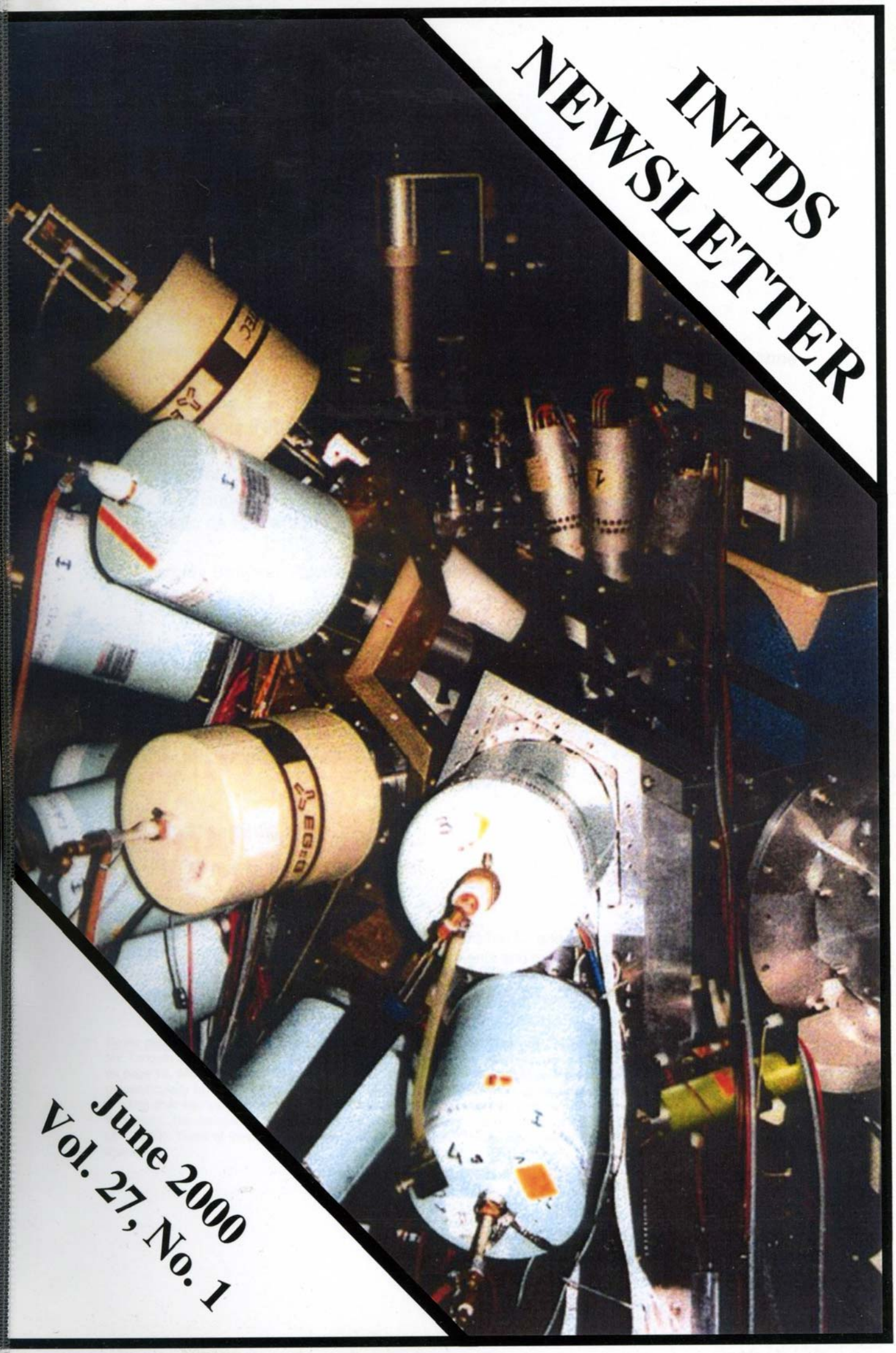
INTDS NEWSLETTER



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CONTENTS

Cover picture: Overall view of the multi e-γ in-beam spectrometer of the CSNSM operating in the experimental area of the MP Tandem accelerator of IPN (Orsay). This picture illustrates the schematic views of fig. 2 shown in Ref. [2,3] of the paper on page 10, where the conical-cylindrical shaped SK magnetic lens (placed on the right hand side of the figure) is oriented perpendicularly to the accelerated ion beam (travelling in the backward –forward direction of the picture within a tubular reaction chamber lying between two target chamber vacuum locks –one lying backwards and another forward the magnetic lens axis). The compound nucleus reactions are detected by a small array of six BaF2 crystals coupled to fast P.M. (XP2020Q). Three of these are seen oriented vertically above the target chamber and three lie symmetrically below that chamber.

Editor's Note

May I remind you of the deadlines for the INTDS conference (2-6 October).

Submission of abstracts	31.07.00
Payment of reduced-rate (early) registration fee (i.e. 12500 BEF for INTDS members instead of 13710 BEF and 14520 BEF for non-members instead of 15730 BEF after this date)	31.07.00
Hotel registration	15.08.00
Submission of papers	02.10.00

Please note also that the INTDS membership of all members expires on 30.09.00 (before the conference).
Conference participants therefore have two possibilities:

- Pay the conference registration fee for non-INTDS members which includes their membership up until October 2002.
- Pay the conference registration fee for INTDS members and pay their INTDS membership (50 USD) separately to the INTDS Treasurer Joanne Heagney either before or at the conference.

I look forward to seeing you in October.

Chris Ingelbrecht
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THE FRANK KARASEK MEMORIAL SCHOLARSHIP FUND – A FIRST REPORT FROM ARGONNE NATIONAL LABORATORY

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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 first recipient of this award was Massimo Loriggiola from the I.N.F.N., Laboratori Nazionali di Legnaro, nominated by longtime INTDS member, Ruggero Pengo and approved by the Board of Directors. The fund provided support for a two-week visit to ANL in May of this year.

Brief Description of Research Interaction

In anticipation of Massimo's visit, some thought was given to the scope of work that could be accomplished during his short stay at ANL. This work, of course, should involve rolling. We didn't have far to look as the experimental demands of research at ATLAS provided us with plenty of opportunities. The following is a short list of some of the interactions afforded during Massimo's stay.

1. *Rolling of ^{54}Fe metallic targets for experiments at the Argonne Fragment Mass Analyzer (FMA).*

Metallic targets of ^{54}Fe of 0.5 mg/cm^2 thickness were requested for an experiment employing (5 pnA) beams of 58Ni provided by the ATLAS accelerator. Due to the high beam current, a simple target rotation scheme was employed which required several large area (approx. 2 cm x 2 cm) rolled foils. For the target preparation, the oxide of the isotope was obtained and reduced using a quartz crucible in a hydrogen furnace [1]. The isotopic metal was consolidated into a bead using an electron beam source, and rolled using a small rolling mill [2].

2. *Rolling of large area gold foils to be used as energy filters in a silicon detector array.*

Pack rolling of gold foil was employed to prepare a series of 15 mg/cm^2 Au filters, which were subsequently mounted in front of a three silicon detectors array.

3. *Reduction of ^{149}Sm and subsequent rolling to produce 1 mg/cm^2 metallic targets.*

Several metallic targets of 1 mg/cm^2 ^{149}Sm were requested and prepared by the pryo-metallurgical reduction of $^{149}Sm_2O_3$ using Hf as a reducing agent [3]. The isotopic metal was collected on a water-cooled Cu block and rolled directly using a small rolling mill.

4. Rolling of 1-2 mg/cm2 natMo foil to be used in a target chamber rotating entrance window application.

Starting with a 0.005 cm Mo foil, an entrance window of 3 cm aperture was prepared by pack rolling in the usual fashion.

Conclusion

In conclusion, the visit to ANL by Massimo Loriggiola was very successful in that it afforded an opportunity to interact with colleagues outside of ones home institution, observe and learn different techniques in target preparation, and begin a new exchange fostered between our two laboratories. This awarding of support to a young researcher engaged in foil rolling for target preparation should be continued and encouraged wherever and whenever possible.

Acknowledgements

The authors would like to thank Dr. Donald Geesaman, the Physics Division Director, and Dr. Robert Janssens, Associate Division Director, for their continuing encouragement and support of these efforts. We would also gratefully acknowledge Ruggero Pengo and Guiseppe Manente of LNL, Legnaro, Italy and INTDS President, Peter Maier-Komor of TUM, München, Germany. Finally, the authors would thank Joanne and Joe Heagney of Micro Matter Company for the establishment and administering the Frank Karasek Memorial Fund.

References

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

[3] R. Pengo, et. al., Nucl. Instr. and Meth. in Phys. Res., **A303** (1991) 146-151

Figures

Photograph of Massimo Loriggiola at the rolling mill in the target fabrication facility at Argonne National Laboratory.

ANL VISIT FROM OUR COLLEAGUE Isao Sugai (Univ. of Tokyo/KEK) along with J. Greene, G. Thomas and M.Loriggiola (INFN, Legnaro). Sugai visited Argonne the week of May 8-10.

Targets of ^{208}Pb on Carbon Backings.

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Abstratct: ^{208} Pb was evaporated on 40 μg/cm^2 thick achieved carbon foils on glass substrates. On the ^{208}Pb a thin ~5 μg/cm^2 C layer was subsequently evaporated. The targets were then obtained floating the films in warm water and fishing them onto appropriate thin Al target frames.

More than one hundred ^{208}Pb targets on carbon backing with a thin carbon layer on it were prepared to be used in the recent experiment carried out in Ganil to search the Z=118 super heavy elements using a ^{86}Kr beam of 453 MeV energy.

As Pb is a toxic material in powder and vapour form, special care was taken because of the unusually large quantity of required targets. Special masks with appropriate filters for particulated material, gloves, disposable paper caps and clothes were dressed to avoid undesirable contamination. In addition, flushing of the vacuum system with dry nitrogen or argon was always performed before openning the bell-jar after Pb evaporation.

Joule heating process using Ta boat was chosen to obtain 300 to 400 μg/cm^2 thick film of ^{208}Pb onto 40 μg/cm^2 thick carbon foils deposited on glass substrates. The carbon foils were achieved from the Arizona Carbon Foil Co., for time saving. The Edwards E12 evaporation unit was used in the Pb evaporation, because in this unit it is easier to clean the residual material, washing many pieces as for example the Pirex bell jar. It is known that Pb contamination is hazardous if a very good final vacuum is to be attained in the chamber. A thin layer of C of about 5 μg/cm^2 was deposited on the Pb layer, to avoid target evaporation during the beam exposure in the experiment. This C evaporation was performed in the new Leybold Univex 450 unit.

There is not any rotational substrate holder available in our laboratory. So, to achieve the appropriate uniformity in the whole batch of substrates it was thought that a very large distance from boat to substrates was necessary. As usually done, the preliminary tests were performed using natural Pb material, in metallic form. Distances of 8 and 13 cm were used. Twelve substrates were mounted on a substrate holder with a shape of a section of a sphere. The obtained uniformity was better for the larger distance, as expected, but the efficiency was not acceptable for enriched isotope use. Shorter distance affords a better efficiency, but the thickness distribution was too wide. Many attempts were made using boats of different sizes and shapes as shown in figure 1.

The best configuration should give the acceptable uniformity of the evaporated film examining each glass slide as well as the whole distribution. There could be a sequence of evaporation runs, so that the glass slides with appropriate deposited thickness could be retired and substituted by new substrates. Some other glasses should be left for two or three evaporation runs until the appropriate thickness is attained.

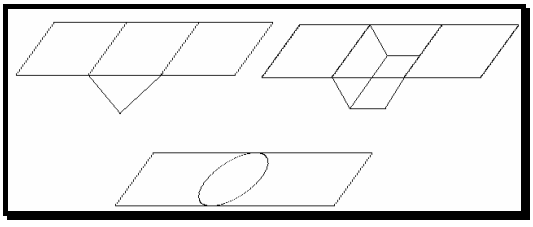

Figure 1 - Ta boats of 0.2mm thick pure Ta sheet, home made by cutting and modelling properly.

Finally it was chosen a distance of 8 cm from boat to the top of the substrate holder and the Ta boat of spherical shape cavity, which was hand made by pressing using a mould with an inox ball of about 1 cm diameter.

The target thickness distribution on the 12 glass slides was carefully determined for this chosen geometry, having in mind the stablishment of a schedule of a systematic loading procedure of the substrates in subsequent evaporation runs, so that by the end of a series of runs all targets would have the appropriate thickness.

As an on line thickness measurement device is not available in the our Edwards evaporation unit, the thicknesses were determined by alpha particle energy loss, after floating the target film onto appropriate thin Al target frames. The effective area of the target was of 1.5 cm x 5 cm and the uniformity of the film Pb deposition along each target of about 10% was also determined for several samples.

To monitor the film thickness deposited in each evaporation run three small thin glass slides (1.5 cm x 1.5cm) were weighed before and after the evaporation of a known amount of mettalic Pb loaded on the boat. One slide was set exactly on the top of the substrate holder and the other two were located aside the carbon slides.

On behalf of the thickness distribution obtained in the test runs it was decided to use 80 mg of material to be fed into the Ta boat for each evaporation run. Only ten of the twelve substrate holders were used, and were named as shown in the figure 2. The two unnamed substrate holders were not used because of the poor uniformity.

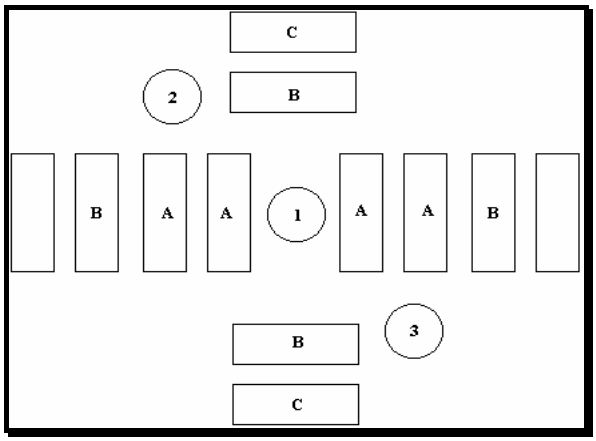

Figure 2 - Schematic view of the substrate holder. The circles numbered 1, 2 and 3 are the sites where the reference glass squares are loaded.

After the first evaporation of 80 mg of Pb the glass slides named A had already the necessary thickness and were therefore removed. New carbon foils and a new amount of Pb on boat were loaded. After the second evaporation run the glass slides named A and B were removed. In the third evaporation run only the slides named A were thick enough. Finally after the fourth evaporation run all slides named A, B and C were removed. Therefore, after four evaporation runs 26 targets were available using 320 mg of Pb attaining a 55% efficiency, which was considered quite good. The glass slides have 2.5 cm width and 7.5 cm length. Some of the B and C slides were turned 180^{o} between evaporations to attain a final better uniformity. Pb thickness after a complete cycle of four evaporations was of 350 $\mu g/cm^2 \pm 20\%$.

It was observed that the control of the heating velocity is very important for a reproducible thickness distribution as well as for the uniformity of the deposition on each substrate.
The heating was performed in 4 to 6 intervals of 20 seconds each, about 3 minutes apart. The maximum applied current has been raised gradually in the subsequent intervals up to the appropriate evaporation current.

When the heating of the Pb was performed at once, only the central glass slides were covered not uniformly and with a very poor efficiency. It seems that Pb is lost through the pumping system. Therefore, the Pb evaporation by Joule heating must be performed very slowly to obtain uniform films and also a reproducible thickness distribution on the batch. The current must be raised very slowly as already described. The mettalic material must be free of colored oxide, which was previously removed using a scalpel. The shape of the Pb piece must also be approximately the same, so that the heating process will not be changed.

On the ^{208}Pb layer a 5 $\mu g/cm^2$ carbon was deposited using the Leybold Univex 450 evaporation unit, where a thickness measurement cristal is installed.

All substrates with deposited Pb films were stored in vacuum. After the thin carbon deposit, the glass slides were stored in dry boxes.

The foils of 40 $\mu g/cm^2$ C + and 350 $\mu g/cm^2$ + 5 $\mu g/cm^2$ C were then floated in 40^{o}C warm distilled water and mounted on thin Al target frames. No zapon was used. As the Pb layer was somewhat thick, the floated foil although perfectly plane and sticked to the frame just after lifting from water, began to roll up when dried. This happened only to the thick Pb layer films (~440 $\mu g/cm^2$). A thin layer of an epoxi mixture (Araldite Ciba) was used on the target frame to glue the foil on the frame during the fishing procedure. This technique demands a good alignment of the floated foil and target frame just in the beginning of the fishing, so that the frame will be entirely covered with the Pb film.

During the fishing procedure with ^{208}Pb isotope, even with the use of the glue, the efficiency was near 100%, almost no loss was verified. For the transportation to France, a little special case was made in Ganil with slots for the fixing of the touchy thin target frames. All targets arrived safely.

The use of the epoxi glue to fix the film to the target frame, although cumbersome during fishing, afforded the necessary mechanical stability to resist the high rotation velocity of the target wheel of 2000 rpm.

INTERPLAY BETWEEN ACCELERATED ION BEAMS, TARGETS AND MULTI e-γ SPECTROMETERS

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The accelerated ion-beam requirements for in beam e-γ spectroscopy as well as the main features of the Orsay MP Tandem accelerator and ion-beam transport system were broadly discussed in the first part of this work [1]. Furthermore, the general features of nuclear targets, recoil ion catchers and reactions used in multi-e-γ spectroscopic measurements, the relative importance of δ-ray background due to accelerated ion-target and recoil-ion target interactions as well as its impact on low energy electron measurements plus the main characteristics of the interplay between accelerated ion beams, targets and recol ion catchers involved in these experiments are dealt with in the second part of this work [2]. Finally a broad survey of the present status of in-beam electron spectroscopy -compared to in-beam γ-ray spectroscopy- followed by a detailed description of several features of important tools reducing electron background (i.e. simultaneous E-Bρ selection, e-γ coincidences) illustrated by several experimental results plus a few theoretical interpretations and prospective projects involving these experiments are condensed altogether in the last part of this recently published work [3].

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Delivery problem for Betaine monohydrate ? !

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Betaine monohydrate is well known as parting agent for self-supporting thin target foils if a corrugated structure is desired to improve the mechanical strength.

The use of Betaine monohydrate as release agent was originally invented in the target laboratory of Heidelberg, who the inventor was is unknown. Hermann Wirth gave me the recipe in May 1969 and I have introduced it to the target-maker community at the pre-INTDS conference in Gatlinburg, Tennessee in October 1971 (P. Maier-Komor, Nucl. Instr. and Meth. 102 (1972) 485).

The Betaine monohydrate was ordered at different chemical companies over the years. We mostly had the material from Merck, Darmstadt, Germany until they did not deliver it any more. Then we ordered it for several years from Aldrich until they stopped the Betaine monohydrate delivery now. After my alarm Hans J. Maier has filled an order for Lancaster, they have delivered several 100 g and promised to deliver the rest in February 2000. Since it is not their own product I doubt that they can fulfill the contract. Anna Stolarz found out that Betaine monohydrate is widely used in cosmetic industries, but I doubt that they can deliver the purity needed to be used for a parting agent.

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

Thank you in advance for your help.

Targets for the IRMM Neutron Data Programme

The Sample Preparation Group at IRMM provides targets for the Geel linear accelerators and for external users. Due to changing programme priorities the intention is to reduce this activities on site and to look for commercial external suppliers of nuclear targets. A number of target preparations laboratories have already been contacted and have indicated their interest. If your laboratory has suitable facilities for the production of these targets and you are interested in receiving more detailed specifications, please contact me.

Typical targets currently requested are:

^{nat}Pb, ^{208}Pb vapour deposited layers
Polyimide substrate foils 30-80µg/cm^2
^{10}B, ^{77}Se, ^{147}Sm vapour deposited layers
^{147,149,152,nat}Sm discs
^{232}Th vapour deposited layers
U (all isotopes) thin layers by electrodeposition or vapour deposition.
Eu discs welded into Al capsules under inert atmosphere

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