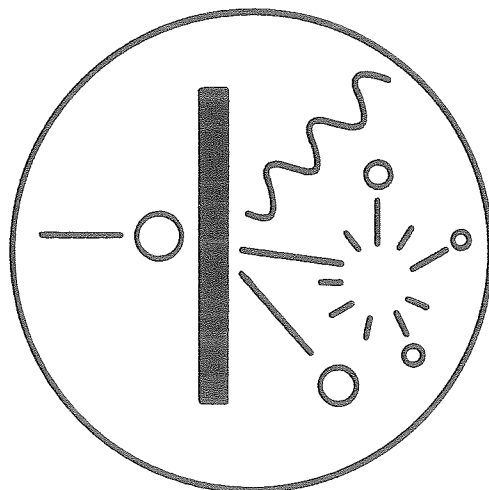


**INTERNATIONAL NUCLEAR
TARGET DEVELOPMENT SOCIETY**

NEWSLETTER



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International Nuclear Target Development Society

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The INTDS Newsletter is an informal source of information for and from the Membership.

The INTDS assumes no responsibility for the statements and opinions advanced by the contributions.

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Editors Note

Dear Colleagues,

It is with great sadness that the members are informed of the death of Ed Kobisk and Joe Gallant. This Newsletter carries a short memorial to each of them.

Elections for INTDS Board members will take place next year at the 18th World Conference in Strasbourg. Members are invited and encouraged to propose candidates in addition to those proposed by the nominating committee.

Please see page 4.9

Seasons greetings to all.

Chris Ingelbrecht
Editor

IN MEMORY OF EDWARD H. KOBISK

It is with great sorrow that we inform you that Ed Kobisk passed away on September 7, 1995. A memorial service was held in Knoxville, TN, on September 12, 1995.

Ed began working at the Oak Ridge facilities on October 23, 1951. In 1961, he became manager of the newly formed Target Preparations Group at the Oak Ridge National Laboratory. The Target Group flourished under Ed's direction and eventually became known as the Isotope Research Materials Laboratory. As many as 25 individuals from a wide variety of scientific disciplines made up the IRML and performed research and development and specialized preparations using enriched stable and radioactive isotopes. These special materials were used in thousands of research and industrial applications around the world. He received numerous awards for his work, including an IR-100 Award. Ed retired from the IRML on August 8, 1982 and started a second career as a very successful Certified Public Accountant.

Ed was the host of the Third International Symposium on Research Material for Nuclear Measurements in Gatlinburg, TN, during 1971 which was one of the precursors to the formation of the INTDS in 1973. He later hosted the 1980 INTDS World Conference in Gatlinburg, TN, and was a major contributor to the successes of the INTDS, including service as it's President. Ed and his wife Dolly most recently attended the 17th World Conference of the INTDS in Bloomington, Indiana in 1994, showing his continuing interest in the Society and the many friends he made over the years.

Ed will always be remembered for his perpetual optimism and inspiring his fellow target makers to strive for the impossible.

W. Scott Aaron

IN MEMORY OF J.L. GALLANT

It is with deep regret to inform INTDS members that J.L. (Joe) Gallant died on Monday, August 7, 1995 in Deep River, Ontario, Canada after a lengthy illness.

Joe was an enthusiastic participant in the formation of the Society. He was instrumental in the hosting of the 1974 INTDS conference at Chalk River which produced the first published proceedings. His dedication to the field of target making is exemplified by the numerous papers he presented at subsequent conferences. Though officially retired from his target making position in August, 1985, Joe made himself available to help organize and co-chair the 1986 INTDS conference at Chalk River.

His tireless contributions to the art of target making and to the community he lived in will be sorely missed.

Condolences are offered by INTDS to his family and friends.

Peter Dmytrenko
Chalk River Laboratories
Ontario, Canada

ELECTIONS FOR THE INTDS BOARD OF DIRECTORS

Four terms of office are expiring in 1996: Jean Pauwels, George Thomas, Ruggero Pengo and Hans Maier (retiring Past President). The President has appointed a nominating committee (C. Ingelbrecht (Chairman), S. Aaron, H. Folger) to propose candidates for the elections for the four positions which will be held during the 18th World Conference in Strasbourg. The nominees (including two retiring Board members) are:

José Dionisio, CSNSM, Orsay, France
John Greene, ANL, Argonne, USA
Hans Maier, Universiteit München, Germany
Ruggero Pengo, INFN/LNL, Legnaro, Italy

You may nominate up to four additional candidates from the current membership list. These nominations should be mailed or faxed to me to be received by June 7, 1996, so that a ballot can be prepared and mailed to all members at least one month prior to the conference.

C. Ingelbrecht
Recording Secretary

Return by mail or fax to:

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2440 Geel, Belgium
Fax: 32-14-590-406

Additional nominations for the INTDS Board of Directors:

- 1.
- 2.
- 3.
- 4.

Nominated by: Name:

Signature:

STRIPPER FOILS FOR THE NEW INJECTOR LEAD-IONS FOR THE PS-SPS ACCELERATORS AT CERN

Giuseppe Battistello
INFN-LNL Laboratorio Bersagli

ABSTRACT

An 100 to 200 $\mu\text{g}/\text{cm}^2$ of amorphous carbon graphite evaporated with electron gun for making stripper foils using barium chloride as release agent.

The CERN Heavy Ion Beam Facility has been developed by an international collaboration between CERN (infrastructure and 200 MHz RF), Germany (Linac and 100 MHz RF), Italy (RFQ and low energy, stripper and filter beam lines), India (software and some vacuum equipments), Sweden and Switzerland. It has, as its key component, a new dedicated Linac to accelerate highly charged lead ions¹).

The Italian IPR project (Ioni Pesanti Relativistici) consists of the development, the design and the construction of an RFQ (Radio Frequency Quadrupole) and the two beam transport lines that were delivered to CERN on 12 April 1994. The LNL Target Laboratory was engaged to prepare the stripper foils for this project.

The carbon stripper foils of 100 to 200 $\mu\text{g}/\text{cm}^2$ were made using the amorphous graphite evaporation technique in a Varian 3317 evaporator with an electron gun. The evaporations of "Carbon Lorraine" graphite were made starting with a vacuum of 2×10^{-7} Torr, using as release agent 35 $\mu\text{g}/\text{cm}^2$ BaCl₂ deposited from a tantalum crucible using Joule effect, before carbon evaporation and without bell ventilation.

The barium chloride has a thin granulosity better than betain or sodium chloride or Teepol parting agent, with which a lot of tests were made. The carbon foils appeared strong, uniform and very shiny; they were mounted on aluminium frames with 15 mm diameter hole which are a standard for LNL. The BaCl₂ hygroscopicity was prevented by paying attention to the handling of the slides and by controlling the air humidity with a dryer. Some foils, especially the thicker ones, were glued with "silver paint."

The stripper foils used in these steps were of 100 $\mu\text{g}/\text{cm}^2$, the nearest thickness of equilibrium. The result was excellent, both of the foil life-time and of the tolerance in thickness (<3%).

REFERENCE

- 1) CERN Bulletin n. 24/94 week Monday 13 June, 1994.

Pure Boron Targets for Neutron-Induced Nuclear Reaction Experiments

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At The Svedberg Laboratory, Uppsala, Sweden, neutron-induced nuclear reaction studies have been carried out in the 100 - 160 MeV region for a number of years¹. Recently, the (n,p) reaction on ¹⁰B and ¹¹B was studied at 100 MeV². For this experiment, a technique to produce isotopically enriched boron targets was developed.

Previously, targets for this kind of experiments have been manufactured by dissolving small amounts of styrene³ or carbowax⁴ into boron powder, which has been pressed to discs. These techniques have the disadvantage that they introduce hydrogen contaminations into the targets, which is a problem, because the ¹H(n,p) cross section is an order of magnitude larger than any other cross section in the energy region of the present experiment.

The requirements of the targets were as follows; they needed to be 7 cm in diameter to match the neutron beam size, with thicknesses of 200 mg/cm², i.e., about 1 mm thick, and the hydrogen content should be minimized.

Isotopically enriched (better than 99 %) ¹⁰B and ¹¹B was purchased from Eagle Picher⁵ as a powder with a 150 μm mesh size. The material was grinded to a mesh size of less than 10 μm in a steel mortar. This introduced a 3.0 % (by weight) contamination of iron, but the background induced from this was known to be negligible in this particular experiment. The powder was mixed with water to a mud, with a typical ratio of 2-to-1 (by weight) of water to boron.

The standard target frames are made of G10 fiberglass, with an inner hole which is 23 times 10 cm. Polypropylene foils, of 6 μm thickness and 11 cm wide, were mounted on these frames. These frames were laid on a glass table inside an oven, and a steel cylinder with an inner diameter of 7.0 cm was positioned on top of each foil. The boron-water mixture was poured into the cylinder, and left to dry in a temperature of +180° C for 3 hours, after which the cylinder was carefully removed. A second polypropylene layer was mounted to seal the boron target. No glue on the actual target was needed, just glue around it.

With this technique, the targets were sufficiently solid to hang vertically without breaking. The material was fragile, but still possible to handle. The hydrogen from the backing foils was $8 \cdot 10^{-4}$ (by weight), which is about a factor three less than in the previous techniques, and it could be corrected for by background measurements.

References:

1. H. Condé, S. Hultqvist, N. Olsson, T. Rönqvist, R. Zorro, J. Blomgren, G. Tibell, A. Håkansson, O. Jonsson, A. Lindholm, L. Nilsson, P.-U. Renberg, A. Brockstedt, P. Ekström, M. Österlund, P. Brady and Z. Szeffinski, A facility for studies of neutron induced reactions in the 50 - 200 MeV range, *Nucl. Instr. Meth. A292* (1990) 121-128.
2. TSL experiment FA71, spokesman: J. Blomgren. Analysis in progress.
3. W. Lozowski, Indiana University Cyclotron Facility, private communication.
4. J. Ullmann, Los Alamos National Laboratory, private communication.
5. Eagle Picher Industries, Inc., Specialty Materials Division, Boron Department, P.O. Box 798, Quapaw, Oklahoma 74363, USA.

Thinning graphite sheets to 3 mg/cm²

William R. Lozowski and Norman B. Jones
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A machine shop surface grinding mill was used to thin a piece of graphite sheet 125- μm thick and 25 mm by 92 mm to a thickness of $16.5 \pm 1.3 \mu\text{m}$ ($2.98 \pm 0.1 \text{ mg/cm}^2$). Previously at IUCF, wet-grinding by hand of adhesive-mounted thin graphite sheets produced pieces of comparable thickness, but typically with areas one-third as large and 2-3 times more thickness variation. The use of common end-milling machines and metal cutting lathes for this purpose had failed decidedly. It was a surprise to do better using a large surface grinder employing a grinding wheel 300 mm in diameter by 25-mm thick and made of 100-grit Al_2O_3 powder.

To begin, the surface of the grinding wheel was prepared by running it across a diamond dressing tool held securely by the magnetic table of the grinder. Final dressing of the wheel was done by removing 25 μm from its radius, advancing the transverse table feed by 75-100 μm /pass. Then, using the wheel, a mounting plate for the graphite (mild steel, 100 mm by 34 mm by 12.7 mm thick) was ground to have smooth, flat, and parallel surfaces on the top and bottom.

The thinnest graphite sheet available from Poco Graphite, Inc. (1601 South State Street, Decatur, TX 76234, USA) was about 58- μm (10.3 mg/cm^2) thick and 10 cm by 15 cm. However, 125- μm (22.9 mg/cm^2) sheet was found easier to glue flat to the steel mounting plate, and was less expensive. Of the three glues tried, Devcon Duco Cement and hard paraffin wax were less effective than 3M Feathering-Disc Adhesive at resisting the tangential force exerted on the graphite by the grinding wheel (estimated speed of 3,200 rpm). Diluted with cyclohexane to the consistency of honey warmed about 20 K above room temperature, this adhesive allowed sufficient time to wring the graphite and steel into contact before becoming stiff.

Initial grinding of the graphite was done in vertical increments 5-8 μm deep, advancing the wheel 75-100 μm per pass across the graphite until the entire wheel had passed over it. When a graphite thickness of about 50 μm was reached, the remaining thinning was done with vertical depth increments of about 3 μm , without changing the wheel advance/pass setting. At the endpoint of 16- μm thickness, the 25 mm by 92 mm graphite piece had defects consisting of a single line of voids less than 2-mm long by 8- μm wide, spaced about 6 mm apart, and a void about 6 mm by 1 mm in size. Fortunately, these were positioned about 3 mm from a long edge. We suspect that dressing the grinding wheel more carefully, or perhaps using a wheel with a smaller particle size will allow thinner large foils to be made with the surface grinder.

Cyclohexane was used to remove the graphite foil from the mounting. Because the adhesive soaks the Poco graphite (17% voids, 1.81 g/cm^3), the foil was thoroughly washed in cyclohexane and then baked in a vacuum at 900 K to remove or carbonize any remaining adhesive.

A simple and homogeneous heating method for degassing of bell jars

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In our paper about CsI photocathodes [1] we had mentioned a simple method for degassing a metal bell jar. In this report we will present details of this heating system.

Many commercially built evaporation systems are equipped with stainless steel bell jars which have cooling lines at their outsides. This water cooling is applied especially when hot long-lasting deposition processes are used where the resulting heating of the bell jar might deteriorate the vacuum. These cooling lines, however, can also be used with hot water for degassing to achieve a better process vacuum. For this purpose tap water is heated mostly by a continuous flow electric heater, forced through the cooling lines of the bell jar and wasted in the sink. There are in addition more disadvantages of this procedure. Especially the heater but also the cooling lines calcify due to the huge amount of tap water and the annealing temperature stays always below 370 K in most cases only at 330 K. In a closed system similar to the cooling

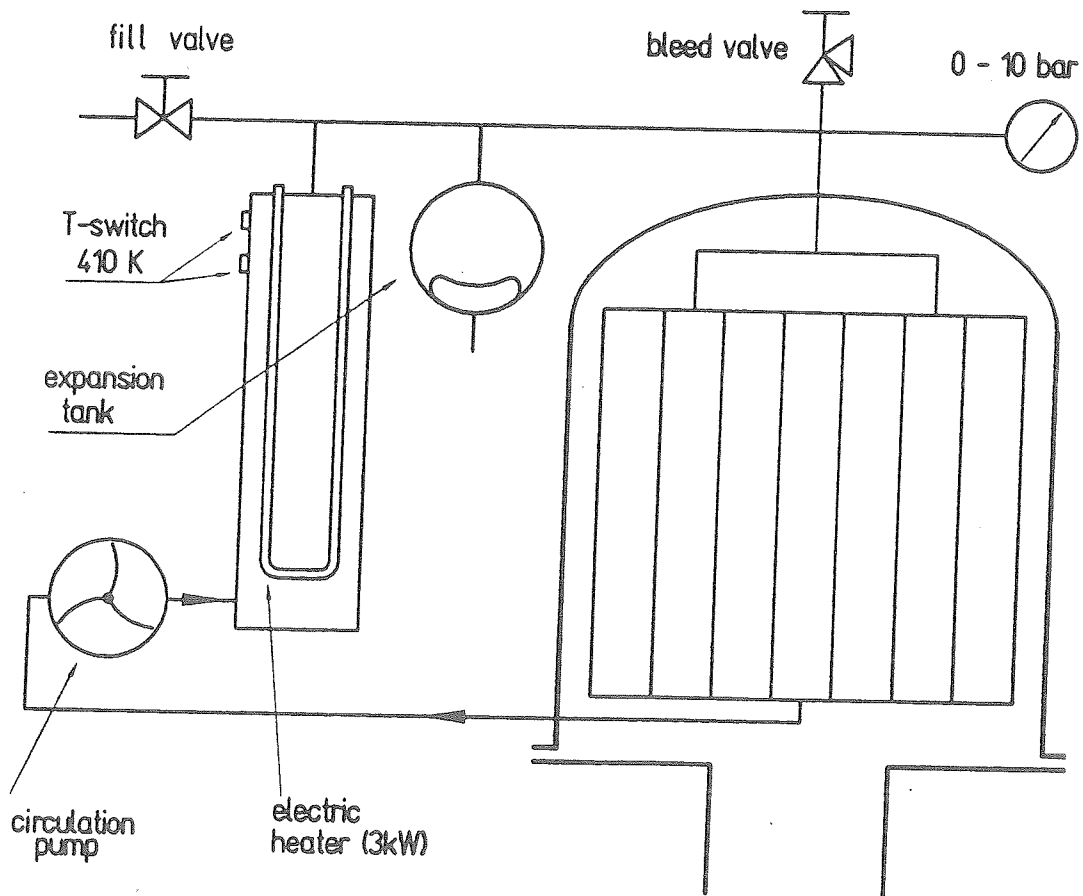


Fig. 1. Schematics of the heating system

system of a car engine water can be pressurized and thus the formation of steam can be avoided. In order not to risk a bursting of the cooling lines we limited the water temperature to 410 K, which means a vapor pressure of water of $3.6 \cdot 10^5$ Pa. Details of the setup are described using fig. 1.

The system for which we constructed the bell jar heater is a Varian 3119 R & D coater system which we had cheaply bought from surplus of solar cell industry. It was modified and dedicated exclusively for CsI evaporations. The former cooling lines of the stainless steel bell jar of 70 cm inner diameter and 70 cm height are now used for hot water. They are connected to a 3 kW continuous flow electric heater, a circulation pump and an expansion tank, which all together are coupled to a closed system by means of copper tubes of 16 mm inner diameter. Nearly all components are commercially available and generally used for home heating by hot water. That is why they are cheap. Only the continuous flow electric heater had to be constructed, because a power of only 3 kW was needed and the safety switches should not switch off before 410 K. The two U-shaped heating rods were installed in a 50 mm inner diameter stainless steel tube and the water is forced from the bottom to the top of the heater by means of the circulation pump. The two temperature switches are mounted at the hottest zone which is the top of the heating vessel. The second temperature switch which is in series to the first one is for redundancy in case if one fails to switch off. The circulation pump is designed for a maximum temperature of 390 K only, nevertheless it works smoothly, because the hot water is cooled down a little during floating through the bell jar. The expansion tank which its maximum volume of 2 liters has the same temperature limitation as the pump, but it needs not to be installed in passage and its hanging position isolates it from the hottest water. Before water filling the rubber bladder of the expansion tank is pressurized with air to 2×10^5 Pa. After it the circulation system is filled and pressurized with tap water to 4×10^5 Pa via the fill valve. The total water volume of the system is about 8 liters. In this condition there is about 1 liter water reservoir in the expansion tank. This is needed for the first heat up, because the liberated air which was dissolved in the cold water must be released via the bleed valve which is at the highest point of the system. With the pressure gauge it can be controlled if the system works normally. A pressure of 5×10^5 Pa can be tolerated. If there is much air dissolved in the water then after cooling down the system must be pressurized again to 4×10^5 Pa via the fill valve. In this way formation of steam can be avoided up to the 410 K, the value of the temperature limit switches.

The whole heating system can easily be integrated, because it is directly coupled to the bell jar. No flexible water hose must remain on the system. The only linkage is an electrical power cable which easily moves with the lifting bell jar.

After heating the bell jar to about 410 K for several hours a final vacuum of 10^{-6} Pa was achieved by means of a DN 200 cryopump with a typical pumping speed of about 1500 l/s for air and about 4500 l/s for water.

References

- [1] P. Maier-Komor et al. Nucl. Instr. and Meth. A 362 (1995) 183-188.

Samples and Targets Prepared at IRMM during 1995

C. Ingelbrecht, F. Peetermans, R. Eykens, A. Moens, J. Van Gestel, S. Palmeri, A. Dean, H. Mast,

S. Clifford*, D. Egan*

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During 1995 the Nuclear Sample Preparation Group supplied 921 samples in support of the IRMM nuclear data programme and to customers in 5 countries in response to 79 requests. Particular preparations and projects include:

- * Thick ^{99}Tc targets of uniform density made by preparing brittle Al-Tc intermetallic, grinding to powder, blending with sulphur powder and compacting into pellets. The samples were required for cross-section measurements for waste transmutation studies.
- * Development of improved electrodeposition methods, including yield and homogeneity measurements by α -counting, for production of uranium and plutonium layers for fission product studies.
- * Construction and testing of equipment for reductions of oxides of stable isotopes with high yields ($\sim 95\%$). Two rigs are available, using either resistance heating or induction heating and test runs have been carried out with rare-earth oxides in quantities from 100 mg up to several grammes to establish optimum procedures.
- * Preparation of metallic Gd-Pu-Nd "spikes" for plutonium determinations in reprocessing plant input solutions by mass spectrometry. A precise method for production control of Pu homogeneity by γ -counting was developed in parallel.
- * Preparation of $^{233}\text{UF}_4$ layers by vacuum deposition and participation in an interlaboratory comparison of low-geometry α -counting using these layers in order to validate calibration methods. The agreement between three laboratories was 0.1% to 0.2% for each measured layer.
- * Distribution of reference materials for reactor neutron dosimetry (173 RM units during 1995), and preparation of three candidate reference materials (Al-Co alloys) for future certification. In addition, a large number of (non-certified) activation foils and wires either alloys or pure metals were supplied externally.
- * Production of a range of polymer foils by spin coating for use as target substrates and for a collaborative study of α -particle stopping powder.

*EC Fellows from the University of Limerick, Ireland.