INTDS NEWSLETTER

International Nuclear Target Development Society

December 2012
Volume 37
Number 1

www.intds.org

CONTENTS

COVER PHOTO

Participants of the INTDS 2012 Conference and the Target Fabrication Workshop on a visit to GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt

(Photo: G. Otto/GSI)

EDITOR
John P. Greene
greene@anl.gov

DESIGN AND LAYOUT
Carolyn J. Straub

SUBSCRIPTIONS
David Gilliam
david.gilliam@nist.gov

ADVERTISING
John P. Greene
greene@anl.gov

LETTER FROM THE EDITOR

To the INTDS Membership,

As was suggested and heartily endorsed at our Conference just passed, beginning with this issue, the INTDS Newsletter is being published and distributed in an electronic format ONLY. This will help in getting out issues in a timely manner, save on postage, and operate more environmentally friendly by avoiding paper copies and envelopes. For those who wish – we could still accommodate the regular paper issue - it would actually however, appear on the website as a .pdf where one could simply print their own copy. Let me know how you feel about this. I look forward to your continued support and feedback.

As Editor of the INTDS Newsletter, I wish to invite you to submit contributions of general or technical interest to the membership for upcoming issues. I feel as a Society, the Newsletters really should hold a center place within our Membership. It is a VITAL conduit for us between Conferences and, if you look, it has contained in the past many wonderfully rich articles about target making techniques which otherwise never made it into print. We owe it to our fellow & future members to keep this a relevant Newsletter by submitting our tips and treasures so that others don't have to "reinvent the wheel." I urge everyone to please CONTRIBUTE!

Examples may include:

- Description of recent target activities, i.e. your annual (or semi-annual) laboratory progress report.
- Information on any newly developed techniques.
- Requests for advice on making specific targets or obtaining special materials (enriched isotopes).
- Literature information regarding techniques and sample preparation.
- Employment opportunities.
- Nominations, promotions, retirement announcements, … etc.

The Newsletter will accept advertisements placed by members, at the discretion of the editor. These ads should be one page in length or less, and must be relevant to target preparation. For instance, isotope services, equipment for sale, thin foil materials and/or targets in stock, etc.

Please send your contribution to my attention at your earliest convenience, preferably by email. Thank you.

John P. Greene
Editor

Agenda of the virtual
2011 INTDS Board meeting
30 November 2011

AGENDA

1. Approval of minutes of:
    1.1. Pre-conf. 2010 INTDS Board Meeting on 12 Sept 2010 (Birgit)
    1.2. INTDS business meeting on 16 Sept 2010,
    1.3. INTDS reviewers meeting
2. Reports on the INTDS Financial and Membership status (David)
3. Conference 2010 (Stefan)
    3.1. Report on the INTDS 2010 Meeting including financial report
    3.2. Proceedings status
4. Status of the 2012 Conference, (Klaus/Bettina)
    4.1. - Proceedings – status
    4.2. - Financial situation and support of attendees (anything more than INTDS?)
    4.3. – Miscall
5. Election 2012 (AS)
6. Status of the INTDS Newsletter (John)
7. Report on the web site and INTDS Database (AS)
8. Miscellaneous (Awards, ...)
9. Closing/summarizing

Board Meeting joined by (ordered by date and time of email):
John Greene, Birgit Kindler, Christelle Stodel, Atsushi Yoshida, Stefan Zeisler, Klaus Eberhardt, David Gilliam, Dannie Steski, Bettina Lommel

Anna Stolarz 30 November 2011

Dear Board Members,

Let us start our Board meeting. I hope we will be able to proceed smoothly and to close the discussions within ... 2 weeks.

To keep life of our Recording Secretary not so difficult I ask all of us to discipline our submissions to the discussions and submit the comments with number of the discussed item as it is on the Agenda.

---

1. Approval of minutes of:

1.1. Pre-conference 2010 INTDS Board Meeting on 12 Sept 2010 (Birgit)

1.2. INTDS business meeting on 16 Sept 2010,

1.3. INTDS reviewers meeting

All minutes were approved!

---

2. Reports on the INTDS Financial and Membership status (David)

The reports were presented and the financial status was discussed. The remainder of the INTDS-2010 funds will be transferred to the INTDS in January 2012 when the bill from Elsevier has been settled definitely and there is nothing else coming.
The reports were approved.

---

3. Conference 2010 (Stefan)

3.1. Report on the INTDS 2010 Meeting including financial report

3.2. Proceedings status

The status report was approved. The 2010 conference in Vancouver was very successful and closed with a surplus that will be transferred to the INTDS account. Many thanks to Stefan for the organization!

The official publication date of the Proceedings volume was November 1. Elsevier informed us that the hardcopies would be mailed out about 4 - 6 weeks later.

---

4. Status of the 2012 Conference (Klaus/Bettina)

4.1. - Proceedings – status

4.2. - Financial situation and support of attendees (anything more than INTDS?)

4.3. - Miscellaneous

4.1 There is still no decision from Elsevier concerning the publication of our proceedings in NIMA despite further enquiries.

4.2 The financial situation looks good.

We hope that many INTDS-members will join the conference in Mainz - the next Circular will be distributed soon next year.

---

5. Elections 2012

[Anna]
The Nominating Committee was appointed as follow: David Gilliam (Chair), Ntombizonke Kheswa and Atsushi Yoshida. I presume that around early spring (February/March) we get a set of nominees. The nominees will be announced on web and members will be informed about it via e-mail as well. Unfortunately I did not manage to modify the web to carry the election as well via web so still we have to go traditionally via faxed, mailed or presented at Mainz Conference ballots.

---

6. Status of the INTDS Newsletter (John)

One Newsletter, volume edited as volume 2010, 1 was posted.
The work of our Newsletter editor was appreciated and John agreed upon continuing the editor's work. The future Newsletter will probably be distributed electronically to make life easier for the editor.

---

7. Report on the web site and INTDS Database (AS)

The INTDS bibliography index is updated with the papers from the proceedings of the 2010 conference published as NIM A 655 volume.

WEB. There were plans to modify the web so that we will be able to have area with limited access (members area) including voting via web, but unfortunately I failed with this for various reasons. I hope it will come later, may be still before next Conference.

The work of our website and database administrator Anna is appreciated!

---

8. Miscellaneous (Awards, ...)

Awards

It was decided that the award will be given to Scott Aaron. The decision was taken by the board with 9 votes and the awardee will be announced during the 2012 conference.

Conference venue 2014

RIKEN in Japan volunteered to organize the INTDS conference in 2014.

In 2016 a place in North America would be appropriate (or Africa?).

---

9. Closing/summarizing

Dear Board Members,

Let me start with best wishes for 2012 to you and your family.

Summarizing our 2011 virtual Board meeting:

Invited: 11 members of the Board of Directors, practically participated: (John joined in the very last minute)

As for agenda:

1 & 2) All reports and minutes mentioned in the agenda point 1 and 2 were submitted and approved by Board members participating in our meeting.

3) Once more congratulation to Stefan for conference in Vancouver, especially at this mail for very nice financial outcome of the conference. It will for sure have significant impact on the Society's possibilities of supporting the participants of next INTDS meetings. Fortunately the proceedings from the conference are completed and are available on-line since November 2011 but still (unfortunately) we have to wait for the hard copies and it is not known when the delivery will happen.

4) The organization of coming INTDS conference at 2012 is developing very promising. Let's hope that waiting for the answer from ELSEVIER will end-up with positive answer.

Best regards.

The 2011 Virtual Board meeting is closed (but any comments to the above closing remarks are of course more than welcome).

Anna

For the protocol: Birgit Kindler, 9.1.2012

INTDS AWARDS OF 2012

At the recent 2012 INTDS World Conference in Mainz, Germany, the International Nuclear Target Development Society presented an Award of Recognition to W. Scott Aaron for his long-standing membership in the International Nuclear Target Development Society. Scott has previously served on the Board of Directors and hosted its 19^{th} World Conference of the INTDS in Oak Ridge in 1998. Scott holds the position of Isotope Development Group Leader since 2000. He joined ORNL in 1976 and his early work involved materials science of ceramic and cermet targets of enriched stable and radioactive isotopes and also ion beam sputtering of actinides, including work on thin deposits of $^{248}CmF_3$ on carbon backings. Later his activities expanded to include tritium process operations and responsibility for the Isotope Enrichment (Calutron) Facility.

Unfortunately, Scott was unable to make the trip to Mainz for the award presentation. However, his colleague, Brian Egle did attend and graciously accepted the award on Scott's behalf. Thank you Scott and Thank You Brian!

The Award presentation at the INTDS Conference Banquet at Kupferbergterrasse.
Anna Stolarz, Brian Egle (with Award) and John Greene pose for the camera.
(Photo courtesy of H. Hasebe)

INTDS Election Results

At the INTDS 2012 Pre-Conference Board Meeting the New Officers were chosen according the INTDS By-Laws, serving four year terms. They are:

President – John P. Greene (ANL, USA)
Vice President – Klaus Eberhardt (U. Mainz, Germany)
Treasurer/Corresponding Secretary (remains) David Gilliam (NIST, USA)
Recording Secretary (remains) Birgit Kindler (GSI, Germany)
Past-President - Anna Stolarz (U. Warsaw, Poland)
Webmaster (remains) Anna Stolarz (U. Warsaw, Poland)
Newsletter Editor (remains) John P. Greene (ANL, USA)

At the INTDS Membership Meeting during the Conference, on Thursday, 23rd of August, the 2012 INTDS Board of Directors election was conducted by the Election Committee consisting of Atsushi Yoshida, David Gilliam (Chair) and Ntombizonke Kheswa with the following election results (in alphabetic order):

- Eberhardt, Klaus (U. Mainz, Germany)
- Hasebe, Hiroo (RIKEN, Wako, Saitama, Japan)
- Kheswa, Ntombi (iThemba Labs, South Africa)
- Steski, Dannie (BNL, Upton, NY, USA)

OBITUARY

Albert Muggleton

From our colleague, Alistair Muirhead of ANU, we regret to inform the Society on the unfortunate passing of Albert Muggleton on December 26, 2011 (Boxing Day). For those of you who never met him, Albert was a Professor at the ANU with his background being in Nuclear Science. His work in the field of target development dates back to the first Conference, with the papers he presented on thin isotopic oxygen and carbon targets, show him to be one of the earliest and most active members. His fine review article, "Historical development and state of the art of the nuclear targetry in the United Kingdom and Australia", was presented at the 1992 Conference in Legnaro where he received the INTDS Award of Recognition. He was one of the first practitioners to fabricate accelerator targets using a modified fine beam saddle-field ion source, a technique later championed by Hans Maier in München. From the INTDS Bibliography, Albert Muggleton was also a frequent author in this newsletter where his contributions shall be missed.

John P. Greene
Editor

Targets on superhydrophobic surfaces for laser ablation ion sources

Dennis Renisch[1], T. Beyer[2,3], K. Blaum[2,3], M. Block[4], Ch. E. Düllmann[1,4,5], K. Eberhardt[1,5], M. Eibach[1,3], Sz. Nagy[2,4], W. Nörtershäuser[1,4] and C. Smorra[1,2,3]
[1]Institut für Kernchemie, Johannes Gutenberg-Universität, 55099 Mainz, Germany;
[2]Max-Planck-Institut für Kernphysik, 69117 Heidelberg, Germany;
[3]Fakultät für Physik und Astronomie, Ruprecht Karls-Universität, 69120 Heidelberg, Germany;
[4]GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt, Germany;
[5]Helmholtz-Institut Mainz, 55099 Mainz, Germany

Introduction: Laser ablation ion sources are a common technique for the production of ion beams. In Penning-trap mass spectrometers, such as TRIGA-TRAP [1], they are used for the production of carbon cluster reference ions [2-5], and to ionize stable nuclides for mass measurements. At TRIGA-TRAP also mass measurements on nuclides of actinide elements will be performed in the future. Considering the limited availability of these nuclides, an efficient target preparation technique is mandatory.

A new preparation technique, based on pretreating the backing material in a way that a superhydrophobic surface is formed, was investigated. Droplets of aqueous solutions retain their spherical shape on such surfaces, because wetting of the surface is energetically unfavourable. Evaporation of the drop yields a circular and more homogeneous spot of the precipitate, compared to a target prepared on an untreated backing [6].

Experimental: To produce superhydrophobic surfaces it is necessary to have a rough surface as well as a non-polar layer. Different metal foils (Zn, Ag, Ti) were used as backings. The first step in target preparation is etching the metal foils in an appropriate acid to increase the surface roughness. Ti foils were etched in 10% HF, Zn foils in 4 M HCl and Ag foils in 65% HNO_3. The etching time was varied to receive different surface roughnesses.

The next step is the formation of a self-assembled monolayer (SAM), which gives the backing a water-repellent property. Zn and Ag foils were immersed in a 1 mmol/L solution of HDFT[1] in CH_2Cl_2. Ti was treated in a 1 mmol/L solution of HDFP[2] in a 1:1-water-ethanol mixture. After 1 h the formation of the SAM was completed and the metal foils were dried afterwards with a heat lamp.

As a final preparative step a single 5 µL drop of a solution of the element of interest was placed on the surface and evaporated using a heat lamp. Gadolinium nitrate (natural isotopic composition) was chosen as target material for all test series. The concentration of the $Gd(NO_3)_3$ solution was 3.3 x 10^{-6} mol/mL (2 x 10^{15} Gd atoms/µL). Therefore, a total number of 10^{16} Gd atoms per target were deposited.

Instrumentation: Contact angle measurements of the backings were performed using an OCA15+ contact angle analyzer from Dataphysics. Surface roughnesses were determined by Atomic Force Microscopy (AFM) using a MFP-3D from Asylum Research. Radiographic imaging of the targets was performed with a FLA-7000 from Fujifim, using ^{153}Gd as radioactive tracer. A MALDI-TOF mass spectrometer (Bruker Reflex III) was modified and equipped with a laser system similar to that of the TRIGA-TRAP setup (λ = 532 nm; 5 ns pulse lenght;

[1] Heptadecafluoro-1-decanethiol
[2] 2-(Heptadecafluoro-decylsulfanyl)-ethylphosphonic acid

20 Hz repetition rate; 1.2 mJ per pulse laser power).

Results and discussion: Table 1 lists all investigated substrates with the measured contact angles θ and roughness R_{rms} as well as the achieved target area.

The influence of the surface roughness and the effect of the coating with an SAM is shown for three Ti substrates in figure 1. The untreated Ti foil (Ti-1) has hydrophilic properties with a contact angle of about 64°. Coating the Ti foil without etching it

Figure 1: AFM pictures with calculated rms-roughness (top) and contact angle measurements (bottom) of three Ti substrates, Ti-1 (left), Ti-5 (middle) and Ti-7 (right). For details on the targets see Table 1. Scan-size of the AFM pictures was 60 x 60 um2. The volume of the droplets for contact angle measurements was 7uL.

previously increased the contact angle only up to 76° (Ti-3, not shown), so the surface remained hydrophilic. With increasing surface roughness also the contact angle increased.

Table 1

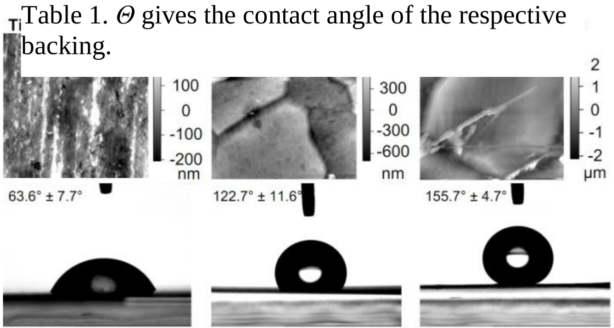
Overview of all investigated metal foils with etching time, contact angle Θ, and rms-roughness R_{rms}. Substrates coated with a self-assembled monolayer (SAM) are marked with "SAM" in the corresponding column. The target area and areal density of deposited $Gd(NO_3)_3$ targets are given as well. The best targets, which were used later in the ion source, are marked in bold face. The last column gives the average number of Gd^+ ions per laser pulse for targets used for laser ablation experiments. Uncertainties are evaluated by the standard deviation (1 σ confidence interval) of multiple measurements.

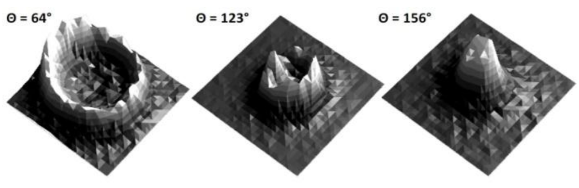
#	Etching time/s	Coating	R_{rms}/nm	Θ/°	Area/mm^2	µg(Gd)/cm^2	Avg. Gd^+/pulse
Ti-1	0	no	91 ± 2	64 ± 8	13.5	19.4	40
Ti-2	300	no	628 ± 82	44 ± 2	–	–[a]	–
Ti-3	0	SAM	91 ± 2	76 ± 9	6.3	41.3	–
Ti-4	30	SAM	93 ± 17	73 ± 6	4.2	62.2	–
Ti-5	60	SAM	189 ± 68	123 ± 12	3.9	66.4	–
Ti-6	120	SAM	236 ± 18	144 ± 8	2.3	112.6	–
Ti-7	**300**	**SAM**	**628 ± 82**	**156 ± 5**	**1.9**	**134.3**	**160**
Zn-1	0	no	67 ± 7	67 ± 4	7.4	35.4	10
Zn-2	20	no	393 ± 12	99 ± 5	8.3	31.4	–
Zn-3	0	SAM	67 ± 7	111 ± 11	6.2	41.9	–
Zn-4	**20**	**SAM**	**393 ± 12**	**138 ± 7**	**1.1**	**232.6**	**40**
Zn-5	40	SAM	430 ± 18	129 ± 8	2.6	99.4	–
Zn-6	60	SAM	348 ± 29	131 ± 6	2.6	99.4	–
Ag-1	0	no	39 ± 8	73 ± 2	7.3	35.8	80
Ag-2	60	no	637 ± 20	76 ± 4	9.8	26.7	–
Ag-3	0	SAM	39 ± 8	131 ± 13	6.1	42.7	–
Ag-4	**60**	**SAM**	**637 ± 20**	**155 ± 3**	**1.6**	**324.9**[b]	**180**

[a] Target area was not determined because of complete wetting of the substrate.
[b] 10 µL $Gd(NO_3)_3$ solution used.

For an etching time of 1 min a hydrophobic surface (Ti-5) and for an etching time of 5 min a superhydrophobic surface (Ti-7) with a contact angle of more than 150° was obtained.

Figure 2 : Radiographic imaging of $Gd(NO_3)_3$ targets prepared on different Ti backings, Ti-1 (left), Ti-5 (middle) and Ti-7 (right). ^{153}Gd was used as radioactive tracer. For details on the targets see Table 1. Θ gives the contact angle of the respective backing.





Radiographic imaging was use to evaluate the distribution of the target material. Figure 2 shows a comparison of three targets deposited on different Ti substrates (Ti-1, Ti-5, Ti-7). With increasing contact angle the distribution of target material changes from a ring-like shape to a centered spot.

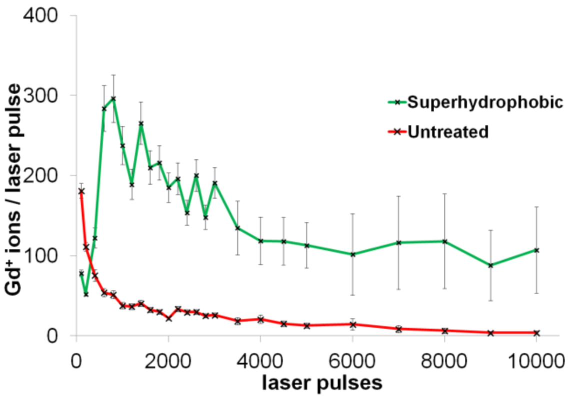


Figure 3: Absolute number of Gd^+ ions produced from $Gd(NO_3)_3$-targets on a superhydrophobic Ti surface (green) and on an untreated Ti backing (red).

Investigations of the ion yield of targets prepared on different backings in a laser ablation ion source showed a significant increase in the number of target ion produced per laser pulse. Figure 3 shows the amount of Gd^+ ions per laser pulse extracted from a superhydrophobic Ti surface and from an untreated Ti backing. The ion yield decreases in the case of the untreated backing within the first 2000 laser pulses to a relative low value of about 40 ions per pulse or even less. In comparison to that, the amount of Gd^+ ions coming from the superhydrophobic surface is about 4-5 times larger during the irradiation period.

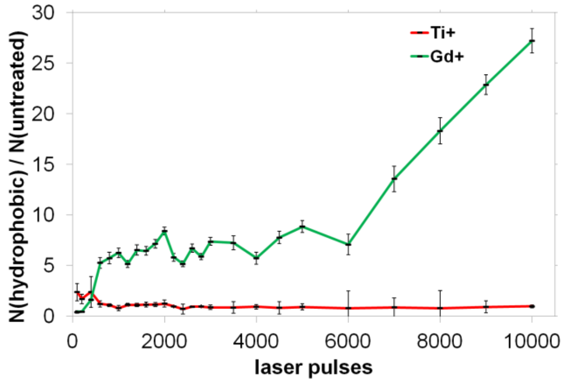


Figure 4: Ratio of ion yield per laser pulse between a Gd(NO3)3-target prepared on a superhydrophobic Ti surface (Ti-7) and a target prepared on an unmodified Ti surface (Ti-1). The green curve shows the ratio of Gd+ ions, the red curve shows the ratio of Gd^+ ions, the red curve shows the ratio of ionized backing material, Ti^+.

The ratio between the number of ions from the hydrophobic target and the reference target plottet against the number of laser pulses is shown in Figure 4. There you can see again, that the ratio for Gd^+ ions stays at a factor of 5 for a long time. After 6000 laser pulses the ratio constantly increases, caused by the continuous decrease of the ion yield of the reference target. Also the ratio of the ionized backing material Ti^+ is plottet. This stays for the whole measurement period at about a factor of 1, which means that the ionization yield of the backing material is independent from the pretreatment. This is not surprising but it is a good prove that the conditions, like laser power or pressure, where similar during all test series. The results for the other substrates are not discussed in this report. See [7] for more details.

References

[1] J. Ketelaer, et al., Nucl. Inst. Meth. A 594 (2008) 162
[2] C. Smorra, et al., Eur. J. Phys. B 42 (2009) 154028
[3] K. Blaum, et al., Eur. Phy. J. A 15 (2002) 245
[4] A. Chaudhuri, et al., Eur. Phy. J. D 45 (2007) 47
[5] V.-V. Elomaa, et al., Nucl. Inst. Meth. B 26 (2008) 4425
[6] I.A. Larmour, et al., Spec. Eur. 21 (2009) 6
[7] D. Renisch, et al., Nucl. Inst. Meth. A 676 (2012) 84

Acknowledgements

Financial support by the Max-Planck Society, by BMBF (06MZ91721), the Research Center "Elementary Forces and Mathematical Foundations" (EMG), and Stiftung Rheinland-Pfalz für Innovation (961-386261/854) is acknowledged. Sz. Nagy acknowledges financial support from the Alliance Program of the Helmholtz Association (HA216/EMMI).