the required surfaces and thicknesses can be produced at the command of the microcomputer.

The quality of ^{235}U acetate deposits (calcined to oxide) in thicknesses between 100 µg/cm^2 and 20 mg/cm^2 are evaluated.

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Atomic Ratio of Li to F in Evaporated LiF Films

E. Norbeck and P. T. Wu*
Physics and Astronomy Dept.
The University of Iowa
Iowa City, Iowa 52242 USA

Thin films of LiF made by evaporation of LiF from hot tantalum filaments were found to contain more lithium atoms than fluorine atoms. Although the excess is only a few percent, this is enough to provide a serious systematic error in a precision experiment that assumes the atomic ratio to be unity. The evaporated films were found to be strongly basic when they were dissolved in water and tested with pH paper. The basic compounds were formed when the atmosphere interacted with lithium metal that had been deposited along with the LiF. The excess of lithium was measured by elastic scattering using 1.5 MeV lithium ion beams. With the evaporation techniques used, the excess of lithium in the LiF film was found to be less than 5%.

*Present address: Institute of Nuclear Energy Research, Lung-Tan, Taiwan 325, Republic of China

ACCELERATOR MASS SPECTROMETRY WITH CARBON AND BERYLLUM

(Invited University of Washington Faculty Speaker)

George W. Farwell

Nuclear Physics Laboratory, University of Washington, Seattle, WA 98195