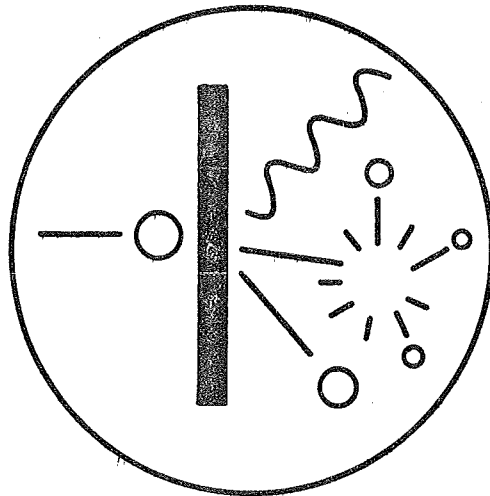


**INTERNATIONAL NUCLEAR
TARGET DEVELOPMENT SOCIETY**

NEWSLETTER



DECEMBER 1981

INTDS NEWSLETTER

DECEMBER 1981

This Newsletter is somewhat later than foreseen but it gives us the opportunity to send you our

"BEST WISHES FOR A MERRY CHRISTMAS AND A HAPPY NEW YEAR"

EDITOR :

JAN VAN AUDENHOVE

Assembled and typed by Edith De Coninck
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Our thanks to the Direction of CBNM for the continuing support in producing the Newsletter.

K.O. Zell

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1. Cd plunger targets on Bi backing

Starting with 4 mg/cm² Cd and 18 mg/cm² Bi plunger targets were roled with an area of 2x2 cm² consisting of 0.5 mg/cm² Cd and a 3 mg/cm² Bi backing. A very low pressure and polished steel plates which were not welded together were used to avoid that the target sticks to them. It was stretched on a 5 mm diameter plunger ring and could stand a 20 nA ¹³C beam on a 3x1 mm² area. Melting was observed at 40 nA. It was necessary to stretch the target once more after it had been heated by the beam and cooled down again but then it proofed to be stable in the beam. In contrast to the target with Bi backing which did not oxidize within weeks Cd roled on Au turned black within an hour and got ripples from internal tensions. Another advantage of Bi is that it produces no γ -background in our measurements.

2. BaO targets on C backing

We tried to evaporate BaO prepared from BaCO₃ by heating in vacuum on a 5x1 cm² 10 ug/cm² C layer. The thickness required was 0.3 mg/cm². Probably because of the tensions caused by the different crystal structures the C foil was always destroyed during the evaporation, but we were successful to prepare the target by rotating the C foil at about 10 turns/sec in such a way that the BaO is condensing on both sides of it at the same time. Part of the BaO transforms to metallic Ba during the evaporation and oxidizes at once when in contact with air. The target even survived this process.

3. Other activities

0.3 mg/cm² Nd targets on C backing were prepared. It was found that one has to be very careful not to increase the heat of the C foil to much as otherwise the Nd forms very small droplets resulting in an effective larger thickness then determined by weight.

Al-Se-Al targets were prepared by evaporation

Graded-Thickness Carbon Foils

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USA

In the course of our investigations, we were asked to make evaporated carbon coatings on substrates about 25mm x 50mm, with the carbon surface density varying continuously from zero to 30 micrograms/cm² in the long dimension.

Standard methods for making graded-thickness evaporated films involve placing a rotating variable-aperture wheel between source and substrate. This method has limited application for our carbon foils because we use a pulsed carbon arc (1) as a source. A variable-aperture mask would either have to rotate at high speed or be carefully synchronized with the arc. In addition, such a wheel would have to be quite large to ensure uniformity of coating thickness across the short dimension of the substrate.

We succeeded in making coatings varying in surface density from 6-30 micrograms/cm² by placing a substrate such that one end was about 5 cm, the other end about 9cm from the arc source. However, the lateral uniformity in thickness was poor.

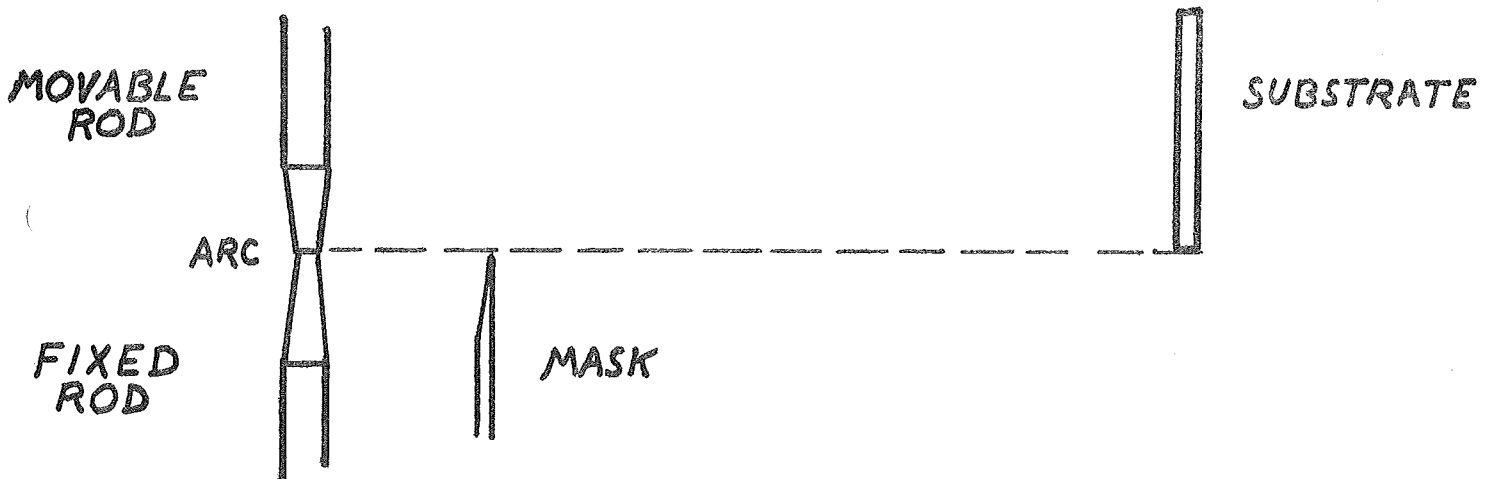
A coating varying almost linearly from 5 to 30 micrograms/cm² in surface density was obtained by taking advantage of the fact that only one of the carbon rods in the arc is permitted to move, and thus the arc itself moves as carbon is evaporated from it. A mask was placed 25mm from the arc, preventing the evaporant from reaching one end of the substrate directly (see figure). As the arc moved slowly downward during evaporation, more of the substrate was masked. By the end of the evaporation process, one end of the substrate had been bombarded continuously, and the other end has received no direct bombardment. Intermediate positions had received intermediate amounts of material.

Some carbon reached the masked parts of the substrate, making it impossible to obtain zero thickness on these parts. We attribute this to scattering of the carbon evaporant atoms by local high pressure regions in the neighborhood of the operating arc, and by residual gas in the vacuum chamber.

This method of making a graded-thickness evaporated coating should be applicable to any situation in which the evaporant originates from an extended source.

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1. John O. Stoner, Jr., and Stanley Bashkin, "Production of a Large Unsupported Carbon-Film Ultraviolet Filter", Appl. Optics 17, 321-324 (1978).



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J.C. Spirlet

Actinide Research at Karlsruhe emphasizes the study of the actinide metals and of the intermetallic and binary compounds. The aim is to obtain information on the influence of 5f electrons and different types of bond to understand and/or predict bonding related properties. Sample and target preparation for physical property measurement are an important part of the program.

Protactinium metal is prepared and refined by the Van Arkel process. A sample of 1.5 g of 99.97 % pure metal was produced for low temperature specific heat measurements. Slices were cut from single crystals for superconducting transition temperature measurements.

Targets of americium metal were prepared by evaporation in vacuum for photoemission measurements (XPS, UPS). Single crystals of NpO_2 are prepared by chemical vapour transport with TeCl_4 as transporting agent, and crystals of intermetallic compounds of the laves phase are pulled from a levitated melt by the Czochralski method for neutron diffraction investigations.

A. Michielsen

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THE PREPARATION OF BARIUM TARGETS

In order to study the reaction $^{134}\text{Ba}(^{40}\text{Ar}, 4n\gamma)^{170}\text{W}$, a method for the preparation of barium targets was developed.

Powder of BaCO_3 or $\text{Ba}(\text{NO}_3)_2$ was thoroughly mixed with about twice the stoichiometric quantity of tantalum powder. This mixture was brought into a cylindrical tantalum crucible (26 mm high, 4 mm inner diameter). Lead backings were used because for the reaction mentioned above a backing material is needed with a Z-value exceeding 80.

The following backings were used.

- 1) Lead with a thickness of 150 μm .
- 2) Between a foil of 65 μm thick lead and a 0.5 mm cleaned copper plate of the same area, a small 0.1 mm thick indium foil was placed. This "sandwich" was rolled between two polished stainless steel plates. The stainless steel plates are used to protect the surface of the lead foil against rests of grease of the roller. The indium is liquid during the rolling and functions as glue.

This backing has been prepared as indicated to prevent the lead foil from melting, because the temperature during the evaporation of barium is quite high.

The backings have been placed 20 mm above the crucible, and have been fixed to a movable manipulator (one backing per evaporation). Between the crucible and the backing is a tantalum heat shield (0.3 mm thick) with a hole of 10 mm diameter, 5 mm above the crucible.

A vacuum of 4×10^{-7} mbar is used. The vacuum has to be good, because otherwise oxidation of the target occurs. This is clearly shown by a thin layer of evaporated barium on glass. The layer becomes transparent due to oxidation after about 30 minutes at a pressure of 4×10^{-6} mbar.

The heating of the crucible has to be done slowly, because CO_2 in the case of BaCO_3 and NO or NO_2 in the case of $\text{Ba}(\text{NO}_3)_2$ escapes and may blow the mixture out of the crucible.

When the outgassing has stopped, the backing is brought above the crucible, and the crucible is heated fast until all the barium has evaporated.

After a cooling period of about 30 minutes, the target is moved above a tungsten boat, filled with about 2 mg of lead powder. By evaporation a layer of about $100 \mu\text{g}/\text{cm}^2$ lead is deposited on the barium target.

We use the above described procedure to prevent oxidation, because we lack a vacuum transport mechanism at our evaporation unit.

After a cooling period, the evaporation chamber is filled with argon. Placed in an argon filled bottle, the target can be transported without oxidation to the target holder at the beam line.

In this way, we have prepared several ^{134}Ba targets of about $2 \text{ mg}/\text{cm}^2$. For one target, about 35 mg BaCO_3 or 45 mg $\text{Ba}(\text{NO}_3)_2$ is used.

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Target Laboratory Activities, January 1981 - August 1981

1. Thin Au, Ag and Bi Single Crystal Films

Thin ($\sim 300 \text{ \AA}$) single-crystal films of Au, Ag and Bi have been produced utilizing a technique, whereby nucleation sites were induced by bombarding the single crystal NaCl substrate with $\sim 100 \text{ eV}$ electrons during deposition; following by annealing at 400°C for 30 minutes.

2. Preparation of Liquid Mercury Targets.

For 'g' factor measurements liquid targets are used as a means of maintaining nuclear alignment.

A 0.1 - 0.4 mm deep recess was pressed into a 0.15 mm thick copper target blank. The blank was nickel plated, except for the recess, to prevent migration of the isotopic mercury. The unplated recess was cleaned with nitric acid and the mercury added dropwise. The mercury wetted the acid treated copper and was prevented from migrating across the blank surface by the nickel plating. The acid was rinsed off with distilled water.

To prevent losses under vacuum the mercury is covered with either a thin nickel foil [0.225 mg/cm^2] or thin mylar held in place by a suitable adhesive.

3. The following targets have been produced during this period:-

Al, Au - $100 \text{ }\mu\text{g/cm}^2$ to 3 mg/cm^2 self supporting.
 $^{134}, ^{136}, ^{138}\text{BaCl}_2$ - $50 \text{ }\mu\text{g/cm}^2$ to $100 \text{ }\mu\text{g/cm}^2$ on thin carbon backings.
Be - $50 \text{ }\mu\text{g/cm}^2$ to $100 \text{ }\mu\text{g/cm}^2$ on thin carbon backings.
 ^{209}Bi - 1 mg/cm^2 to 4 mg/cm^2 self supporting.
CaF - $20 \text{ }\mu\text{g/cm}^2$ on $100 \text{ }\mu\text{g/cm}^2$ Au.
C - $\leq 2 \text{ }\mu\text{g/cm}^2$ self supporting
 $^{164}, ^{166}, ^{167}, ^{168}, ^{170}\text{Er}$ - $100 \text{ }\mu\text{g/cm}^2$ on thin carbon backings.
 ^{170}Er - 4 mg/cm^2 self supporting.
 ^{160}Gd - $20 \text{ }\mu\text{g/cm}^2$ and $40 \text{ }\mu\text{g/cm}^2$ on thin carbon backings.
 ^{24}Mg - $100 \text{ }\mu\text{g/cm}^2$ on thin carbon backings.
 ^{208}Pb - 1.0 mg/cm^2 and 4 mg/cm^2 self supporting
 ^{208}PbS - $15 \text{ }\mu\text{g/cm}^2$ to $25 \text{ }\mu\text{g/cm}^2$ on thin carbon backings.
 ^{198}Pt - $600 \text{ }\mu\text{g/cm}^2$ and $800 \text{ }\mu\text{g/cm}^2$ electro plated onto thin lead backings.
 ^{28}SiO - $100 \text{ }\mu\text{g/cm}^2$ self supporting.
 $^{148}, ^{150}\text{Sm}$ - 1 mg/cm^2 and 7 mg/cm^2 self supporting.
 ^{238}U - $40 \text{ }\mu\text{g/cm}^2$, $600 \text{ }\mu\text{g/cm}^2$ and $800 \text{ }\mu\text{g/cm}^2$ on thin Al and carbon backings.
 ^{174}Y - $20 \text{ }\mu\text{g/cm}^2$ and $40 \text{ }\mu\text{g/cm}^2$ on thin carbon backings.

QUALITY TESTING OF POLYPROPYLENE AS SUBSTRATE MATERIAL FOR NUCLEAR TARGETS

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1. INTRODUCTION

A thin polypropylene foil of 19 cm diameter was prepared by the stretching method (7) using the foil stretching apparatus (8) at the Hahn-Meitner-Institut für Kernforschung. This foil was used to carry out comparative tests with other foils used at CBNM for nuclear target preparation. To enable this comparison the original foil was transferred to a series of aluminium rings of 40 mm external- and 20 mm internal diameter as used in previous studies (1) (2). This was carried out by gluing the rings with UHV-glue to the foil according to Fig. 1 and cutting them out when dry. In this way fourteen smaller foils were obtained, of which one broke during the manipulation.

2. THICKNESS MEASUREMENT AND HOMOGENEITY

To examine the properties of the foil the thicknesses of the smaller ones had to be measured. This was carried out by the spectrophotometric method described in Ref. (3), using the thick foil calibration and observing in the transmission mode. Foil E was used as the reference foil. Its thickness was determined by the measurement of the energy loss of α particles emitted from a ^{148}Gd source (4). From the spectrophotometric measurements the peaks listed in Table I were found for the reference foil, and the relation calculated for $\rho/n = f(\lambda)$ according to Ref. (3) was :

$$\rho/n = 0.7044 + 0.2208 \cdot 10^{-3} \lambda - 0.3526 \cdot 10^{-6} \lambda^2 + 0.2416 \cdot 10^{-9} \lambda^3$$

in which :

ρ = specific mass in g/cm^3 ;

n = refractive index

λ = wavelength in nm at which a minimum or maximum transmission occurs.

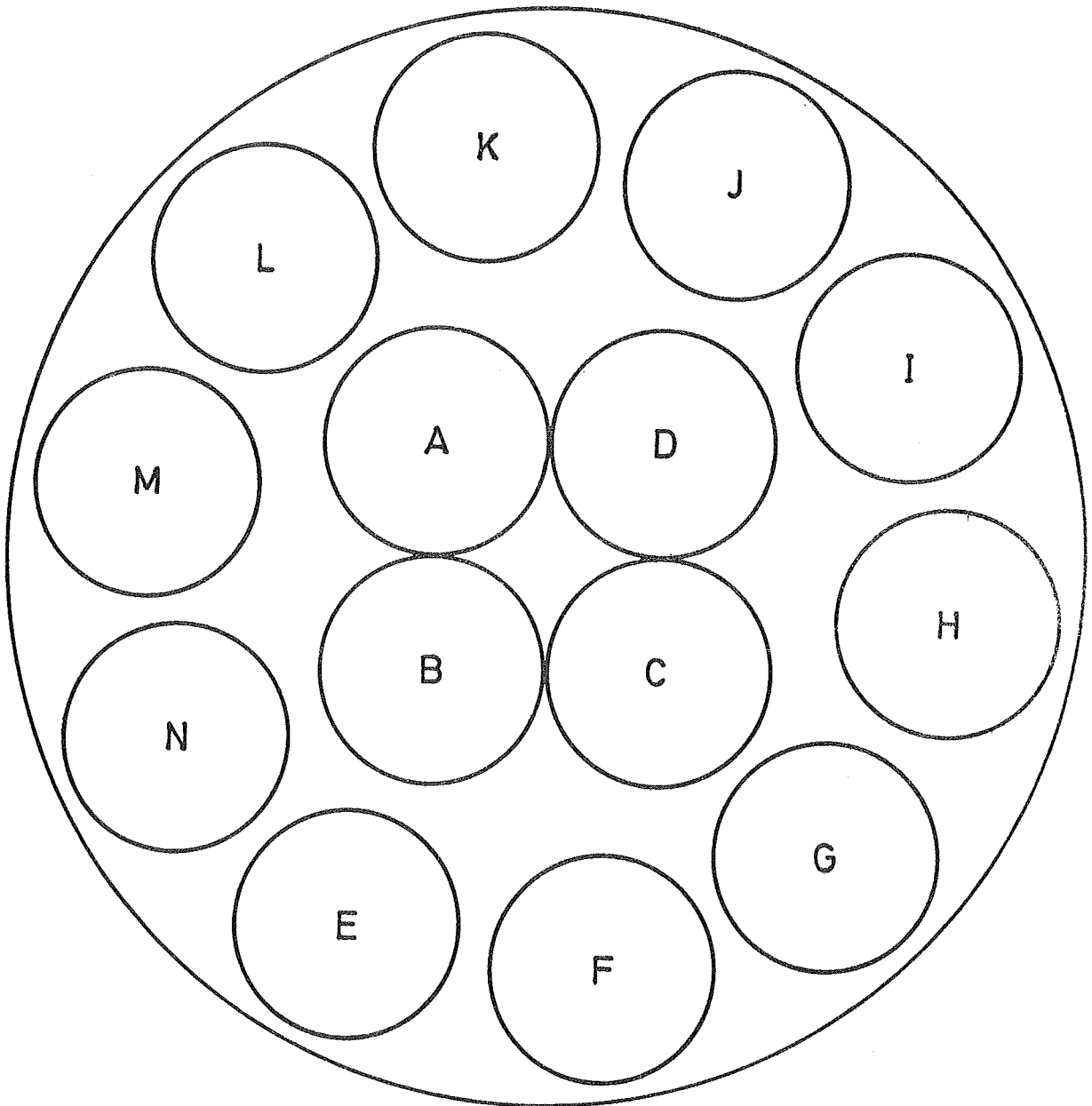


Figure 1 : Subdivision of the original foil of \varnothing 19 cm

The k-value of the first peak is obtained via the equation :

$$k_m = \frac{\lambda_{m-1}}{\lambda_m - \lambda_{m-1}}$$

and in this case a value of 6.26 for k was found.

The thickness of the remaining foils can then be calculated from :

$$d = \left(\frac{\rho}{n}\right)_\lambda \cdot k \cdot \frac{\lambda}{4}$$

i.e. for λ in nm and in $\mu\text{g}/\text{cm}^2$;

$$d = k [0.01761 \lambda + 0.00552 \cdot 10^{-3} \lambda^2 - 0.00882 \cdot 10^{-6} \lambda^3 + 0.00604 \cdot 10^{-9} \lambda^4]$$

The values found are given in Table II. The precision of these measurements is of the order of $0.5 \mu\text{g}/\text{cm}^2$. Their accuracy, which is mainly determined by the uncertainty on the thickness of the reference foil, is evaluated at $\pm 5\%$.

The measured homogeneity of the original foil is shown in Fig. 2. From the topography of this foil it can be seen that it is difficult to obtain foils of 2 cm diameter with a homogeneity better than $5 \mu\text{g}/\text{cm}^2$.

k - value	λ (nm)	ρ/n
6	669.7	0.767
7	577.5	0.762
8	509.4	0.756
9	453.3	0.755
10	409.2	0.753
11	373.1	0.750
12	343.1	0.748

Table I : Spectrophotometric data of foil
E of thickness $77 \pm 4 \mu\text{g}/\text{cm}^2$

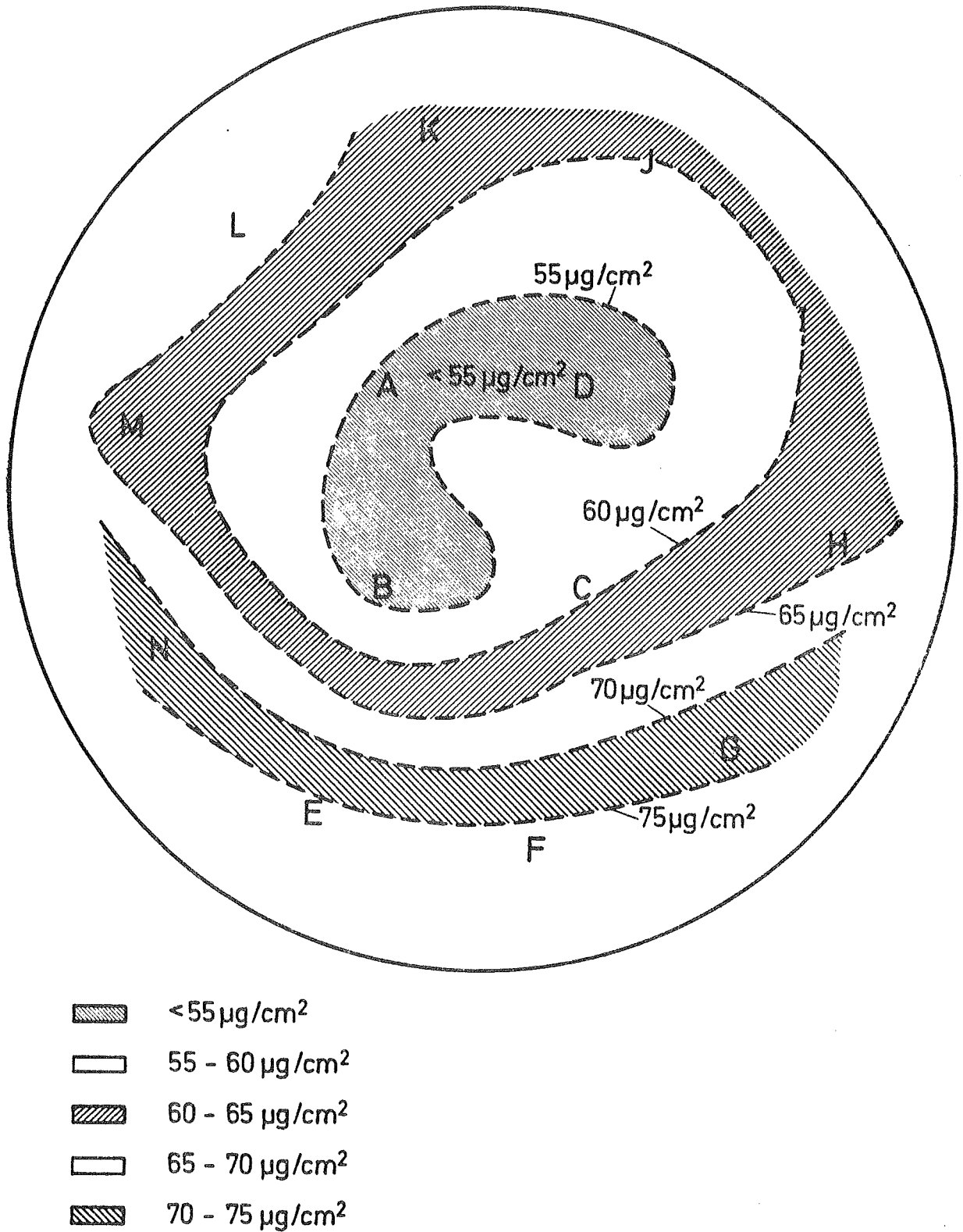


Figure 2 : Topography of a stretched polypropylene foil of 19 cm diameter

Foil	Thickness ($\mu\text{g}/\text{cm}^2$)	Internal St. Dev. ($\mu\text{g}/\text{cm}^2$)	Number of peaks
A	54.0	0.4	6
B	50.7	0.3	5
C	58.7	0.5	6
D	51.6	0.3	5
E	77.0	0.1	7
F	76.9	0.3	7
G	73.8	1.2	8
H	63.9	0.3	6
I	60.4	0.4	7
J	59.8	0.4	7
K	-	-	-
L	68.3	0.6	7
M	62.7	0.4	6
N	73.0	0.7	8

Table II : Results of spectrophotometrical thickness measurements

Foil thickness ($\mu\text{g}/\text{cm}^2$)	Pressure (Pa)	Rupture constant(5) ($\text{cmHg}\times\text{cm}/\text{mg}\cdot\text{cm}^{-2}$)
51.6	9787	284
60.4	12798	318
62.7	12180	291
73.8	16916	344
76.9	17338	338
		315 \pm 27

Table III : Results of pressure tests according to ref. (1)

3. MECHANICAL STRENGTH

The mechanical strength of polypropylene was measured by both pressure and dropping tests (1). Two foils tested by the dropping method gave results similar to these of formvar and polyimide of equivalent thickness, and significantly better than polysulfone and vyns. From pressure tests on 6 foils the rupture strength was found to be 315 ± 27 (Table III), a value which is significantly higher than any previous obtained at CBNM and which ranged from 10 for carbon to 122 for polyimide. However it is lower than those which can be calculated from the report presented by Didriksson at the INTDS Conference of 1978 in Munich (7), for foils in the range 10 to $70 \mu\text{g}/\text{cm}^2$ ($R = 463 \pm 62$).

However, these tests prove that the foils have outstanding mechanical properties, which are significantly better than those of other foils generally used as thin substrates for nuclear targets.

4. RESISTANCE TO HEAT AND RADIATION

The resistance to heat of thin polypropylene foils is poor and comparable to that of vyns. The foils collapsed completely at 120°C .

The resistance to radiation was examined using an Am 241 source. In air the radiation resistance is approximately 5 times worse than that of formvar, 10 times worse than that of vyns and 40 times worse than that of polyimide. In primary vacuum the resistance to radiation of polypropylene is 30 times higher than in air.

5. CONCLUSION

Stretched polypropylene show outstanding mechanical strength, and thus may be an interesting substrate material for nuclear targets. Its use is however limited by the fact that its resistance to heat and radiation seems to be rather poor.

ACKNOWLEDGEMENTS

The authors are particularly grateful to Mr. P. Rietveld of CBNM's analytical science group who carried out the alpha-particle energy loss measurements.

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Request for advice

Who has experience in use of Thallium, Zinc, Cadmium targets during irradiation by protons (24 m V, 10 μ A - 1 MA) in vacuum ?

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Abstracts of the papers presented at the 10th World Conference of the
International Nuclear Target Development Society, October 19 - 23, 1981
Kiryat Anavim (Jerusalem) Israel

CARBON STRIPPER FOIL LIFETIME TESTS

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and

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and

D. Tolfree
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Carbon stripper foils prepared by several different methods have been tested in the terminal of the Argonne FN tandem using a 7.7 MV ^{58}Ni beam. The ion transmission ratio, foil lifetime, and beam energy straggling were measured. The results will be presented and discussed.

* Work supported by the U. S. Department of Energy under Contract W-31-109-Eng-38.

A NEW SLACKENING PROCEDURE FOR THIN STRIPPER FOILS

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Wet stripper foils mounted on their standard stripper frames have been slackened by pulling them with reduced air pressure through their frame holes until a desired convexity was reached. The slackening apparatus, which will be described in details, guarantees an efficiency of nearly 100% for $5 \mu\text{g}/\text{cm}^2$ standard carbon foils, about 80% for $4 \mu\text{g}/\text{cm}^2$ and 30-40% for $3 \mu\text{g}/\text{cm}^2$ foils without collodion backing.

LIFETIME PERFORMANCE OF GLOW DISCHARGE CARBON STRIPPER
FOILS

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Germany

Systematic investigations have shown that carbon foils produced by cracking of hydrocarbons have quite different physical properties compared with standard evaporated foils. Characteristic differences have been found in the electron diffraction pattern of different types of carbon foils after irradiation with heavy ion beams. After extensive lifetime measurements with an external heavy ion beam the glow discharge foils have been now successfully used in the terminal stripper of the Heidelberg tandem accelerators since about one year. Under bombardment with various heavy ion beams in a mass range between ^{32}S and ^{197}Au lifetime improvements of a factor of 20 in comparison to the standard foils were obtained.

STRIPPING SYSTEM FOR SINGLE-STAGE
VAN DE GRAAFF ACCELERATOR

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A stripping system that can be placed inside a single-stage Van de Graaff accelerator permitting exposure of any part of a 120 cm^2 foil has been built. One preliminary test run has been made.

PRODUCTION OF THICK ELEMENTAL LOW-OXYGEN CONTENT ^{26}Mg
FROM ^{26}MgO

Gervas M. Hinn, Eric B. Norman, Timothy E. Chupp, and
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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 $100\text{ mg}/\text{cm}^2$ targets of elemental magnesium (^{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.

THE PREPARATION OF ISOTOPIC SULPHUR TARGETS BY ION
IMPLANTATION.

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Isotopic sulphur targets have been prepared by implanting S ions at 30keV into $100\mu\text{gcm}^{-2}$ Mg foils. Measurements using proton-induced x-ray emission show that the saturation value is $\sim 10\mu\text{gcm}^{-2}$ and so thicker targets have been produced by building up successive layers of Mg and S. The implantation equipment is described and also the technique of producing the Mg foils.

EXPERIENCES WITH ^{48}Ca -TARGETS

Maria Katharina Nacke and P. Maier-Komor
Physik-Department, Technische Universität München,
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The violent increase in price of ^{48}Ca -material demanded the redesign of ^{48}Ca -target preparation methods. The technical resources to prepare, to handle and to store ^{48}Ca -metal targets will be demonstrated. In contrast with these techniques the preparation of chemical stable $^{48}\text{CaF}_2$ -targets is very simple, which will be explained in detail.

PREPARATION OF METALLIC BA-TARGETS

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The preparation of metallic Ba-targets by reductive evaporation techniques is described. Emphasis is given to the handling of the targets after completion of the evaporation procedure. A special designed interlock system allows the transfer of the targets under vacuum into a dry argon atmosphere, where mounting into the reaction chamber is accomplished. The conditions which permit the handling of Ba-targets in an argon glove box are discussed in some detail.

TECHNIQUES FOR PRODUCING ISOTOPIC METAL TARGETS $< 100 \mu\text{G}/\text{CM}^2$

Judith C. Gursky
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Low energy nuclear reaction studies require thin, preferably self-supporting targets. Standard techniques for producing them include resistance and electron beam heating, focused ion sputtering, varying release agents and geometry, substrate heating and stress relief using formvar and collodion. These can be combined in various ways. Specific applications to a number of metals will be discussed.

GENERAL TARGET TECHNOLOGY

Leo Sapir and B. Rosenwasser
Target Laboratory, Weizmann Institute of Science

This paper will present the Target Laboratory activities for the last year.

A new target holder for evaporation isotopes was developed. Using this holder we are able to get the same thickness for 6 targets during one evaporation.

Electrolytic bath for small quantities of isotopes will be described.

Carbon stripper foils were prepared using many techniques. Results will be presented.

Iron, silver and chromium were evaporated on polycarbonate or collodion substrate.

THIN SINGLE CRYSTAL GOLD FILMS

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Australian National University
PO Box 4, Canberra ACT 2600, Australia

Thin, single crystal gold films were required in a study of lattice dynamics by channeling techniques; also in the investigation of coherent x-ray production following channeled heavy-ion excitation.

A "pulse and anneal" technique was employed initially to produce single crystal gold films but more satisfactory results were obtained using a technique, whereby condensation sites were increased by flooding the substrate with scattered electrons from the electron-gun evaporation source.

Abstract not presented

Production of mercury sulphide and various other targets using a high yield method.

Mr. T.L. Morgan, Manchester University, Manchester, U.K.
Mr. J. Reynolds, Liverpool University, Liverpool, U.K.
Mr. R. Darlington, Daresbury Laboratory, Warrington, U.K.

TILTED MULTI FOIL TECHNIQUES

C. Broude, O. Kistner*, B. Rosenwasser and L. Sapir
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Weizmann Institute of Science, Rehovot, ISRAEL

A recent development in nuclear physics spectroscopy uses a stack of about 10 thin carbon foils within the recoil gap of a plunger apparatus for the measurement of nuclear g-factors. The techniques of production and mounting will be described.

*Brookhaven National Laboratory, Upton, NY.

Not presented

SOME TECHNIQUES IN TARGET PREPARATION FOR CHALK RIVER NUCLEAR PHYSICS EXPERIMENTS

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An economical technique for the reduction of isotopically-enriched magnesium oxide by mixing it with finely divided tantalum metal filings is described. The resulting metal is suitable for the preparation of $^{24,25,26}\text{Mg}$ target films. Foils of thickness 2 mg/cm^2 suitable for accelerator targets of Cs can be prepared by rolling the halide CsI. The preparation of ^{14}C targets by the glow discharge cracking of acetylene prepared from ^{14}C enriched barium carbonate is also described.

PREPARATION OF NONMETALLIC TARGETS BY LASER BEAM EVAPORATION

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Targets of chemical active metals show not negligible deteriorations of the resolution in heavy ion experiments. A reason for this attitude is the oxidation of the target which occurs even in a vacuum of 10^{-6} torr during the heavy ion bombardment. Another reason is the crystallographic transformation due to the ion bombardment. Such target deteriorations can be minimized for targets prepared by evaporation of their oxides in an oxygen atmosphere of 10^{-3} torr using laser beam evaporation techniques. The preparation method and the possible reasons for the resolution stability of such targets will be discussed.

TARGET PREPARATION OF SOLID NITROGEN

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A reactive sputtering method was utilized to prepare solid nitrogen targets. A detailed description of the preparation is given as well as estimation of its efficiency.

PREPARATION OF HIGHER ACTINIDE BURNUP AND CROSS SECTION SAMPLES*

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A joint research program involving the United States and the United Kingdom was instigated about four years ago for the purpose of studying burnup of higher actinides using in-core irradiation in the fast reactor at Dounreay, Scotland. Simultaneously, determination of cross sections of a wide variety of higher actinide isotopes was proposed. Coincidental neutron flux and energy spectral measurements were to be made using vanadium encapsulated dosimetry materials in the immediate region of the burnup and cross section samples. The higher actinide samples chosen for the burnup study were ^{241}Am and ^{244}Cm in the forms Am_2O_3 , Cm_2O_3 , and $\text{Am}_6\text{Cm}(\text{RE})_7\text{O}_{21}$, where (RE) represents a mixture of lanthanide sesquioxides. It is the purpose of this paper to describe technology development and its application in the preparation of the fuel specimens and the cross section specimens that are being used in this cooperative program.

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HIGH PURITY STABLE ISOTOPE SEPARATION

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The MEIRA electromagnetic isotope separator was planned and built at the Soreq Nuclear Research Centre and has been operated there since 1973. It has a high output capacity which approaches that of the large U.S. calutrons at Oak Ridge. At the same time, it also provides the high enrichment coefficient (E.C.) which was previously associated only with much smaller output machines in Europe. These features are important in the production of relatively large isotope quantities with a high enrichment coefficient or in the separation of a very low abundance isotope to a high degree of purity. As an example, we recently produced ^{124}Te with a purity better than 99.5% (E.C. 4000) in a single pass with a total ion beam intensity of 50 mA (2 mg/h). The collected material is further refined by vacuum distillation to yield a chemical purity typically better than 20 ppm. This isotope is used as a target in a cyclotron for the production of the radioimaging agent ^{123}I by the (p,2n) reaction. A high isotopic purity of the target material is important to reduce the simultaneous production of other radioiodines (in particular ^{124}I) which would reduce image quality and increase patient dose. To achieve the stated enrichment other isotopes of tellurium are also collected at the same time and may be used for other applications.

MOLECULAR STRUCTURE STUDIES BY COULOMB EXPLOSION OF FAST IONS

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Information on molecular ion structure is obtained by detecting dissociation fragments and measuring their relative velocities. The molecular ions are accelerated at 3-4% the velocity of light and passed through thin (100-200 Å) carbon targets. Inside the foil the binding electrons are stripped away leading to repulsion between the remaining positive ions. The relative position of the nuclei in the molecule determines the final velocities of the break-up products. We measure these velocities and are able to draw conclusions on the structure of the unexploded ion.