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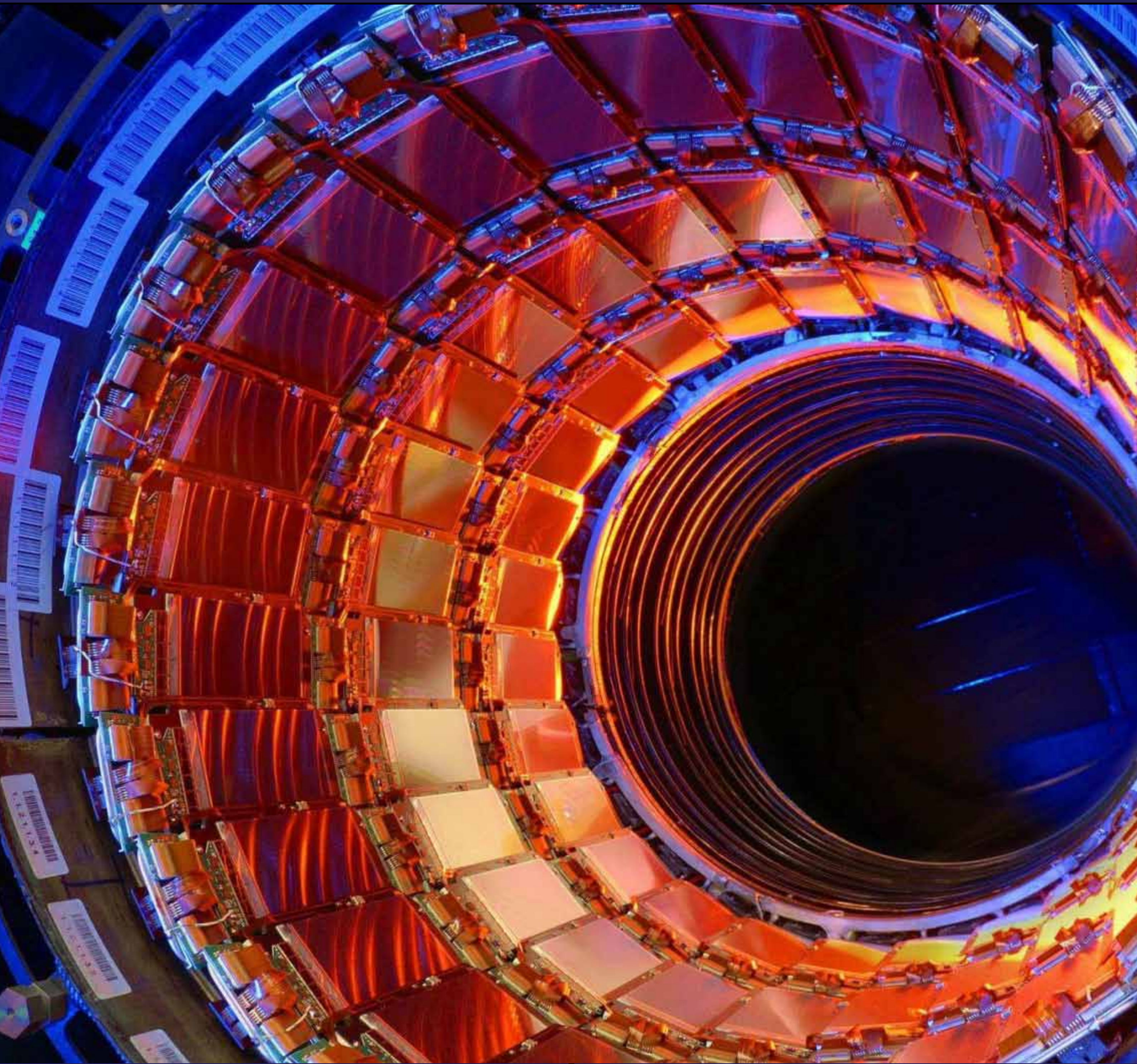
TANTALUM-NIOBIUM
INTERNATIONAL STUDY CENTER

ISSN 1019-2026

Bulletin No.188

JULY 2022



The Ekeberg Prize: a retrospective and the 2022 shortlist
(pages 8 - 15)

63rd General Assembly: Technical Programme Abstracts
(pages 25 - 28)

President’s Welcome

Dear members and friends of the T.I.C.,

As I write this letter, the staff is in the midst of finalizing plans for our 63rd General Assembly (GA63) to be held in Geneva on October 16th to 19th. I am very excited about GA63 as we expect great attendance given the evaporation of most quarantine and lockdown requirements globally. While China remains the most notable standout regarding quarantine requirements, I am hoping that China will relax these requirements, therefore allowing our Chinese members to attend in Geneva. The Russian occupation of the Ukraine also represents a travel issue for some of our Asian members, most notably the Japanese, as it is adding about 5 hours air travel time to avoid the affected airspace. We remain unified in our hopes that this situation will find a peaceful resolution in the near-term.

We have received excellent submissions for the Ekeberg prize which have gone to the panel of experts for review and selection of the winner. The quality of submissions is increasing every year as the Ekeberg prize becomes more recognizable in the metals-based community. Ian has been doing extensive outreach in this area, with the entries supporting the effort. The abstracts of the entries are printed in this Bulletin.

The technical program for GA63 is also coming along quite well. Without giving anything away, I will say that we have two excellent keynotes, one for Monday and one for Tuesday, which will be of broad interest to our members. We are in the final stages of locking in the technical program which is also outlined in this edition of the Bulletin.

Regarding the Global Witness report “The ITSCI Laundromat”, we can expect this to be topic of discussion at GA63. As you are aware, the T.I.C. published an abbreviated official response in the form of a press release. That said, we can all agree that doing business in central Africa is fraught with challenges and the T.I.C., along with other organizations, must look deeply into their performance to determine how we can do better, as we can always do better. We are determining how we can more fully address this issue at GA63, in order to obtain member input on a path forward for the T.I.C. on this and other issues.

In closing, I look forward to hearing from you as we continue to move through this year and closer to GA63. I am eager to discuss your thoughts on what is most important to you individually and how the Executive Committee can work to serve you better.

Sincere regards, stay safe and please get your vaccine boosters.

Daniel F. Persico, Ph.D., President

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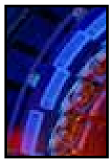


Featured articles:

Regular articles:

主席致辞

亲爱的T.I.C.会员和朋友们：

在我写这封信的时候，我的团队正在为本年10月16日至19日在日内瓦举行的第63届大会（GA63）作最后的准备。我对第63届大会感到非常兴奋，因为考虑到全球大多数国家对检疫和隔离要求的放宽，我们预计会有很多人出席。虽然中国仍然是在检疫要求方面最触目的国家，但我希望中国将放宽这些要求，从而使我们的中国会员能够参加这次日内瓦会议。俄罗斯占领乌克兰也对我们一些亚洲国家会员制造了旅游限制的问题，尤其是日本人，因为他们增加了约5个小时的飞航时间来避开受影响的领空。我们仍然团结一致，希望这种局势能在短期内找到一个和平解决的方案。

我们已经收到了申请埃克伯格奖的优秀作品，这些作品很快将被提交给专家小组进行审查并选出获奖者。随着埃克伯格奖在金属界的认可度越来越高，投稿的质量也在逐年提升。伊恩在这方面进行了广泛的宣传，参赛者也非常支持他。参赛作品的摘要将刊登在下一期的期刊中。

GA63的技术演讲筹划方面也进展得相当顺利。在不透露任何内容的情况下，我会说我们有两个出色的主题演讲，一个在周一，一个在周二，这将是我们的会员很感兴趣的话题。我们正处于锁定技术方案的最后阶段，这也将在即将出版的期刊中概述。

关于全球见证组织的报告 “ITSCI自助洗衣店”，我们可以预计这将成为GA63的讨论主题。如你所知，T.I.C.以新闻稿的形式发布了一个简短的官方回应。尽管如此，我们都同意，在中非开展业务充满了挑战，T.I.C.与其他组织必须深入研究他们的表现，以确定我们如何能够做得更好，而我们总是能够做得更好的。我们正在确定如何在GA63会议上更全面地解决这个问题，以便就T.I.C.在这一问题和其他问题上的前进道路征求会成员的意见。

最后，随着我们今年继续前进并接近 GA63，我期待收到您的来信。我渴望讨论你们的想法，知道什么对你们个人来说是最重要的，以及执行委员会如何能够更好地为你们服务。

真诚的问候，保持安全，并接种疫苗增强剂。

Lettre du Président

Chers membres et amis du T.I.C.,

Au moment où j'écris cette lettre, le personnel est en train de finaliser les plans de notre 63ème Assemblée Générale (GA63) qui se tiendra à Genève du 16 au 19 octobre. Je suis très enthousiaste à propos de la GA63 car nous attendons une grande participation étant donné la levée de la plupart des exigences de quarantaine et de confinement dans le monde. Si la Chine reste la principale exception en matière d'exigences de quarantaine, j'espère qu'elle assouplira ces exigences, ce qui permettra à nos membres chinois de venir à Genève. L'occupation russe de l'Ukraine représente également un problème de voyage pour certains de nos membres asiatiques, notamment les Japonais, car elle ajoute environ 5 heures de voyage en avion pour éviter l'espace aérien touché. Nous restons unis dans l'espoir que cette situation trouvera une solution pacifique à court terme.

Nous avons reçu d'excellentes candidatures pour le prix Ekeberg, qui ont été soumises au panel d'experts pour examen et sélection du lauréat. La qualité des candidatures augmente chaque année, car le prix Ekeberg est de plus en plus reconnu dans la communauté des métaux. Ian a mené des actions de sensibilisation dans ce domaine, et les candidatures soutiennent cet effort. Les résumés des candidatures sont imprimés dans ce Bulletin.

Le programme technique de la GA63 est également en bonne voie. Sans rien dévoiler, je dirai que nous avons deux excellentes présentations 'keynote', l'une pour lundi et l'autre pour mardi, qui seront d'un grand intérêt pour nos membres. Nous sommes en train de finaliser le programme technique qui est également présenté dans cette édition du Bulletin.

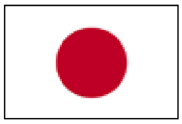
En ce qui concerne le rapport de Global Witness "The ITSCI Laundromat", nous pouvons nous attendre à ce qu'il soit un sujet de discussion à la GA63. Comme vous le savez, le T.I.C. a publié une réponse officielle abrégée sous la forme d'un communiqué de presse. Cela dit, nous sommes tous d'accord pour dire que faire des affaires en Afrique centrale est semé d'embûches et que le T.I.C., ainsi que d'autres organisations, doivent examiner en profondeur leurs performances pour déterminer comment nous pouvons faire mieux, car nous pouvons toujours faire mieux. Nous sommes en train de déterminer comment nous pouvons aborder cette question de manière plus approfondie lors de la GA63, afin d'obtenir la contribution des membres sur la voie à suivre pour le T.I.C. sur cette question et d'autres.

En conclusion, je me réjouis d'avoir de vos nouvelles alors que nous continuons à avancer dans l'année et que nous nous rapprochons de la GA63. Je suis impatient de discuter de vos idées sur ce qui est le plus important pour vous individuellement et sur la façon dont le Comité Exécutif peut travailler pour mieux vous servir.

Sincères salutations, prenez soin de vous et, s'il-vous-plaît, faites-vous vacciner.

Daniel F. Persico, Ph.D., Président

社長のあいさつ



親愛なるT.I.C.のメンバーおよび友人の皆様へ。

この手紙を書いている今、スタッフは10月16日から19日にかけてジュネーブで開催される第63回総会（GA63）の計画を詰めている最中です。世界的に検疫やロックダウンの必要性が薄れてきていることから、多くの参加者が見込まれるGA63に、私はとても期待しています。検疫については中国が突出していますが、中国が検疫要件を緩和し、中国のメンバーもジュネーブに参加できるようになることを期待しています。また、ロシアのウクライナ占領は、アジアの一部のメンバー、特に日本人にとって、影響を受けた空域を回避するために約5時間の飛行時間が必要となるため、旅行上の問題となっている。私たちは、この状況が近い将来、平和的に解決されることを願いつつ、結束を固めています。

エーケベルグ賞には素晴らしい作品の応募があり、間もなく専門家委員会の審査に入り、受賞者が決定される予定です。エーケベルグ賞が金属ベースのコミュニティでより認知されるようになるにつれ、応募作品の質は年々高まっています。イアンはこの分野で広範囲な働きかけを行っており、応募作品はその努力を支えています。応募作品のアブストラクトは次回の会報に掲載される予定です。

GA63の技術プログラムもかなり順調に進んでいます。何も語らずに申し上げると、月曜日と火曜日にそれぞれ1つずつ、会員の皆様に広く興味を持っていただけるような素晴らしい基調講演を用意しています。また、テクニカル・プログラムについても最終的な詰めの段階に入っており、近日発行の会報にその概要を掲載する予定です。

Global Witnessの報告書「The ITSCI Laundromat」については、GA63で議論されるものと思われます。ご存知のように、T.I.C.はプレスリリースという形で略式の公式回答を発表しています。とはいえ、中央アフリカでのビジネスには課題が多く、T.I.C.も他の組織とともに、どうすればもっとうまくやれるか、どうすれば常にもっとうまくやれるか、自分たちのパフォーマンスを深く見つめなければならないことは、誰もが認めるところでしょう。私たちは、この問題やその他の問題に関してT.I.C.が進むべき道についてメンバーの意見を得るため、GA63でこの問題をより完全に取り上げる方法を決定しているところです。

最後に、今年も引き続きGA63に向けて、皆様からのご意見をお待ちしております。皆さんにとって何が一番大切なのか、また執行委員会がどのように皆さんに貢献できるのか、皆さんのご意見を伺いたいと思います。

そして、ワクチン接種をお願いします。

Boas-vindas do Presidente

Caros membros e amigos do T.I.C.,

Enquanto escrevo esta carta, a equipe está finalizando os planos para nossa 63ª Assembleia Geral (GA63), a ser realizada em Genebra, de 16 a 19 de outubro. Estou bastante entusiasmado com a GA63, pois esperamos uma grande participação – dada a suspensão da maioria das exigências de quarentena e confinamento em todo o mundo. Embora a China continue tendo o maior destaque nas exigências de quarentena, eu espero que estas possam ser relaxadas, assim permitindo que nossos membros chineses compareçam em Genebra. A ocupação da Ucrânia pela Rússia também representa uma dificuldade de viagem para alguns de nossos membros asiáticos, mais notadamente os japoneses, já que são acrescentadas cerca de 5 horas à viagem de modo a se evitar o espaço aéreo afetado. Continuamos unidos em nossas esperanças de que se encontre, a curto prazo, uma solução pacífica para esta situação.

Recebemos excelentes trabalhos para o prêmio Ekeberg, que em breve seguirão para o painel de especialistas para revisão e escolha do vencedor. A qualidade dos trabalhos submetidos vem aumentando a cada ano, à medida que o prêmio Ekeberg tem sido mais reconhecido pela comunidade focada em metais. Ian tem feito uma ampla divulgação nesta área, com as inscrições respondendo a este esforço. Os resumos dos trabalhos inscritos serão impressos no próximo Boletim.

O programa técnico para a GA63 também segue muito bem. Sem revelar nada, posso adiantar que teremos dois excelentes temas, um para segunda e outro para terça-feira, que serão de amplo interesse de nossos membros. Estamos na fase final de fechamento do programa técnico, que também será delineado na próxima edição do Boletim.

Com relação ao relatório “The ITSCI Laundromat” (“A Lavanderia do ITSCI”, em tradução livre), da Global Witness, podemos esperar que ele seja tema de discussão na GA63. Como você deve saber, o T.I.C. publicou uma breve resposta oficial na forma de um comunicado à imprensa. Dito isto, podemos todos concordar que fazer negócios na África Central é algo repleto de desafios, e o T.I.C., juntamente com outras organizações, deve analisar profundamente seus resultados para determinar como podemos fazer melhor – pois sempre podemos fazer melhor. Estamos avaliando como podemos abordar esta questão na GA63 de forma mais completa, a fim de obter a contribuição dos membros sobre um caminho para o T.I.C. seguir, a respeito desta e de outras questões.

Para finalizar, gostaria de ouvir seus comentários à medida que avançamos neste ano e que nos aproximamos da GA63. Estou ansioso para discutir suas ideias sobre o que é mais importante para vocês, individualmente, e sobre como o Comitê Executivo poderia trabalhar para atendê-los melhor.

Cumprimentos sinceros, permaneçam seguros e tomem os reforços das vacinas.

Daniel F. Persico, Ph.D., President

Diary of industry events*

October 2022

EPMA World PM2022 Congress & Exhibition, October 9th to 13th 2022, Lyon, France - www.worldpm2022.com

T.I.C.'s 63rd General Assembly and 2022 AGM, October 16th to 19th 2022, Geneva, Switzerland, - www.tanb.org/view/63rd-general-assembly

RBA and RMI Conference 2022, October 17th to 20th 2022, Santa Clara, California and online - https://www.responsiblebusiness.org/training-events/ac2022/

LME Week, October 24th to 28th 2022, London, UK - https://www.lme.com/en/events/lme-week

CRU Ferroalloys 2022, October 30th to November 1st 2022, Scottsdale, AZ, USA - https://events.crugroup.com/ferroalloys/home

November 2022

Formnext 2022, November 15th to 18th 2022, Frankfurt Messe, Germany - https://formnext.mesago.com/frankfurt/en.html

45th Meeting of the Transport Safety Standards Committee (TRANSSC), November 28th to December 2nd 2022 Vienna, Austria - https://www.iaea.org/events/evt2102914

2023

Investing in African Mining Indaba, February 6th to 9th 2023, Cape Town, South Africa - https://miningindaba.com/Home

MMTA International Minor Metals Conference, April 24th to 26th 2023, Charlotte, North Carolina, USA - https://mmta.co.uk/event/mmta-internationa-minor-metals-conference-2023/

Rapid + TCT 2023, May 2nd to 4th 2023, McCormick Place, Chicago, USA - https://www.rapid3devent.com/

PowderMet 2023 June 18th to 21st 2023, Caesars Palace, Las Vegas, USA - https://www.mpif.org/Events/PowderMet2023/CallforPapersandPosters.aspx

* correct at time of print

Editor's Notes

Dear T.I.C. members and stakeholders,

I hope you have had time to enjoy the sunshine.

My colleagues and I are looking forward to welcoming you to the 63rd General Assembly, which this year is held in Geneva, Switzerland from October 16th to 19th 2022.

This will be the first T.I.C. meeting since 2019 that will not have any of the Covid restrictions (hopefully) and we have our fingers crossed that our Chinese colleagues can attend.

The planned trip this year after the conference will be to CERN (please book early to avoid disappointment).

You will know that CERN studies the fundamentals of the particles that formed the universe using detectors that are made of tonnes of niobium metal and smaller amounts of tantalum metal. It is also the birthplace of the World Wide Web in 1988 to 1990 by Sir Tim Berners-Lee. Need I say any more about how exciting this private tour given to T.I.C. will be?

With all Covid boosters up-to-date, have a safe journey to Geneva.

Warmest regards,

Ian Margerison

Executive Marketing Manager and Technical Officer.

Sign up to attend at -
www.tanb.org/view/63rd-general-assembly

The Bulletin is published by the Tantalum-Niobium International Study Center (T.I.C.);
ISSN 1019-2026. Editor: Ian Margerison; Production Director: Emma Wickens.
The T.I.C. can be contacted at info@tanb.org; www.tanb.org; +32 2 649 51 58, or at the registered address: Chaussée de Louvain 490, 1380 Lasne, Belgium.

The T.I.C. is an international, non-profit association founded in 1974 under Belgian law that represents around 90 members from over 30 countries involved with all aspects of the tantalum and niobium industry. The T.I.C. is managed by an Executive Committee elected from the membership and representing all segments of the industry. Corporate membership costs EUR 2750 per year and full details of benefits are available at www.TaNb.org

The Anders Gustaf Ekeberg Tantalum Prize: a retrospective

Recognising excellence in tantalum research and innovation

The Anders Gustaf Ekeberg Tantalum Prize (‘Ekeberg Prize’) is awarded annually by the T.I.C. for excellence in tantalum research and innovation and the new shortlist for the 2022 award shows that the level of interest in element #73 remains as high as ever*.

The Ekeberg Prize was established by the T.I.C. in 2017 to increase awareness of the many unique properties of tantalum products and the applications in which they excel. To date the Ekeberg Prize has been awarded for outstanding work on the subjects of tantalum capacitors (2018, Dr Yuri Freeman), additive manufacturing (2019, Nicolas Soro et al), recycling tantalum by solvent extraction (2020, Prof. Jason Love et al) and cutting of tantalum (2021, Dr Jason M. Davis et al).

Technology-driven innovations will ensure the long-term future of the tantalum market and with so many potential new or embryonic applications in development there is every reason for optimism.

* Although T.I.C. represents and supports both tantalum and niobium equally, the Ekeberg Prize focuses on tantalum, because CBMM’s Charles Hatchett Award (www.charles-hatchett.com) already superbly recognises niobium published research.

The judging panel for the Ekeberg Prize

The Ekeberg Prize is judged by an independent Panel of Experts who are selected from around the world to provide an impartial assessment on the technical merit of the shortlisted papers. Members of the current T.I.C. Executive Committee and staff cannot sit on the Panel. This year, we are honoured to have on the Panel the following experts:

Dr Axel Hoppe (Chair)

Commerce Resources / consultant, Canada / Germany

Dr Axel Hoppe holds a doctorate in chemistry and has worked in the tantalum industry for many years. He has published several papers on the subject and holds various tantalum patents. For over 30 years Dr Hoppe worked at H.C. Starck, then a subsidiary of Bayer (and now TANIOBIS). His last position at Starck was Head of Technical Services and Engineering Group. Dr Hoppe was a member of the T.I.C.’s Executive Committee from 1997 to 2007 and served two terms as President (2001-2 & 2006-7). Currently he is Chairman of the Board of Commerce Resources, a Canadian junior mining company, and works as a consultant for rare and refractory metals.

Professor Elizabeth Dickey

Carnegie Mellon University, United States of America

Dr Elizabeth Dickey is the Teddy & Wilton Hawkins Distinguished Professor and Department Head of Materials Science & Engineering at Carnegie Mellon University. Her research aims to develop processing-structure-property relationships for materials in which the macroscopic physical properties are governed by point defects, grain boundaries or internal interfaces. She is regarded as a leader in the application of electron microscopy and spectroscopy techniques to understand the role of material defects on electrical and chemical transport in dielectric materials. She has over 150 peer-reviewed journal publications in these areas. She is a fellow of the American Ceramic Society, the Microscopy Society of America, and the American Association for the Advancement of Science (AAAS).

Magnus Ericsson

Luleå University of Technology, Sweden

Magnus Ericsson is adjunct professor of Mineral Economics at Luleå University of Technology in the mining heart of Sweden. He is a founding partner in the independent advisors RMG Consulting. He has for decades been closely involved in developing a global mining database. He has established a reputation for developing among the best overviews of the world's mining industry. He has been involved in tantalum mining in Namibia and in an advisory capacity regarding social and community matters for a niobium project in Malawi. He is the deputy chair of the foundation establishing a museum at the site on Resarö outside Stockholm where tantalum was first isolated. He is a co-founder and Editor-in-Chief of the scientific journal Mineral Economics / Raw Materials Report, now in its 35th year.

Dr Nedal Nassar

U.S. Geological Survey (USGS), United States of America

Dr Nassar is the Chief of the Materials Flow Analysis Section at the National Minerals Information Center, USGS. Dr Nassar and his team quantify the global stocks and flows of non-fuel mineral commodities at each stage of their life cycle, analyse trends and examine concerns regarding foreign mineral dependencies, develop supply and demand scenarios, and assess the mineral commodity supply risk to the U.S. economy and national security. He is a member of the U.S. National Science and Technology Council (Executive Office of the President) Critical Minerals Subcommittee. He received his Ph.D. from Yale University where he worked on the development and application of a methodology for identifying critical minerals. In 2019 he was awarded the Presidential Early Career Award for Scientists and Engineers and he also holds an MBA from Cornell University and two master's degrees from Yale University. Previously, he worked as a consultant and as a process development engineer.

Professor Toru H. Okabe

The Institute of Industrial Science, The University of Tokyo.

Dr Okabe's doctorate examined the processing of reactive metals, such as titanium and niobium, and his subsequent career has included postdoctoral research with Professor Donald Sadoway at Massachusetts Institute of Technology (MIT), USA. Dr Okabe specialises in materials science, environmental science, resource circulation engineering and rare metal process engineering. In addition to the research on the innovative production technology, he has worked on new recycling and environmental technology of rare metals, such as niobium, tantalum, scandium, tungsten, rhenium, and precious metals. Dr Okabe is Director General of the Institute of Industrial Science at The University of Tokyo. In 2021 he received an honorary degree from the Norwegian University of Science and Technology for his groundbreaking work on "urban mining".

Tomáš Zedníček Ph.D.

President of the European Passive Components Institute (EPCI).

Dr Zedníček's doctorate examined tantalum capacitors and was awarded in 2000 from the Technical University of Brno in the Czech Republic. Prior to establishing EPCI in 2014, he worked for over 21 years at a major tantalum capacitor manufacturer, including 15 years as the worldwide technical marketing manager. He has authored over 60 technical papers and a US/international patent on tantalum and niobium capacitors. He regularly presented at the CARTS passive component conference and other leading events. Since 2017 he has organized the PCNS bi-annual passive components symposium hosted by a European University. Dr Zedníček is a regular contributor to the Bulletin.

How the winner of the Ekeberg Prize 2022 will be announced

The winning publication will be announced in September 2022. The lead author will be invited to give a paper at the 63rd General Assembly, to be held in Geneva, Switzerland, in October 2022. During the General Assembly there will be an award ceremony at which the lead author will be recognized by the tantalum industry and receive his/her Ekeberg Prize medal, made by the Kazakhstan Mint from pure tantalum metal (pictured on page 8). The T.I.C.'s General Assembly is open to both members and non-members; full details about the event, including speakers and how to book tickets are available at www.tanb.org/view/63rd-general-assembly.

Previous winners

Since the Ekeberg Prize was launched there have been four winning publications, examining cutting of tantalum, recycling tantalum by solvent extraction, additive manufacturing and tantalum capacitors.

In 2021 the Anders Gustaf Ekeberg Tantalum Prize ('Ekeberg Prize') was awarded to a US-Japanese team led by Dr Jason M. Davis of the Center for Materials Processing and Tribology at Purdue University, IN, USA, for its paper "Cutting of tantalum: Why it is so difficult and what can be done about it" published in the journal International Journal of Machine Tools and Manufacture and also available in Bulletin issue 187, October 2021.

In 2020 the Ekeberg Prize was awarded to a team from Edinburgh University, UK, lead by Prof. Jason Love, for "Tantalum recycling by solvent extraction: chloride is better than fluoride" published in Metals. The paper examined the difficulties of recycling tantalum and discussed their work showing how Ta(V) halides, such as $TaCl_5$ and TaF_5, can potentially be accessed from tantalum metal upon acid halide leaching, and can then be recovered by solvent extraction using a simple primary amide reagent. They concluded that extraction of the fluorides was poor (up to 45%), excellent extraction under chloride conditions is found (>99%) and presents an alternative route to Ta recycling.

In 2019 the winning publication was by a team from The University of Queensland, Australia, for "Evaluation of the mechanical compatibility of additively manufactured porous Ti–25Ta alloy for load-bearing implant applications". The authors were Nicolas Soro, Hooyar Attar, Martin Veidt and Matthew Dargusch from the University of Queensland, Australia, and Erin Brodie and Andrey Molotnikov from Monash University, Australia.

The paper examined how additive manufacturing using Ti–25Ta alloy has enabled the optimisation of the mechanical properties of metallic biomaterials. The mechanical properties were found to be suitable for bone replacement applications, showing significantly reduced elastic moduli and superior mechanical compatibility compared to the conventionally used biomedical Ti–6Al–4V alloy, making the Ti–25Ta alloy a promising candidate for a new generation of load-bearing implants.

In 2018, the inaugural Ekeberg Prize was won by Dr Yuri Freeman of KEMET Electronics, for his book "Tantalum and Niobium-Based Capacitors".

Dr Freeman has devoted most of his career to the development of Ta-based capacitors and made significant contributions, technological breakthroughs and performance improvements in these devices.

Dr Freeman is the Director of Advanced Research in the Tantalum (Ta) business unit and a member of the Advanced Technology Group at KEMET Electronics. He has published more than 30 papers and received 26 patents in the field of physics and technology of Ta and Nb-based capacitors.

The judges' decision to choose the book by Dr Yuri Freeman reflected the general lack of basic books about tantalum and tantalum capacitors in education, as well as it being "a very good scientific overview, providing basic insight into the manufacturing process of Ta-based electrolytic capacitors".

The Ekeberg Prize 2022: shortlisted abstracts

Recognising excellence in tantalum research and innovation

The Anders Gustaf Ekeberg Tantalum Prize ('Ekeberg Prize') is awarded annually by the T.I.C. for excellence in tantalum research and innovation. The winner will be announced in September and the lead author will receive the award during the T.I.C.'s 63rd General Assembly, scheduled to be held in Geneva, Switzerland, on October 16th to 19th 2022. Full details of the Ekeberg Prize winning publication and how to attend the 63rd General Assembly are published on www.tanb.org

The following publications are shortlisted for the Ekeberg Prize 2022:

Self-actuating isothermal nanomechanical test platform for tensile creep measurement of freestanding thin films

Authors: Longchang Ni and Maarten P. de Boer

Organisation: Department of Mechanical Engineering, Carnegie Mellon University, Pittsburgh, PA 15213 USA (e-mail: longchan@andrew.cmu.edu; mpdebo@andrew.cmu.edu).

Full article at: https://ieeexplore.ieee.org/abstract/document/9638438 for more information.

Abstract -

Microelectromechanical systems (MEMS) enable potent methods for nanomechanical testing. In many MEMS based test platforms, high force polycrystalline silicon chevron-type thermal actuators are used as on chip actuators. Here, we implement thermal actuators using the refractory metal tantalum (Ta) as a new micromachined structural material in such a way that it can be integrated to test mechanical properties of a wide variety of metals. Because Ta's coefficient of thermal expansion is more than double that of silicon, actuation is accomplished simply by raising the temperature. An isothermal condition is attained, while no force is lost to a heat sink. The platform is batch fabricated by conventional surface micromachining processes and is especially well suited to measure creep of thin films because the load spring is soft compared to the specimen uniaxially loaded in tension. This in turn gives rise to a slow stress relaxation and a large displacement range. Specimen alignment is excellent and handling procedures for thin films are simple and robust. As a validation of the apparatus, uniaxial Au tensile specimens of 110 nm thickness are fabricated and tested. Young's modulus is measured and compares well with literature values, while creep rate is lower than other reported values for nanocrystalline Au, indicating that steady state creep is approached. This work demonstrates a powerful drift-free nanomechanical test platform for mechanical property measurement of freestanding thin films subjected to uniaxial tension. [2021-0171]

The 2022 Anders Gustaf Ekeberg Tantalum Prize will be awarded at the 63rd General Assembly to be held October 16th to 19th 2022, Geneva, Switzerland.

Demonstration of tantalum as a structural material for MEMS thermal actuators

Authors: Longchang Ni[1], Ryan M. Pocratsky[1,2], and Maarten P. de Boer[1]

Organisations: [1]CMU Mechanical Engineering Dept., 5000 Forbes Ave., Pittsburgh, PA 15213, USA. [2]Present address: Fischione Instruments, 9003 Corporate Cir, Export, PA 15632, USA. Correspondence: Maarten P. de Boer (mpdebo@andrew.cmu.edu)

Full article at: https://www.nature.com/articles/s41378-020-00232-z for more information.

Abstract -

This work demonstrates the processing, modeling, and characterization of nanocrystalline refractory metal tantalum (Ta) as a new structural material for microelectromechanical system (MEMS) thermal actuators (TAs). Nanocrystalline Ta films have a coefficient of thermal expansion (CTE) and Young's modulus comparable to bulk Ta but an approximately ten times greater yield strength. The mechanical properties and grain size remain stable after annealing at temperatures as high as 1000 °C. Ta has a high melting temperature (Tm = 3017 °C) and a low resistivity (ρ = 20 μΩ cm). Compared to TAs made from the dominant MEMS material, polycrystalline silicon (polysilicon, Tm = 1414 °C, ρ = 2000 μΩ cm), Ta TAs theoretically require less than half the power input for the same force and displacement, and their temperature change is half that of polysilicon. Ta TAs operate at a voltage 16 times lower than that of other TAs, making them compatible with complementary metal oxide semiconductors (CMOS). We select α-phase Ta and etch 2.5-μm-thick sputterdeposited films with a 1 μm width while maintaining a vertical sidewall profile to ensure in-plane movement of TA legs. This is 25 times thicker than the thickest reactive-ion-etched α-Ta reported in the technical literature. Residual stress sensitivities to sputter parameters and to hydrogen incorporation are investigated and controlled. Subsequently, a V-shaped TA is fabricated and tested in air. Both conventional actuation by Joule heating and passive self-actuation are as predicted by models.

Characterization of pure tantalum manufactured using laser powder bed fusion (L-PBF)

Authors: Faith Oehlerking*, Michael Stawovy**, Scott Ohm**

Organisations: *Beehive 3D, Deerfield Beach, FL, USA **H.C. Starck Solutions, Coldwater, MI, USA

Full article at: Presented at the 20th Plansee Seminar, 30th May to 3rd June 2022 - https://www.plansee-seminar.com/ for more information.

Abstract -

Tantalum and its alloys are one of the refractory material groups of interest for additive manufacturing (AM), as they meet the property requirements for specific applications in aerospace and medical industries. The present research and development work aims to characterize the microstructure, mechanical and thermal properties of AM tantalum using Laser Powder Bed Fusion technology (L-PBF). Primary parameter optimization of the laser power, point distance, exposure time, and hatch distance were tested using a design of experiments to optimize the relative density of the specimens for the L-PBF metal AM technology. A final parameter set was selected and produced solid samples with >99.9% density. Using this parameter set, samples were printed and tested for room temperature tensile, hardness, thermal conductivity, coefficient of thermal expansion, and electron backscatter diffraction (EBSD) analysis and compared to traditionally manufactured wrought materials.

Tantalum, easy as Pi: understanding differences in metal–imido bonding towards improving Ta/Nb separations

Authors: Alexander B. Weberg, [‡a] Subhajyoti Chaudhuri, [‡b] Thibault Cheisson, [§a] Christian Uruburo, [a] Ekaterina Lapsheva,[a] Pragati Pandey, [a] Michael R. Gau, [a] Patrick J. Carroll, [a] George C. Schatz [*b] and Eric J. Schelter [*a]

Organisations: [a]P. Roy and Diana T. Vagelos Laboratories, Department of Chemistry, University of Pennsylvania, 231 S. 34th St., Philadelphia, PA, 19104, USA. E-mail: schelter@sas.upenn.edu
[b]Department of Chemistry, Northwestern University, 2145 Sheridan Rd., Evanston, IL, 60208, USA. E-mail: g-schatz@northwestern.edu

‡ These authors contributed equally to this work (ABW experimental, SC theoretical).
§ Current address: Eramet Ideas, 1 Albert Einstein Ave, 78190 Trappes, France.

Full article at: https://pubs.rsc.org/en/content/articlelanding/2022/SC/D2SC01926D for more information.

Abstract -

The separation and purification of niobium and tantalum, which co-occur in natural sources, is difficult due to their similar physical and chemical properties. The current industrial method for separating Ta/Nb mixtures uses an energy-intensive process with caustic and toxic conditions. It is of interest to develop alternative, fundamental methodologies for the purification of these technologically important metals that improve upon their environmental impact. Herein, we introduce new Ta/Nb imido compounds: M(^{t}BuN)(TriNOx) (**1-M**) bound by the $TriNOx^{3-}$ ligand and demonstrate a fundamental, proof-of-concept Ta/Nb separation based on differences in the imido reactivities. Despite the nearly identical structures of **1-M**, density functional theory (DFT)-computed electronic structures of **1-M** indicate enhanced basic character of the imido group in **1-Ta** as compared to **1-Nb**. Accordingly, the rate of CO_2 insertion into the $M{=}N_{imido}$ bond of **1-Ta** to form a carbamate complex (**2-Ta**) was selective compared to the analogous, unobserved reaction with **1-Nb**. Differences in solubility between the imido and carbamate complexes allowed for separation of the carbamate complex, and led to an efficient Ta/Nb separation ($S_{Ta/Nb}$ = 404 ± 150) dependent on the kinetic differences in nucleophilicities between the imido moieties in **1-Ta** and **1-Nb**.

The TARANTULA project has received funding from the European Union's EU Framework Programme for Research and Innovation Horizon 2020 under Grant Agreement No 821159.

Extraction of polyoxotantalate by Mg–Fe layered double hydroxides: elucidation of sorption mechanisms

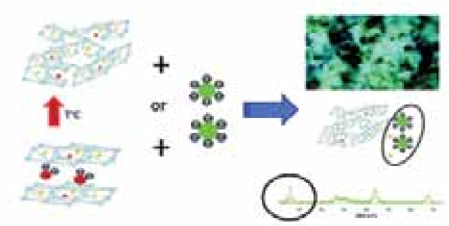
Authors: Rana Choumane,[a] Victor Carpentier [b] and Grégory Lefèvre [*a]

Organisations: [a]PSL University, Chimie ParisTech_CNRS, Institut de Recherche de Chimie Paris, Paris, 75005, France. E-mail: gregory.lefevre@chimieparistech.psl.eu
[b]TND, ZAC du Val de la Deûle, rue de la filature, 59890 Quesnoy sur Deûle, France

Full article at: https://pubs.rsc.org/en/Content/ArticleLanding/2021/RA/D1RA07383D for more information.

Abstract -

The extraction of Ta(V) as polyoxometallate species ($H_xTa_6O_{19}{}^{(8-x)-}$) using Mg–Fe based Layered Double Hydroxide (LDH) was evaluated using pristine material or after different pre-treatments. Thus, the uptake increased from 100 ± 5 mg g^{-1} to 604 ± 30 mg g^{-1}, for respectively the carbonated LDH and after calcination at 400 °C. The uptake with calcined solid after its reconstruction with Cl^- or NO_3^- anions has also been studied. However, the expected exchange mechanism was not found by X-ray Diffraction analysis. On the contrary, an adsorption mechanism of Ta(V) on LDH was consistent with measurements of zeta potential, characterized by very negative values for a wide pH range. Moreover, another mechanism was identified as the main contributor to the uptake by calcinated LDH, even after its reconstruction with Cl^- or NO_3^-: the precipitation of Ta(V) with magnesium cations released from MgO formed by calcination of the LDH. This latter reaction has been confirmed by the comparison of the uptake of Ta(V) in dedicated experiments with solids characterized by a higher magnesium solubility (MgO and $MgCl_2$). The obtained precipitate has been analyzed by X-ray diffraction (XRD) and would correspond to a magnesium (polyoxo)tantalate phase not yet referenced in the powder diffraction databases.



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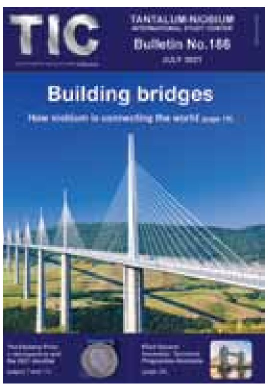
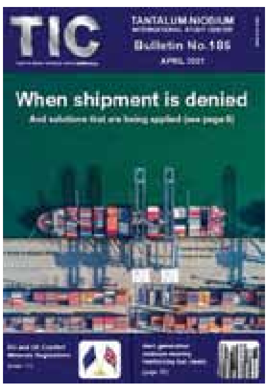
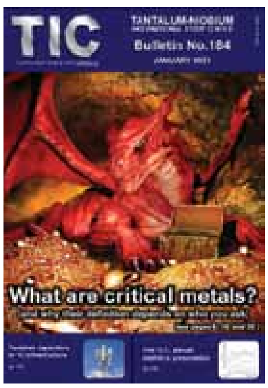
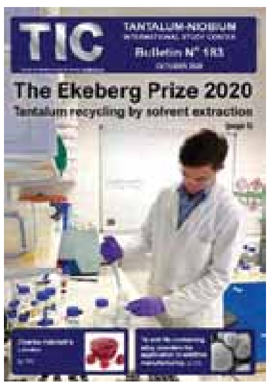
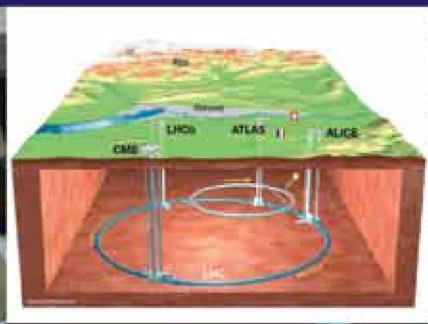


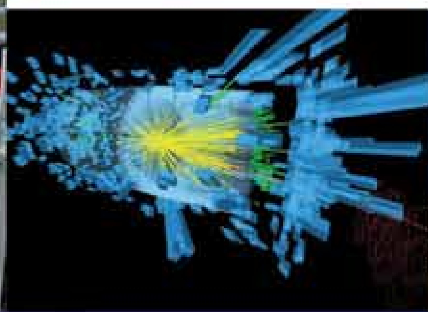


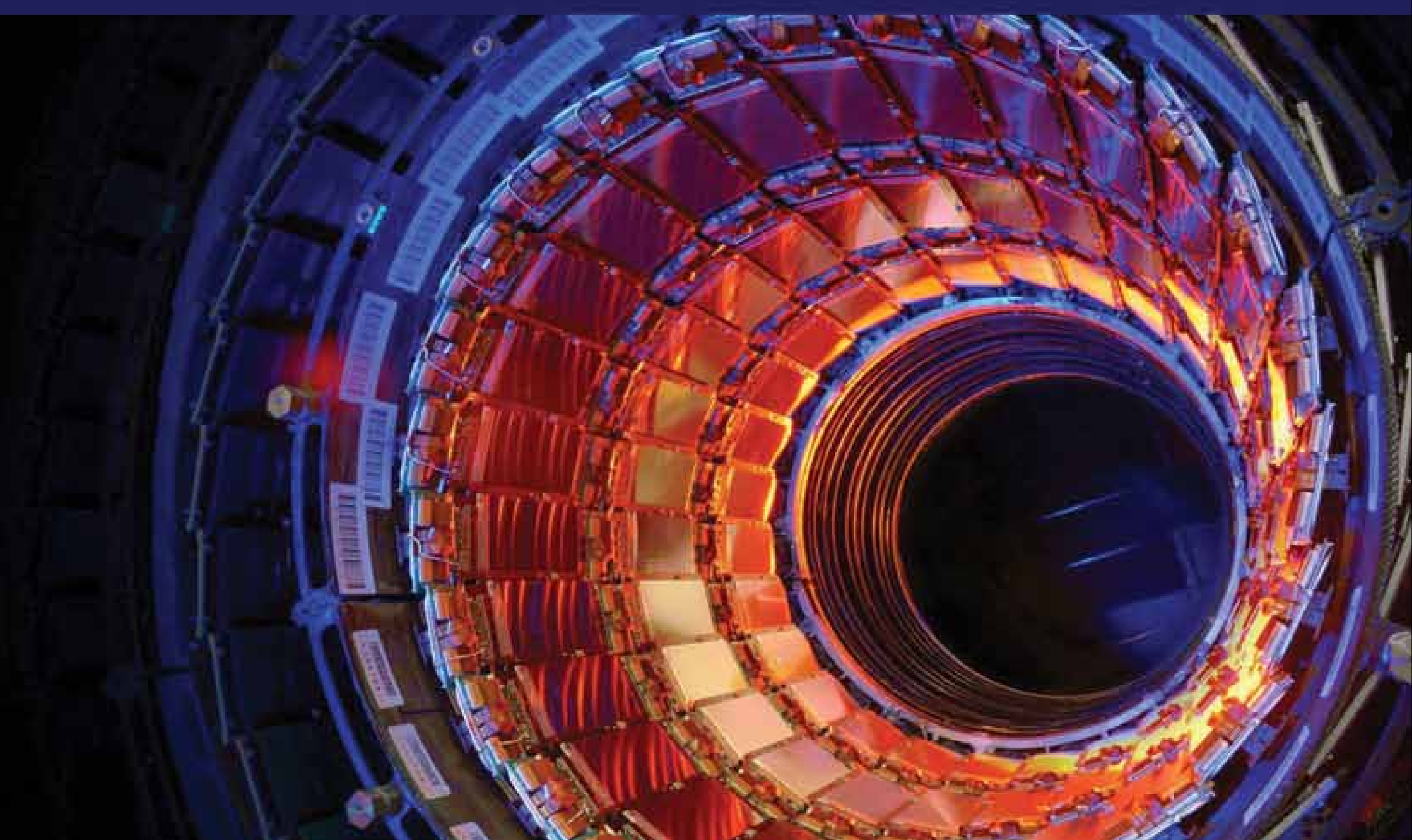




HISTORY OF CERN







THE HISTORY OF CERN

What is CERN's mission?

At CERN, our work helps to uncover what the universe is made of and how it works. We do this by providing a unique range of particle accelerator facilities to researchers, to advance the boundaries of human knowledge.

The Laboratory, established in 1954, has become a prime example of international collaboration.

Our mission is to:

- provide a unique range of particle accelerator facilities that enable research at the forefront of human knowledge.
- perform world-class research in fundamental physics.
- unite people from all over the world to push the frontiers of science and technology, for the benefit of all.

CERN's origins can be traced to the 1940s

A small number of visionary scientists in Europe and North America identified the need for Europe to have a world-class physics research facility. Their vision was both to stop the brain drain to America that had begun during the Second World War, and to provide a force for unity in post-war Europe.

Today, CERN unites scientists from around the world in the pursuit of knowledge

What's in a name?

At an intergovernmental meeting of **UNESCO in Paris in December 1951**, the first resolution concerning the establishment of a European Council for Nuclear Research (in French *Conseil Européen pour la Recherche Nucléaire*) was adopted.

Two months later, an agreement was signed establishing the provisional Council – t**he acronym CERN was born.**

This agreement gave the Council 18 months to produce the formal CERN Convention.

Today, our understanding of matter goes much deeper than the nucleus, and CERN's main area of research is particle physics. Because of this, **the laboratory operated by CERN is often referred to as the European Laboratory for Particle Physics.**


La sixième session du Conseil fut organisée à Paris du 29 juin au 1er juillet 1953. C'est à cette occasion que la Convention établissant l'Organisation fut signée, sous réserve de ratification, par douze Etats membres.

The Sixth Session of the CERN Council took place in Paris on 29 June—1 July 1953. It was here that the Convention establishing the Organization was signed, subject to ratification, by twelve States.

The sixth session of the CERN Council took place in Paris, June 29th - July 1st 1953. It was here that the Convention establishing the Organization was signed, subject to ratification, by 12 States. (Image: CERN)

And so it begins

On June 10th 1955, CERN Director-General, Felix Bloch, laid the foundation stone on the Laboratory site, watched by Max Petitpierre, the President of the Swiss Confederation. (Image: CERN)

In June 1953, the final draft of the CERN Convention was agreed upon and signed by 12 new Member States. It laid out the ways Member States would contribute to CERN's budget, as well as early indications of CERN's ethos and organisation -- from adopting a policy of open access, to CERN's internal structure being divided into Directorates (today, CERN's size means that these Directorates are sub-divided into departments and then, in turn, groups and sections).

Signing the convention led to a huge swell in momentum, and very quickly staff were hired, architects were brought in and plans were drawn up.

In July 1955, Felix Bloch, CERN's Director-General, laid the first foundation stone.

Since then, CERN has more than fulfilled the early plans of those few optimistic scientists who dreamt of creating an international laboratory to make great strides in fundamental research and stretch the limits of our technology and imaginations.

Credit - https://home.cern/about/who-we-are/our-history

The Standard Model

The Standard Model explains how the basic building blocks of matter interact, governed by four fundamental forces.

The theories and discoveries of thousands of physicists since the 1930s have resulted in a remarkable insight into the fundamental structure of matter: everything in the universe is found to be made from a few basic building blocks called fundamental particles, governed by four fundamental forces. Our best understanding of how these particles and three of the forces are related to each other is encapsulated in the Standard Model of particle physics. Developed in the early 1970s, it has successfully explained almost all experimental results and precisely predicted a wide variety of phenomena. Over time and through many experiments, the Standard Model has become established as a well-tested physics theory.

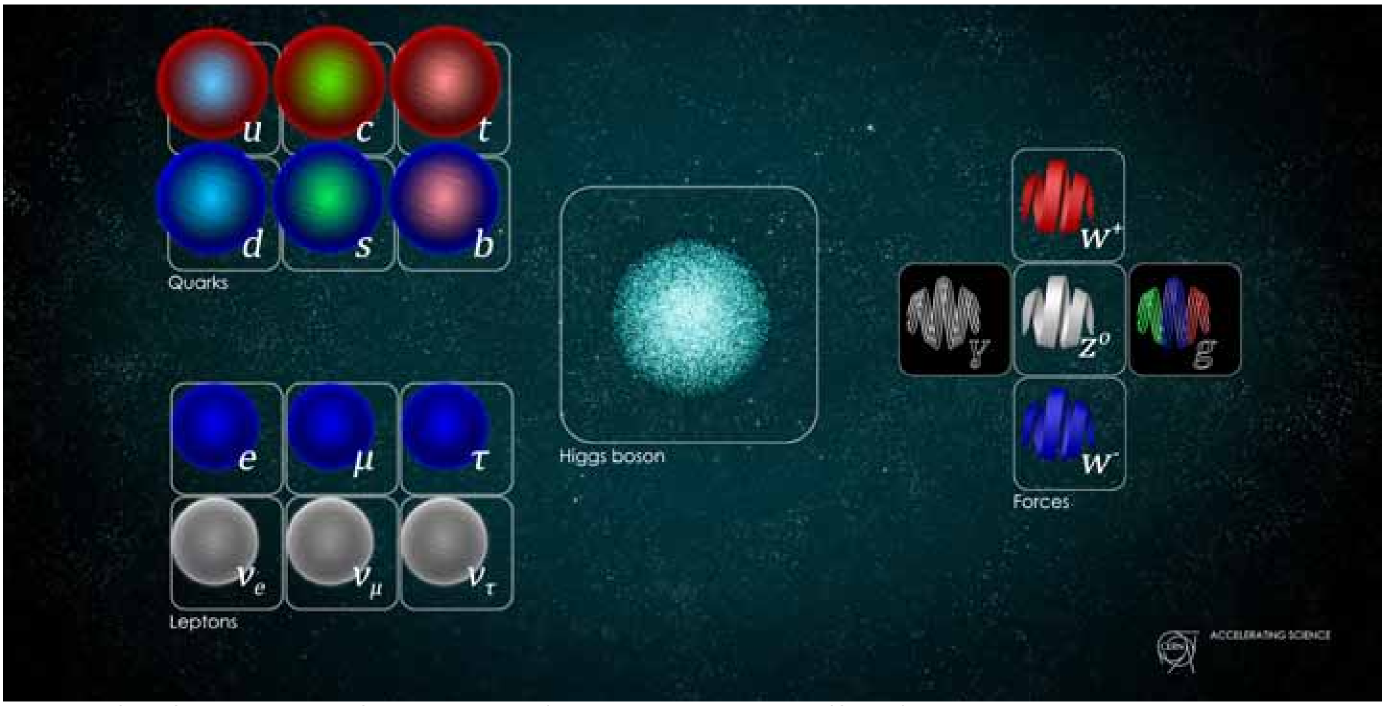
Matter particles

All matter around us is made of elementary particles, the building blocks of matter. These particles occur in two basic types called quarks and leptons. Each group consists of six particles, which are related in pairs, or "generations". The lightest and most stable particles make up the first generation, whereas the heavier and less-stable particles belong to the second and third generations. All stable matter in the universe is made from particles that belong to the first generation; any heavier particles quickly decay to more stable ones. The six quarks are paired in three generations – the "up quark" and the "down quark" form the first generation, followed by the “charm quark” and “strange quark”, then the “top quark” and “bottom (or beauty) quark”. Quarks also come in three different “colours” and only mix in such ways as to form colourless objects. The six leptons are similarly arranged in three generations – the “electron” and the “electron neutrino”, the “muon” and the “muon neutrino”, and the “tau” and the “tau neutrino”. The electron, the muon and the tau all have an electric charge and a sizeable mass, whereas the neutrinos are electrically neutral and have very little mass.

Forces and carrier particles

There are four fundamental forces at work in the universe: the strong force, the weak force, the electromagnetic force, and the gravitational force. They work over different ranges and have different strengths. Gravity is the weakest but it has an infinite range. The electromagnetic force also has infinite range but it is many times stronger than gravity. The weak and strong forces are effective only over a very short range and dominate only at the level of subatomic particles. Despite its name, the weak force is much stronger than gravity but it is indeed the weakest of the other three. The strong force, as the name suggests, is the strongest of all four fundamental interactions.

Three of the fundamental forces result from the exchange of force-carrier particles, which belong to a broader group called “bosons”. Particles of matter transfer discrete amounts of energy by exchanging bosons with each other. Each fundamental force has its own corresponding boson – the strong force is carried by the “gluon”, the electromagnetic force is carried by the “photon”, and the “W and Z bosons” are responsible for the weak force. Although not yet found, the “graviton” should be the corresponding force-carrying particle of gravity. The Standard Model includes the electromagnetic, strong and weak forces and all their carrier particles, and explains well how these forces act on all of the matter particles. However, the most familiar force in our everyday lives, gravity, is not part of the Standard Model, as fitting gravity comfortably into this framework has proved to be a difficult challenge. The quantum theory used to describe the micro world, and the general theory of relativity used to describe the macro world, are difficult to fit into a single framework. No one has managed to make the two mathematically compatible in the context of the Standard Model. But luckily for particle physics, when it comes to the minuscule scale of particles, the effect of gravity is so weak as to be negligible. Only when matter is in bulk, at the scale of the human body or of the planets for example, does the effect of gravity dominate. So the Standard Model still works well despite its reluctant exclusion of one of the fundamental forces.



Particles of the Standard Model of particle physics (Image: Daniel Dominguez/CERN)

So far so good, but...

...it is not time for physicists to call it a day just yet. Even though the Standard Model is currently the best description there is of the subatomic world, it does not explain the complete picture. The theory incorporates only three out of the four fundamental forces, omitting gravity. There are also important questions that it does not answer, such as “What is dark matter?”, or “What happened to the antimatter after the big bang?”, “Why are there three generations of quarks and leptons with such a different mass scale?” and more. Last but not least is a particle called the Higgs boson, an essential component of the Standard Model.

On July 4th 2012, the ATLAS and CMS experiments at CERN’s Large Hadron Collider (LHC) announced they had each observed a new particle in the mass region around 126 GeV. This particle is consistent with the Higgs boson but it will take further work to determine whether or not it is the Higgs boson predicted by the Standard Model. The Higgs boson, as proposed within the Standard Model, is the simplest manifestation of the Brout-Englert-Higgs mechanism. Other types of Higgs bosons are predicted by other theories that go beyond the Standard Model.

On October 8th 2013 the Nobel prize in physics was awarded jointly to François Englert and Peter Higgs “for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN’s Large Hadron Collider”.

So although the Standard Model accurately describes the phenomena within its domain, it is still incomplete. Perhaps it is only a part of a bigger picture that includes new physics hidden deep in the subatomic world or in the dark recesses of the universe. New information from experiments at the LHC will help us to find more of these missing pieces.

Credit - https://home.cern/science/physics/standard-model

Detectors for a new era of ATLAS physics

New Small Wheel system joins the ATLAS experiment

November 4th 2021, Geneva. The ATLAS Experiment at CERN welcomes a brand-new detector: the Muon New Small Wheel system. Its successful installation follows nearly a decade of design and construction, and marks a major milestone in ATLAS’ high-luminosity era.

The High-Luminosity upgrade of the Large Hadron Collider (HL-LHC) will dramatically increase the rate of collisions in the ATLAS experiment. While an opportunity for physicists to explore some of the rarest processes in the Universe, the large collision rate brings new challenges – in particular, higher radiation levels and significantly more data. The ATLAS Collaboration is adapting its experiment to deal with these challenges, upgrading all parts of its detectors with new, state-of-the-art instruments.

“The Muon New Small Wheels (NSW) are the first new detectors in ATLAS specifically designed to handle high luminosity conditions,” says Andreas Hoecker, ATLAS Spokesperson. “Today’s installation of the second – and final – NSW follows nearly a decade of dedicated efforts from ATLAS members, who designed, constructed and assembled this high-tech muon detector from scratch. These new detectors will significantly expand our experiment’s capabilities, readying us for the exciting high luminosities to come.”

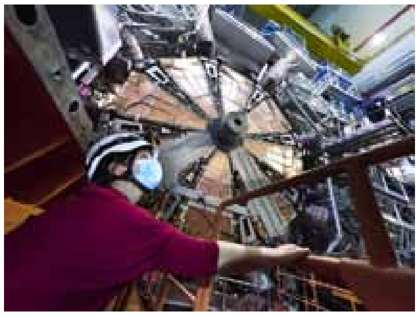
Cutting-edge technology

The ATLAS NSW system is made up of two wheel-shaped detectors, sitting on opposite ends of the experimental cavern. Named in comparison to ATLAS' 25-metre "big wheel" detectors, each NSW weighs more than 100 tonnes and is nearly 10 metres in diameter.

More important than size is function. The New Small Wheel detectors are at the forefront of detector design, using two innovative gaseous detector technologies: micromegas (MM) and small-strip thin-gap chambers (sTGC). These provide both fast and precise muon-tracking capabilities. "This combination of technologies will allow us to study particles at the high rates expected from the HL-LHC, while also improving our spatial resolution," says Mario Antonelli, NSW Phase-I Upgrade Project Leader. "This will be especially critical for the ATLAS "trigger", the system that decides which collision events to keep and which to discard. The trigger will rely on the NSW's excellent resolution to confirm whether a particle originated from the interaction point, thus reducing our chances of saving data from unwanted background events."

The readout capabilities of the overall system are staggering: two million MM readout channels and 350,000 sTGC electronic readout channels. Each wheel has 16 sectors, each containing two layers of MM and sTGC chambers with four measurement planes apiece, providing physicists with useful redundancy as they trace a muon's track through the detectors.

Assembly of the NSW chambers at CERN. (Image: CERN)



NSW "A" positioned in place inside the ATLAS experiment. (Image: CERN)

The dance of detectors

While 2021 has seen the NSW detectors journey underground, this was not their first time on the move! "The NSW effort was multinational, with members from across the global ATLAS Collaboration contributing to design and construction," says Philipp Fleischmann, ATLAS Muon System Project Leader. "In particular, the chambers were built at institutes in nine countries: Canada, Chile, China, France, Germany, Greece, Israel, Italy and Russia. The chambers were then shipped to CERN, where they underwent careful checks before being assembled into wedges and mounted on the wheels." In total, the team placed 128 MM and 192 sTGC chambers onto the wheels.

The first fully-assembled wheel was NSW "A", completed in May 2021. While work on the second wheel continued at pace, teams immediately kicked off plans to take the detector underground. They were operating under a tight schedule, with the ATLAS and LHC timetable dependent on the successful installation of the new wheels.

Waiting in the wings were the original Small Wheels, which first had to be removed from the ATLAS site to make way for their replacement. Following a decade of excellent service to the experiment, the original wheels were officially retired on July 2nd and October 12th, and moved to Building 191 on the CERN site.

NSW “C” enters the ATLAS surface hall, located just above the experiment, on October 14th 2021. (Image: CERN)

On July 6th, the NSW “A” was driven from Building 191 to the ATLAS surface hall – a careful journey of 2 kilometres that lasted several hours. On July 12th, the wheel was lowered into the ATLAS cavern, and moved into its final position between the calorimeter endcap cryostat and the endcap toroid magnets. A few months later, this momentous occasion was repeated for NSW “C”. With construction finalised in September, the wheel was transported to the ATLAS site on October 14th. It sat ready on the surface for two weeks, while the LHC carried out a pilot beam run, before being lowered into the cavern today.

“When we set out to complete the NSW detectors in time for Run 3 of the LHC (starting next year), we knew it would be a tough assignment,” says Ludovico Pontecorvo, ATLAS Technical Coordinator. “That the team managed to keep the project on track – despite a global pandemic and the tragic loss of their project leader, Stephanie Zimmermann – is a testament to their incredible talent and dedication.”

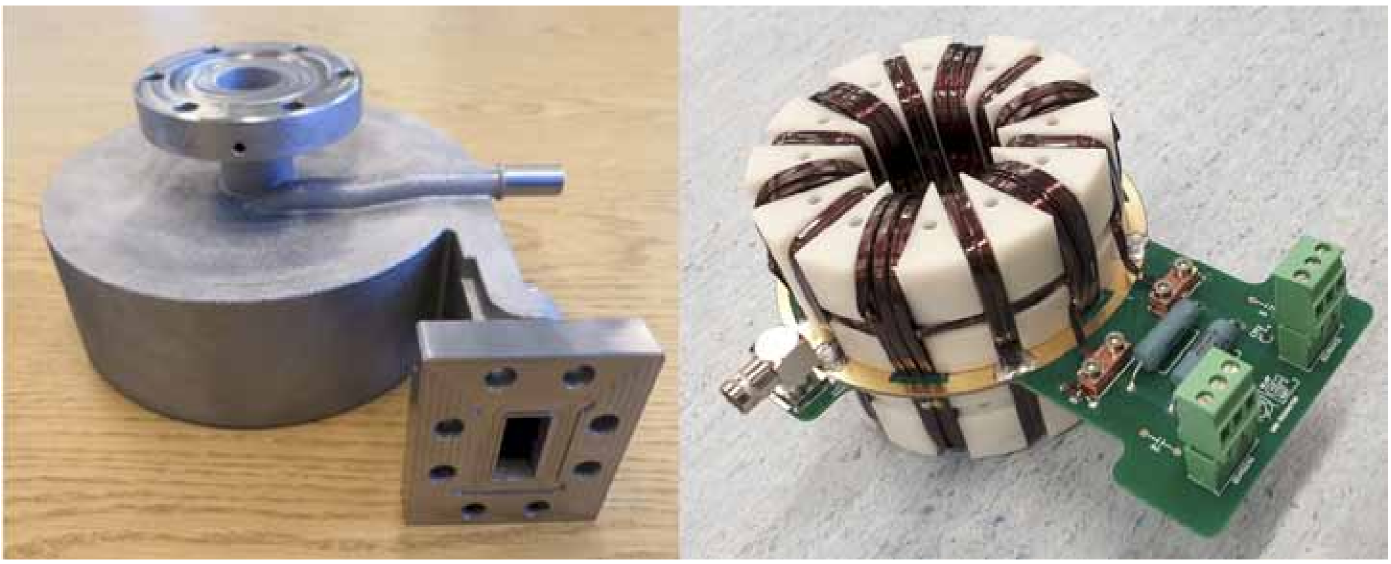
New wheels in motion

The NSW detectors will be instrumental in Run 3 data-taking, as a moderate increase in luminosity is already planned for the LHC. While waiting to see the wheels in action, the ATLAS Collaboration turns their focus to the next major upgrades of the experiment. “The next long shutdown of the LHC (LS3, scheduled for 2025) will be the last before the HL-LHC begins operation,” says Francesco Lanni, ATLAS Upgrade Coordinator. “We have a lot to accomplish in the intervening years, including the construction and assembly of an entire new inner tracking system. But with each new upgrade, we get one step closer to the next chapter of LHC physics and the exciting discoveries that may lay within.”

Credit & Author - November 4th 2021 | By Katarina Anthony - https://atlas.cern/updates/news/NSW-complete

Additive manufacturing opens up new prospects at CERN

Lightweight, robust, complex parts produced using additive manufacturing (3D printing) are proving their worth in the accelerators



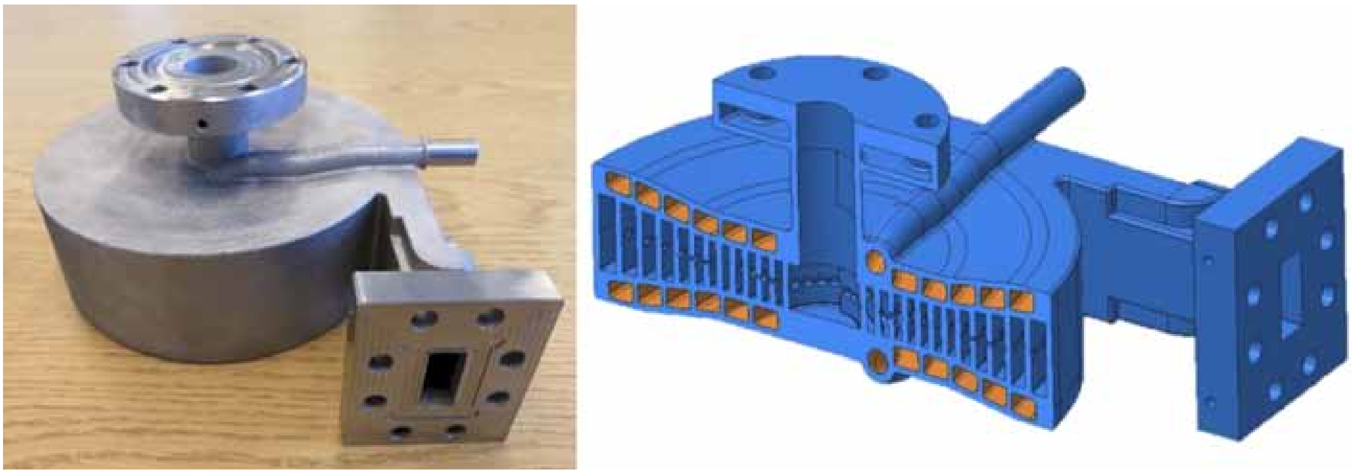
Plastic and metal pieces printed in CERN’s 3D printers (Image: CERN)

The advantage of additive manufacturing lies in the production of lightweight, seamless, multifunctional components. This process is proving itself in the aerospace and medical industries, where its use has skyrocketed. Until now, however, it has not been widely used in the field of particle accelerators, where unique specifications have to be met. For ultra-high vacuum, cryogenics and radiofrequency cavities, in particular, CERN produces and characterises components that need to meet very specific requirements and may require the use of rare materials like niobium.

The additive manufacturing technique adopted by CERN is selective laser melting: metallic powder is melted successively, layer by layer, using a laser beam. The laser's trajectory is set using a three-dimensional model. The layers of powder are deposited and melted over and over, up to thousands of times, until the object takes shape.

For four years now, the Mechanical and Materials Engineering group in the Engineering department (EN-MME) has been using a metal-additive manufacturing machine (also known as a 3D printer) to produce geometrically complex parts.

This process makes it possible to conceptualise and design parts that until now would have been difficult, if not impossible, to manufacture. Selective laser melting results in robust parts of complex shapes, which include features such as cooling channels (as illustrated below in a radiofrequency spiral load for CLIC). The process requires relatively little raw material while preserving good mechanical properties. This is shown in the case of beam wire scanners, which have to be light but rigid.



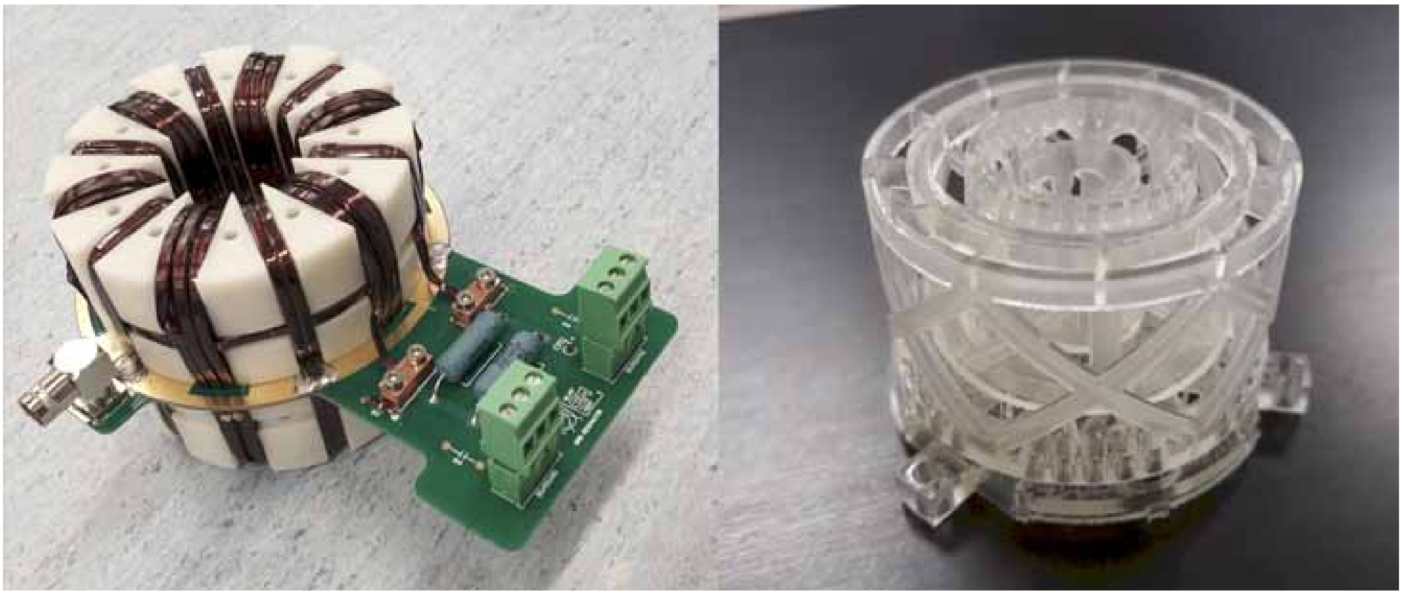
The spiral load serves to dissipate the electromagnetic power of the radiofrequency cavities in the CLIC project's X-band testing facility (Xbox). Additive manufacturing makes the part compact while still incorporating cooling channels (shown in orange on the 3D image). (Image: CERN)

Although this technology has been tried and tested with common materials, such as aluminium and titanium alloys and stainless steel, additive manufacturing involving rare materials such as niobium, a superconducting element that is used throughout the radiofrequency cavities of CERN's accelerators, is relatively uncharted territory. A development programme has been under way for several years and has produced promising results with some of the first components, like the HOM couplers below. Nevertheless, there are still challenges to overcome, related in particular to the purity of the materials, the roughness of the surfaces and the high dimensional precision that these parts require.

(Above) This HOM coupler prototype made of niobium has cooling channels going right down to the point of the hook, where the electromagnetic fields are intense. (Image: CERN)

In addition to the metal-additive manufacturing machine, CERN also has a plastic 3D printer, which is used by the Magnets, Superconductors and Cryogenics group (TE-MSC) to produce parts from plastic resin (mainly epoxy) using stereolithography, a technique that involves using a laser to harden the liquid resin. The applications of this technique include making radiation-resistant parts and high-voltage electrical insulation for the detectors, as well as many moulds and prototypes.

Additive manufacturing is set to continue making inroads into the world of accelerators. By expanding the range of possibilities offered by conventional technologies, this new tool is likely to help resolve many technical challenges posed by future projects, such as the Future Circular Collider (FCC).



Plastic 3D printed coil holder for the electronic components of the PS particle beam acceleration system (left, white parts) and thermally insulated optical reflector for superconducting magnet position monitoring system. (Image: CERN)

Credit - https://home.cern/news/news/engineering/additive-manufacturing-opens-new-prospects-cern

HISTORY OF CERN

63rd General Assembly: Technical Programme Abstracts

The following papers are expected. The announced presenter is the first author listed, unless otherwise specified. Please note that this list is subject to change.

Ekeberg Prize, winning publication

The winner will be announced in September.

ICGLR Regional Certification Manual (RCM) introduces a new status for mine sites and exporters – the "Blue Status"

By Gerard Nayuburundi - International Conference on the Great Lakes Region – ICGLR Secretariat

The release of the Second Edition of the Regional Certification Mechanism (RCM) Manual introduced a new concept of "Blue Status" for classifying 3TG mine sites and exporters. The Blue Status is a new, fourth status criterion under the RCM. It complements the previous three status criteria of Green (valid), Yellow (provisionally valid) and Red (not valid), which denote the outcome of the verification process. By contrast, Blue Status is the default status for all legally registered mine sites and exporters when no verification has taken place or where a verification has been requested but has not been carried out within the timeframe specified in the RCM. By this we mean when new mine sites and exporters are legally established and have not yet been verified in accordance with the RCM requirements, and when they are already in existence but State and / or ICGLR led verification processes do not have the resources available to conduct verification within the timeframes detailed in the RCM Manual. We contend that this change is an essential ingredient to ensuring the commercial viability of formal 3TG mineral supply chains in the Great Lakes Region. The introduction of the Blue Status for 3TG mine sites and exporters is aligned with the OECD Due Diligence Guidance for Responsible Minerals from Conflict Affected and High-risk Areas as it creates an opportunity for Member State and ICGLR programs as well as businesses operating within their territories to mature in a low-capacity situation and it reaffirms the role of industry in effective due diligence. Finally, in order to avoid a situation of perpetual Blue Status, which could potentially undermine the additional checks and balances allowed for in the RCM, the revision incorporated a time limit of 3 years after which non-verified mine sites/exporters once again revert to Red Status.

Characterization of pure tantalum manufactured using Laser Powder Bed Fusion (L-PBF)

By Michael Stawovy and Scott Ohm - H.C. Starck Solutions and Faith Oehlerking - Beehive 3D

Tantalum and its alloys are one of the refractory material groups of interest for additive manufacturing (AM), as they meet the property requirements for specific applications in aerospace and medical industries. The present research and development work aims to characterize the microstructure, mechanical and thermal properties of AM tantalum using Laser Powder Bed Fusion technology (L-PBF). Primary parameter optimization of the laser power, point distance, exposure time, and hatch distance were tested using a design of experiments to optimize the relative density of the specimens for the L-PBF metal AM technology. A final parameter set was selected and produced solid samples with >99.9% density. Using this parameter set, samples were printed and tested for room temperature tensile, hardness, thermal conductivity, coefficient of thermal expansion, and electron backscatter diffraction (EBSD) analysis and compared to traditionally manufactured wrought materials.

The next decade capacitor requirements

By Tomas Zednicek - EPCI European Passive Components Institute

Materials, reliability and sustainability are becoming the key factors of next generation capacitor designs. The presentation will provide overview of key trends in electronic applications and consequences for capacitor manufacturers. Specifically material considerations are highlighted from the perspective of supply chain, critical supply chain (magnified by the current Russia – Ukraine war challenges), reliability and sustainability upcoming requirements. Life cycle assessment comparing tantalum and MLCC ceramic capacitors will be shown as a case study as well as benchmarking of how tantalum capacitors answer such needs.

Recent breakthroughs in tantalum capacitors - introduction to the second edition of the Springer book on tantalum and niobium-based capacitors

By Yuri Freeman - KEMET Yageo

Y. Freeman's book "Tantalum and Niobium-Based Capacitors", published by Springer in 2017, is the only book dedicated to the science, technology, and applications of these capacitors. This book received excellent feedback from the industry and academia. Since the publication of the original book, very important new results on the impact of technology on the reliability, failure mode, volumetric efficiency, and environmental stability of solid electrolytic and polymer tantalum capacitors, which dominate the market, were obtained. These new results not only significantly expand the scope of the book, but also provide important corrections and clarity to the earlier published material. This presentation introduces the second edition of the book "Tantalum and Niobium-Based Capacitors" with these additions, corrections, and clarifications. The presentation will focus on new possibilities for growth of the tantalum capacitors market, including mission-critical applications of non-hermetic polymer tantalum capacitors.

Transporting radioactive materials in an increasingly challenging global supply chain

By Kevin Loyens - TAM International LP

Logistics continues to be the lifeblood of the radioactive material industry - whether that be in the nuclear fuel cycle, or for critical minerals with NORM containing traces of uranium, thorium, or others. Critical minerals, with their highly complex global supply chains, are facing significant supply-side risks due to the disruptions in international trade from COVID-19 restrictions and the war in Ukraine and consequent sanctions. These issues added to the already strong global capacity gap in ocean, road and air transportation. Rising fuel prices, port congestions, lack of cargo space and constant routing changes have become the order of the day for international shippers. The complex nature of radioactive shipments adds to the complexity and requires a strong understanding of various compliance regulations from around the world for a seamless and efficient transport of these vital resources. Once cargo is categorized as "IMO class 7", the framework for packaging and transportation significantly changes. Not only do different regulations apply in different jurisdictions, these regulations are sometimes subject to different interpretation by various stakeholders. While the industry continues to adapt to these restrictions, it will continue to see change in this post-COVID environment. Properly understanding the regulatory, transport and handling framework of radioactive material will enable companies to implement an optimal strategy for efficiently managing these materials throughout the current and future supply chains. With almost two decades of proven experience in this industry, TAM International is ideally positioned to provide an overview of current trends, challenges, and best practices for NORM transportation.

Accelerating impact – the role of the tantalum industry in tackling ASM child labour

By Josephine Carlsson - CCLA and Quintin Lake - PACE Consortium/Fifty Eight

Child labour is one of the most prevalent types of exploitative work globally. The worst and most harmful forms affect at least 79 million children, predominantly in agriculture and ASM, and the number has been rising in recent years. Primarily, child labour is a geographic challenge and so to meaningfully understand and address it, a new model is required to better identify the key stages of the supply chain, and particularly to see origin communities as a critical part of the industry that they enable. This session will present research into child labour, and potential pathways to remove young people from it, in the tantalum mining areas of North Kivu. There is a need to quickly move from a focus on finding and assessing the risks - to identifying effective interventions and minimising unintended consequences. What is the role of the tantalum industry? This session will start to explore opportunities for companies, investors and others connected to the tantalum industry to work together to achieve better and faster impact where child labour exists.

Novel technologies for the recovery of tantalum and niobium from tin mining streams

By L. Yurramendi, J. Nieto and A. Siriwardana - TECNALIA Basque Research & Technology Alliance (BRTA), Materials and Processes, J. Spooren - VITO n.v. Flemish Institute for Technological Research, Unit Sustainable Materials Management, E. Seftel and V. Tu - KU Leuven, Department of Chemistry and M. Foreman - CHALMERS University of Technology, Department of Chemistry and Chemical Engineering, Industrial Materials Recycling and Nuclear Chemistry.

In the last years, tantalum (Ta) and niobium (Nb) have attracted great interest from the scientific community, due to their multiple applications (electronic devices, high strength steels and superconducting magnets among others) and the scarcity of these metals (known as critical raw materials CRM) in the EU. With the aim to reduce the dependence from external countries, the valorization of Ta/Nb co-existing as by-products with tin in cassiterite deposits is proposed, as there are important cassiterite deposits in the EU (Spain, Portugal, France). The recovery of Ta and Nb from tin mineral fractions is challenging, due to the fact that Ta and Nb are highly refractory to the action of the majority of acids or alkalis. Current technologies for Ta/Nb leaching, aiming the production of their oxides, from tin slags and concentrates involve the use of HF, that causes corrosion of equipment and environmental pollution, together with the liberation of radioactive Th and U from the mineral matrix. In the frame of TARANTULA project (EU H2020 GA 821159), environmentally-friendly technologies are proposed for the recovery of Ta and Nb from tin mining processing fractions as metal oxides: solvoleaching coupled to non-aqueous solvent extraction (NASX), deep eutectic solvent (DES) leaching followed by IL extraction, single step microwave assisted fusion with solid/liquid extraction and alkaline leaching coupled with solvent extraction. The main achievements obtained up to now for the recovery of Ta and Nb as oxides will be disclosed.

Tarantula workshop - Horizon 2020

The T.I.C. is part of a consortium studying innovative new ways to recover niobium (Nb), tantalum (Ta) and tungsten (W) from mine by-products and processing waste streams, materials which are currently uneconomical. If you are interested in learning more about this project visit https://h2020-tarantula.eu/ or to register your interest contact the T.I.C. at info@tanb.org.

The TARANTULA project has received funding from the European Union’s EU Framework Programme for Research and Innovation Horizon 2020 under Grant Agreement No 821159.

Structural changes in the electronics supply chain

By Renzo De Meo - RCD Strategic Advisors

Demand for tech hardware is at a high point. Yes, there are inflationary headwinds, and a war is raging in Ukraine. But the long-term prospects are bright. Electric vehicles and wearables are two of several technology trends that will drive growth for the rest of the decade. The surge in tech hardware demand strained global supply chains throughout the pandemic. For sectors like automotive, semiconductor shortages were a wake-up call for closer cooperation with suppliers. Suppliers responded by expanding capacity with an influx of new investments. But there are two major structural forces reshaping the supply/demand balancing effort. First, increasing geopolitical competition is forcing governments to incentivize more regional manufacturing. The trend started with advanced ICs but is spreading to other areas. These trends will have long-term consequences on who and where suppliers fabricate components and assemble electronic devices and equipment. Second, custom silicon, software-defined functions, and system-in-package change how value is delivered. For example, high-end ICs are becoming custom fabricated parts levelling the playing field for new entrants. Likewise, system-in-package has shifted value away from the PCB assembly and into the IC module. These trends are creating unprecedented new opportunities. Yet, at the same time, they are threatening existing supplier business models. This presentation will review the current state of the industry and its prospects. It will then delve into these structural changes and show how they will reshape the electronics supply chain by the end of the decade.

Dynamic material flow analysis of tantalum in the United States between 2002 and 2020

By Abraham Padilla and Nedal Nassar - United States Geological Survey (USGS)

Tantalum has received considerable attention in recent years largely due to its increasing use in modern electronics and the high risks associated with its supply chain. In 2020, approximately 70% of the world's supply of tantalum originated from countries in Africa, with nearly 40% thought to originate in the Democratic Republic of Congo alone. The United States (U.S.), a leading consumer of tantalum materials, has been entirely reliant on imports for its supply of primary tantalum since the 1950s. However, properly quantifying total U.S. tantalum consumption is problematic because two of the most important intermediate forms of tantalum (Ta_2O_5 and K_2TaF_7) do not have unique tariff codes and thus a significant part of tantalum material trade is not documented. Furthermore, tantalum incorporated in semi-finished and finished goods is not tracked as tantalum. As a result, current estimates of consumption only capture a fraction of the total volume of tantalum consumed in any given year. In this study, we perform a material flow analysis (MFA) to quantify the total volume of tantalum consumed in the United States from 2002 through 2020. Our results indicate that U.S. tantalum consumption may be significantly higher, and up to twice as much at times, than previously estimated. Interestingly, our results show that some years U.S. tantalum demand has exceeded the volume of primary tantalum produced globally according to U.S. Geological Survey estimates. This suggests that either a significant volume of global primary tantalum production is not accounted for, the volume of secondary (recycled) tantalum available is significantly underestimated, or both. Lastly, the detailed MFA results allow us to quantify the volume of tantalum in use as well as the quantity that may potentially be available for recycling in any given year, thereby providing valuable insight to both industry and policymakers for identifying possible tantalum above-ground resources available for re-use as recovery technologies, especially for electronic waste, improve.

The management of Class 7 maritime transportation

By Michael Meier and Lucie De Araujo - ORANO NPS

Today, some liner companies don't accept Class 7 transport because Class 7 maritime transportation is complicated to handle for various reasons:

- There are many requirements applied by the carrier (Radiation Program Plan, stowage plan, information for the crew).
- Over the world, each port and each country has different requirements regarding Class 7.
- Some ports don't even accept the transit or unloading/loading of Class 7 material due to a certain lack of knowledge of the product (e.g. if only one transit port doesn't accept Class 7, the sea line can't transport Class 7) or for political reasons.

During this session, I would like to explain how Orano Nuclear Packages Services manages its Class 7 shipments with liners, in accordance with international laws and regulations. I will mention the benefits of Class 7 maritime transportation, I will explain the list of requirements from the different ports, how Orano NPS can open new ports to Class 7 and how we manage this with our Global Acceptance Program and how Orano NPS can support its customers / the shipping companies to perform these transports.
In order to give a global overview, this paper will present examples of current Class 7 sea lines and some lessons learned regarding rare earth shipments.

Panel discussion - Future markets and their evolving material requirements

© Geneva Tourism

Member company updates

Since the last edition of this newsletter the following changes have been made to delegate contact details:

- Australian Strategic Materials Ltd has a new delegate, Mr Peter Finnimore. He can be contacted on pfinnimore@asm-au.com. The company has relocated its offices to Level 4, 66 Kings Park Road, West Perth WA 6005, Australia.

- B.W. Minerals (s) Pte Ltd has a new office address: 50 Raffles Place, Level 30, Singapore Land Tower, Singapore 048623.

- Globe Metals & Mining Ltd has nominated a new delegate, Mr Grant Hudson, who can be reached on gh@globemm.com.

- Imerys Ceramics France has a new delegate, Mr Shivendra Kumar. He can be contacted on shivendra.agrawal@imerys.com.

- Jiangxi Tuo Hong New Material Co., Ltd has nominated a new delegate, Ms Huang Yan. Her email is 710612919@qq.com.

- MTALX Ltd has relocated to MTALX House, 166 Hampstead Way, London NW11 7YE, United Kingdom.

- Pilbara Minerals has moved to Level 2, 146 Colin Street, West Perth WA 6005, Australia.

- Roskill / Wood Mackenzie has a new delegate: Ms Sue Shaw. She can be reached on suzanne.shaw@woodmac.com.

- Rwanda Mines, Petroleum & Gas Board (RMB) has nominated a new delegate, Ambassador Yamina Karitanyi. Her email address is yamina.karitanyi@rmb.gov.rw.

- Responsible Minerals Initiative (RMI) has nominated a new delegate, Ms Marianna Smirnova, who can be reached on msmirnova@responsiblebusiness.org

- The company Shalina Resources Limited has changed name to Chemaf Resources Limited. Mr Uday Shetty's email is now uday.shetty@chemaf.com.

- Specialty Metals Resources Ltd has a new delegate, Ms Ximena Rodriguez. Her email address is ximena.rodriguez@smr.hk.

- Traxys has appointed a new delegate, Mr Ioannis Kallinikos. His email is Ioannis.Kallinikos@traxys.com

- Ulba Metallurgical Plant JSC has appointed a new delegate, Mr Talgat Yerzhanov. The company can be reached on marketing_ta@ulba.kz.

A&R Merchants Inc. Tantalum & Niobium

MATERION

SILVER SPONSORS

63rd General Assembly
AGM & technical conference
October 16th to 19th 2022, Geneva, Switzerland

(photo: Shutterstock)

BOOKINGS

The special **'early bird'** booking rate closes on **Wednesday August 31st 2022**. The final booking deadline is **Friday October 7th 2022**.

It will not be possible to attend the event without booking in advance. Tickets will not be available on the door. A booking form is sent with this notice: please use one form per delegate.

Delegates from non-member companies will only be confirmed after payment or receipt of credit card details.

REGISTRATION DESK

The T.I.C. **registration desk** will be open from **15:00 to 18:00 on Sunday October 16th.** Please come to the desk as early as you can to collect your papers and your badge.

Please wear your badge at all times during any conference event.

PROGRAMME

The **Annual General Meeting (AGM)** of the Association will be held at 8:30 on Monday October 17th.

Technical presentations will be given on Monday (morning and afternoon) and Tuesday morning.

On Monday afternoon, there will be a **workshop** around the **Tarantula project**, of which the T.I.C. is a partner.

On Wednesday, delegates will be given the opportunity to join a **private tour of CERN**, followed by lunch.

The T.I.C. invites all delegates and accompanying persons to a **Welcome Reception** on Sunday evening, from 18:00 to 20:00.

On Monday evening, all participants are invited to a **Gala Dinner** at the Château des Bois, a 20-minute drive away from the Fairmont Hotel (transport by bus).

DELEGATES (TECHNICAL MEETING)

Delegates of member companies:
The AGM at 8:30 on Monday is restricted to delegates from member companies. All the delegates from a member company may attend, but only one delegate may vote. He or she will be required to sign in on arrival at the AGM so please arrive in time. If you have a vote, it is important that you attend.

Delegates of non-member companies:
People from companies which are not T.I.C. members may attend a maximum of two annual conferences as an observer/potential applicant. If non-members are interested in attending more conferences they should apply for membership.

NINGXIA ORIENT TANTALUM INDUSTRY CO., LTD. (OTIC)

■CLEAN TANTALUM SUPPLY CHAIN ●RESPONSIBLE GLOBAL SUPPLIER

- **Founded in 1965 (former Ningxia Nonferrous Metals Smeltery)**
- **1052 employees**
- **The biggest Ta & Nb manufacturer in China**
- **Certified to CFSI annual audit successively since 2011**
- **Sourcing all non–conflict tantalum minerals in compliance with RBA requirements**
- **The first listed Ta & Nb processing company in China in January 2000**
- **The earliest TIC member in China and an Asian member of the TIC Executive Committee**
- **Executive member of Ta & Nb Branch of the China Nonferrous Metal Industry Association**
- **The Chinese National Ta & Nb Special Metal Material Engineering Technology Research Center**
- **Standardization leader of the tantalum and niobium industry in China**

Key Product Show

OTIC specializes in producing Ta and Nb key materials for high-tech industry: powders,compounds and customer-specific fabricated parts of tantalum, niobium and their alloys such as wires,ingots,plates, foils,bars, rods, RF superconducting cavity,sputtering target blank,furnace parts and so on for various applications.





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