TANTALUM-NIOBIUM
INTERNATIONAL STUDY CENTER

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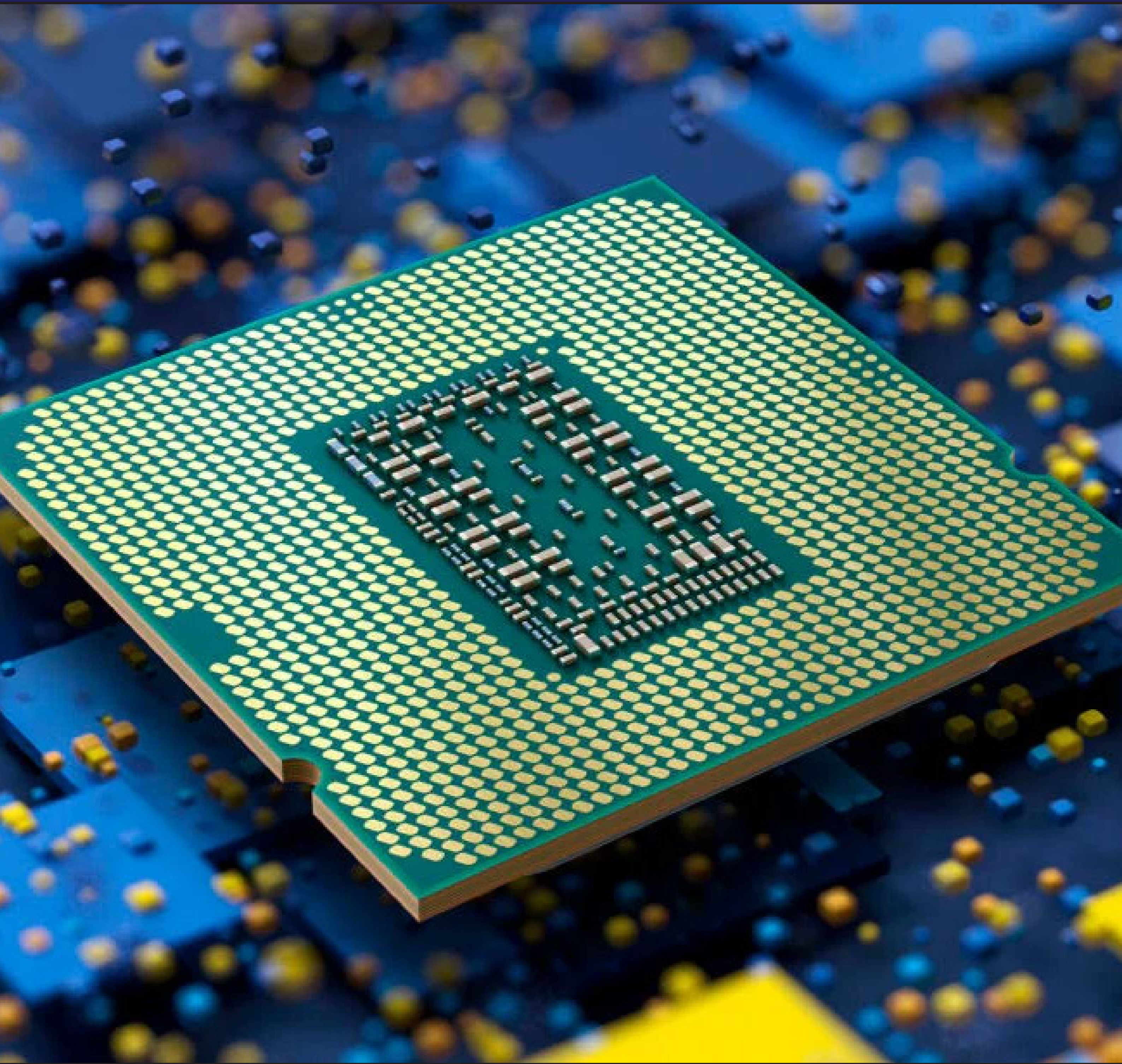
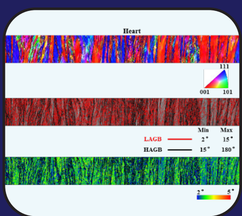


The Crystallographic Evolution Behavior of Tantalum sputtering blank during Heat Treatment



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Member Updates

(Page 11)

Message from the President of T.I.C.

Dear TIC Members,

As we move through 2026, the tantalum and niobium industry continues to benefit from dynamic market activity and stable demand across a wide range of applications. Strong investment in AI infrastructure, advanced semiconductor manufacturing, and related technology supply chains have become an important driver of demand. In addition, a variety of government-supported industrial, infrastructure, and strategic resource programs around the world are expected to provide further support to market demand in the months ahead.

While demand fundamentals remain robust, supply-side challenges continue to affect parts of the industry. In particular, sourcing and due diligence requirements in Central Africa remain complex and continue to present operational challenges for market participants. Although the signing of the peace agreement between Rwanda and the Democratic Republic of Congo, facilitated through the efforts of the United States, was welcomed by the industry, the anticipated near-term improvements in operating conditions and supply chain stability have not yet materialized to the extent many had hoped.

In this environment we are encouraged by the strong interest in the TIC's Enhanced Due Diligence (EHDD) Guidance. The growing number of inquiries and requests for support demonstrates the value of practical guidance for responsible sourcing and procurement of various raw materials. In response to evolving regulatory and market requirements, the TIC remains actively engaged with a broad range of industry stakeholders. Together, we are committed to ensuring that our guidance remains relevant and up to date whenever significant developments require further clarification or adjustment.

Against this backdrop of a strong and evolving market, we are particularly excited about the upcoming TIC GA67, which will take place in Yinchuan, China. We expect this event to be a highlight of the year for both members and industry participants. The conference will provide an outstanding platform to exchange market insights, strengthen existing relationships, establish new business contacts, and explore opportunities for future growth.

We are especially grateful for the tremendous efforts already being made by our main sponsor, Ningxia Orient Tantalum Industry Co. Working closely with the TIC General Secretary, they are dedicating significant time and resources to ensure that GA67 becomes a truly memorable event for all participants.

We warmly encourage all members and interested participants to join us for what promises to be an engaging and productive gathering. Whether your focus is market developments, responsible sourcing, technical innovation, or business development, GA67 will offer valuable opportunities to connect with colleagues from across the global tantalum and niobium community.

We wish all our members a pleasant and successful summer season and look forward to welcoming you to Yinchuan on 13 September 2026.

We hope to see you there.

Sincerely,
Silvana Fehling
President, TIC

TIC 主席致辞

尊敬的TIC会员们：

随着2026年的推进，钽和铌行业继续受益于活跃的市场动态以及广泛应用领域中稳定的需求。对人工智能基础设施、先进半导体制造及相关技术供应链的大力投资已成为需求的重要驱动力。此外，全球范围内各类由政府支持的工业、基础设施及战略资源计划，预计将在未来数月内进一步支撑市场需求。

尽管需求基本面依然强劲，但供应端的挑战仍在影响着行业的部分领域。特别是中非地区的采购和尽职调查要求依然复杂，继续给市场参与者带来运营挑战。尽管在美方斡旋下，卢旺达与刚果民主共和国签署了和平协议，并受到业界欢迎，但业界期待的运营条件和供应链稳定性在短期内的改善，尚未如许多人所希望的那样实现。

在此背景下，我们对业界对TIC《强化尽职调查（EHDD）指南》表现出的浓厚兴趣感到鼓舞。日益增多的咨询和支持请求，彰显了针对各类原材料负责任采购与供应的实用指南所具有的价值。为应对不断变化的监管和市场要求，TIC 始终积极与广泛的行业利益相关方保持互动。我们共同致力于确保，每当重大发展需要进一步澄清或调整时，我们的指南都能保持相关性和时效性。

在市场强劲且不断演变的背景下，我们对即将在中国银川举行的TIC GA67大会倍感期待。我们预计此次活动将成为会员和行业参与者今年的亮点。本次大会将提供一个绝佳的平台，用于交流市场见解、巩固现有关系、建立新的商业联系，并探索未来增长的机会。

我们特别感谢主要赞助商宁夏东方钽业股份有限公司迄今为止所付出的巨大努力。他们与TIC秘书长密切合作，投入了大量时间和资源，以确保GA67大会成为所有参与者难忘的盛会。

我们热忱邀请所有会员及感兴趣的参与者加入我们，共同参与这场必将充满活力且富有成效的盛会。无论您的关注重点是市场动态、负责任采购、技术创新还是业务拓展，第67届大会都将为您提供宝贵的机会，与全球钽铌行业的同仁建立联系。

我们祝愿全体会员度过一个愉快而充实的夏季，并期待于2026年9月13日在银川欢迎各位的到来。

期待与您相聚。

Silvana Fehling
TIC主席

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Featured articles:

Regular articles:

Mensagem do presidente da TIC

Prezados membros da TIC,

À medida que avançamos em 2026, o setor de tântalo e nióbio continua se beneficiando de uma atividade de mercado dinâmica e de uma demanda estável em uma ampla gama de aplicações. Os fortes investimentos em infraestrutura de IA, fabricação avançada de semicondutores e cadeias de suprimentos de tecnologias relacionadas tornaram-se um importante impulsionador da demanda. Além disso, espera-se que diversos programas industriais, de infraestrutura e de recursos estratégicos apoiados por governos em todo o mundo ofereçam ainda mais suporte à demanda do mercado nos próximos meses.

Embora os fundamentos da demanda permaneçam robustos, os desafios do lado da oferta continuam afetando setores da indústria. Em particular, os requisitos de abastecimento e due diligence na África Central permanecem complexos e continuam a apresentar desafios operacionais para os participantes do mercado. Embora a assinatura do acordo de paz entre Ruanda e a República Democrática do Congo, facilitada pelos esforços dos Estados Unidos, tenha sido bem recebida pelo setor, as melhorias previstas no curto prazo nas condições operacionais e na estabilidade da cadeia de suprimentos ainda não se concretizaram na medida em que muitos esperavam.

Nesse contexto, nos sentimos encorajados pelo forte interesse nas Orientações de Due Diligence Aprimorada (EHDD) do TIC. O número crescente de consultas e solicitações de apoio demonstra o valor de orientações práticas para o abastecimento e aquisição responsáveis de diversas matérias-primas. Em resposta aos requisitos regulatórios e de mercado em constante evolução, o TIC mantém-se ativamente engajado com uma ampla gama de partes interessadas do setor. Juntos, estamos comprometidos em garantir que nossas orientações permaneçam relevantes e atualizadas sempre que desenvolvimentos significativos exigirem esclarecimentos ou ajustes adicionais.

Nesse contexto de um mercado forte e em evolução, estamos particularmente entusiasmados com a próxima TIC GA67, que será realizada em Yinchuan, na China. Esperamos que este evento seja um dos destaques do ano, tanto para os membros quanto para os participantes do setor. A conferência proporcionará uma excelente plataforma para trocar insights de mercado, fortalecer relacionamentos existentes, estabelecer novos contatos comerciais e explorar oportunidades de crescimento futuro.

Somos especialmente gratos pelos enormes esforços já empreendidos por nosso patrocinador principal, a Ningxia Orient Tantalum Industry Co. Trabalhando em estreita colaboração com o Secretário-Geral da TIC, eles estão dedicando tempo e recursos significativos para garantir que a GA67 se torne um evento verdadeiramente memorável para todos os participantes.

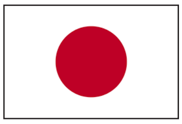
Incentivamos calorosamente todos os membros e participantes interessados a se juntarem a nós para o que promete ser um encontro envolvente e produtivo. Seja seu foco os desenvolvimentos do mercado, o abastecimento responsável, a inovação técnica ou o desenvolvimento de negócios, a AG67 oferecerá oportunidades valiosas para se conectar com colegas de toda a comunidade global de tântalo e nióbio.

Desejamos a todos os nossos membros uma temporada de verão agradável e bem-sucedida e esperamos recebê-los em Yinchuan no dia 13 de setembro de 2026.

Esperamos vê-los lá.

Silvana Fehling
Presidente, TIC

TIC会長からのメッセージ



TIC会員の皆様へ

2026年に入り、タンタルおよびニオブ業界は、幅広い用途にわたる活発な市場動向と安定した需要の恩恵を受け続けています。AIインフラ、先端半導体製造、および関連技術のサプライチェーンへの積極的な投資が、需要の重要な牽引役となっています。さらに、世界各国で政府が支援する様々な産業・インフラ・戦略的資源関連プログラムが、今後数ヶ月間にわたり市場需要をさらに下支えすると予想されます。

需要のファンダメンタルズは堅調に推移しているものの、供給面での課題が業界の一部に影響を与え続けています。特に、中央アフリカにおける調達やデューデリジェンスの要件は依然として複雑であり、市場参加者にとって業務上の課題となり続けています。米国の尽力により仲介されたルワンダとコンゴ民主共和国間の和平協定の調印は業界から歓迎されたものの、事業環境やサプライチェーンの安定性における短期的な改善は、多くの関係者が期待したほどにはまだ実現していない。

こうした状況下において、TICの「強化されたデューデリジェンス（EHDD）ガイダンス」に対する強い関心が寄せられていることは、我々にとって心強い。問い合わせや支援要請の増加は、様々な原材料の責任ある調達・購入に向けた実践的なガイダンスの価値を物語っています。変化し続ける規制や市場の要件に対応するため、TICは幅広い業界関係者と積極的に連携を続けています。私たちは、重要な進展によりさらなる明確化や調整が必要となった際には、ガイダンスが常に適切かつ最新の状態を維持できるよう、共に尽力してまいります。

このように力強く変化し続ける市場を背景に、中国・銀川で開催されるTIC GA67を特に楽しみにしています。このイベントは、会員および業界関係者の皆様にとって、今年のハイライトとなるものと期待しています。本会議は、市場に関する知見を交換し、既存の関係を強化し、新たなビジネス上のつながりを築き、将来の成長の機会を探るための素晴らしいプラットフォームとなるでしょう。

メインスポンサーである寧夏オリエント・タンタル工業株式会社が、すでに多大な努力を傾けてくださっていることに、心より感謝申し上げます。同社はTIC事務局長と緊密に連携し、GA67がすべての参加者にとって真に記憶に残るイベントとなるよう、多大な時間とリソースを注いでいます。

魅力的で実り多い集まりとなることが約束されている本イベントに、すべての会員および関心をお持ちの皆様のご参加を心よりお勧めいたします。市場の動向、責任ある調達、技術革新、あるいは事業開発のいずれに焦点を当てておられる場合でも、GA67は、世界中のタンタル・ニオブ業界の仲間たちと交流する貴重な機会を提供します。

会員の皆様が快適で実り多い夏を過ごされることをお祈りするとともに、2026年9月13日に銀川でお迎えできることを楽しみにしております。

会場でお会いできることを心よりお待ちしております。

温かいご挨拶を申し上げます。
シルヴァナ・フェーリング
TIC会長

Message du président de TIC

Chers membres du TIC,

À mesure que l'année 2026 avance, le secteur du tantale et du niobium continue de bénéficier d'un marché dynamique et d'une demande stable dans un large éventail d'applications. Les investissements massifs dans les infrastructures d'intelligence artificielle, la fabrication de semi-conducteurs de pointe et les chaînes d'approvisionnement technologiques associées sont devenus un moteur important de la demande. De plus, divers programmes industriels, d'infrastructure et de ressources stratégiques soutenus par les pouvoirs publics à travers le monde devraient soutenir davantage la demande du marché dans les mois à venir.

Si les fondamentaux de la demande restent solides, des difficultés du côté de l'offre continuent d'affecter certaines parties du secteur. En particulier, les exigences en matière d'approvisionnement et de diligence raisonnable en Afrique centrale restent complexes et continuent de poser des défis opérationnels aux acteurs du marché. Bien que la signature de l'accord de paix entre le Rwanda et la République démocratique du Congo, facilitée par les efforts des États-Unis, ait été saluée par le secteur, les améliorations attendues à court terme en matière de conditions d'exploitation et de stabilité de la chaîne d'approvisionnement ne se sont pas encore concrétisées dans la mesure où beaucoup l'espéraient.

Dans ce contexte, nous sommes encouragés par le vif intérêt suscité par les lignes directrices du TIC relatives à la diligence raisonnable renforcée (EHDD). Le nombre croissant de demandes de renseignements et d'assistance témoigne de l'utilité de ces recommandations pratiques pour un approvisionnement et des achats responsables de diverses matières premières. Face à l'évolution des exigences réglementaires et du marché, le TIC poursuit son engagement actif auprès d'un large éventail d'acteurs du secteur. Ensemble, nous nous engageons à veiller à ce que nos recommandations restent pertinentes et à jour chaque fois que des développements importants nécessitent des clarifications ou des ajustements supplémentaires.

Dans ce contexte de marché dynamique et en constante évolution, nous attendons avec une impatience particulière la prochaine conférence générale du TIC (GA67), qui se tiendra à Yinchuan, en Chine. Nous espérons que cet événement constituera un moment fort de l'année tant pour nos membres que pour les acteurs du secteur. La conférence offrira une plateforme exceptionnelle pour échanger des informations sur le marché, renforcer les relations existantes, nouer de nouveaux contacts professionnels et explorer des opportunités de croissance future.

Nous sommes particulièrement reconnaissants des efforts considérables déjà déployés par notre sponsor principal, Ningxia Orient Tantalum Industry Co. En étroite collaboration avec le secrétaire général du TIC, cette entreprise consacre beaucoup de temps et de ressources pour faire de la GA67 un événement véritablement mémorable pour tous les participants.

Nous encourageons chaleureusement tous les membres et les participants intéressés à se joindre à nous pour ce qui s'annonce comme un rassemblement captivant et productif. Que vous vous intéressiez aux évolutions du marché, à l'approvisionnement responsable, à l'innovation technique ou au développement commercial, la 67e Assemblée générale vous offrira de précieuses occasions d'échanger avec des collègues issus de l'ensemble de la communauté mondiale du tantale et du niobium.

Nous souhaitons à tous nos membres une saison estivale agréable et fructueuse et nous nous réjouissons de vous accueillir à Yinchuan le 13 septembre 2026.

Nous espérons vous y voir nombreux.

Silvana Fehling
Présidente, TIC

Editor's notes

Dear Members and Stakeholders,

As we move towards the height of summer, 2026 has already proven to be a busy year for the T.I.C. team. We have already attended the MMTA conference in Vancouver, where I participated on the panel discussing critical materials. We have also continued our outreach efforts in China and will soon be travelling to Japan for further engagement with industry partners. I look forward to meeting members and stakeholders and answering your questions.

Of course, GA67 continues to hold much of the attention for the T.I.C., with preparations for Yinchuan, China, now well underway. The T.I.C. Secretary-General, Heather, will travel there in a few weeks to oversee the final preparations ahead of the event.

On a more sombre note, the current geopolitical situation around the world, and particularly in Central Africa, has created challenges within our members' supply chains. We remain hopeful that, going forward — or as the German saying goes, "Der Zukunft zugewandt" ("Facing toward the future") — positive results and constructive discussions will emerge from GA67 in Yinchuan, China, taking place from 13–16 September 2026.

We have already selected the venue for GA68, which will be held in Prague, Czech Republic, from 19–22 September 2027. From the T.I.C.'s perspective, we continue to plan ahead in support of our members' long-term interests.

The T.I.C. continues to support both upstream and downstream mechanisms within the supply chain and reiterates to members that OECD due diligence guidance should always be pursued. The tantalum and niobium industries have consistently remained at the forefront of supply chain challenges, and the T.I.C. strives to help members remain ahead of these developments through the enhanced due diligence booklet produced in line with OECD protocols.

On a more positive note, we look forward to delivering an exciting programme at GA67, and I am confident that our hosts, Ningxia Orient Tantalum and Niobium Industry Co. Ltd, together with the Executive Committee, will help the T.I.C. deliver a memorable General Assembly and conference.

Warmest regards,

Ian.

Ian Margerison

Executive Marketing Manager and Technical Officer.

Sign up to attend at -
www.tanb.org/view/67th-general-assembly

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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 3200 per year and full details of benefits are available at www.TaNb.org

BLOOM

LiBeration anaLysis for Optimising extraction and prOcessing of CRMs

The BLOOM (Liberation Analysis for Optimizing Extraction and Processing of CRMS) project is a research and development project EU by Horizon Europe programme that innovatively integrates the Laser-Induced Breakdown Spectroscopy with online Mineral Liberation Analysis (MLA), leveraging machine learning and artificial intelligence. This cutting-edge technology aims to increase the efficiency of CRM and non-CRM extraction and processing with a smart and modular solids analysis system consisting of an online MLA, making the exploitation of low-grade deposits more financially viable.

With the focus on achieving optimal and useful results, the BLOOM consortium consists of two mining partners and their mining projects - Capacitor Metals Corp with its Blue River deposit in Canada and Taurus Infinity with its Mostove deposit in Ukraine. Both are tantalum and niobium deposits. These minerals are and will be key to global progress and having the MLA sensor online will improve mineral recovery and increase the viability of the project during project development and after the start of operation. This BLOOM development will impact the mining and processing stages, increasing recovery and products grade and optimizing mining extraction. Capacitor Metals Corp and Taurus Infinity will assist in this objective, providing samples for sensor development, validation, monitoring and evaluation of the technology with the improvements that this technology will have in the Blue River and Mostove projects.

Regarding the mining partners with polymetallic operating mines (Hudbay Mineral Inc, Sandfire Matsa and Cobre las Cruces), the BLOOM project will develop technology to improve recovery and product quality, reducing energy consumption and saving reagents in froth flotation units. These mining partners, like the others, will assist in the BLOOM objective, providing plant samples for the development of the MLA sensor, validation, monitoring and evaluation of the technology with the improvements that this technology will have in their mineral processing plants.

The BLOOM project brings together a multidisciplinary group of 14 partners from 6 different countries and is lead by Universitat Politècnica de Catalunya (UPC).

https://bloomproject.eu/

https://www.linkedin.com/company/bloomproject/

https://www.instagram.com/bloomproject.eu

https://bsky.app/profile/bloomproject.bsky.social

Grant Agreement 101177962

Funded by the European Union

Member company updates

Since the last edition of this newsletter, the following changes have been made to member details:

- Australian Strategic Materials Ltd has resigned its membership of the T.I.C.
- Halcyon Inc has amended its company address to 11th Floor, Al Sarab Tower, Global Market Square, Al Maryah Island, Abu Dhabi, United Arab Emirates. The contact email address has also been amended to admin@halcyonmetals.com. GmbH has merged its membership with Tantec GmbH.
- HAMC Ltd has resigned its membership of the T.I.C. Sapphire Rare Metal Co. Ltd of Zhaoqing has been terminated from T.I.C.
- Mitsui Mining & Smelting Co., Ltd has changed its company name to Mitsui Kinzoku Company, Limited. The company address has also been amended to 20F Gate City Ohsaki-West Tower, 1-11-1 Osaki, Shinagawa-ku, Tokyo 141-8584, Japan.
- Samwood Neo Inc has changed its company name to NEO GAIA Inc. The company address has also been amended to 6F TKK Building, 1-2 Kandatomiyamacho, Chiyoda-ku, Tokyo 101-0043, Japan. Tel: +81-3-3527-1239. The delegate email address has also been amended to satomi@neogaia.tokyo.
- Sizer Metals Pte Ltd has resigned its membership of the T.I.C.
- Vishay has amended its company name to Vishay Intertechnology. The company address has also been amended to 3 Dr. Felix Zandman Street, New Industrial Park, Dimona 8610101, Israel. The contact email address has also been amended to david.tkach@vishay.com.
- ZAF Pharmaceuticals PLC has resigned its membership of the T.I.C.

Executive Committee

The Executive Committee is drawn from the T.I.C. membership. Members of the Executive Committee may, but are not required to be, the official delegates of their respective member companies. The current Executive Committee was elected by the T.I.C. membership at the 66th General Assembly and is listed below:

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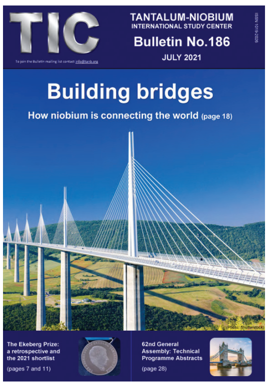
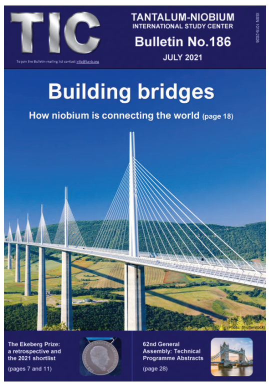
Join our mailing list to receive the Bulletin by email, free of charge

Our mission with the Bulletin is to provide the global tantalum and niobium community with news, information and updates on our work. We hope you enjoy reading it! Recipients will also receive messages about the T.I.C. and our General Assemblies.

Email **info@tanb.org** to join our mailing list and keep up to date with the T.I.C.

The full archive of Bulletins, including Bulletin Reviews, are available at **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 2025 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 Philip Lessner

Consultant
Dr Philip Lessner is a seasoned consultant in the electronic components industry, bringing with him four decades of experience. He previously served as Chief Technology Officer at both the YAGEO Group and KEMET Electronics. Dr. Lessner holds a B.E. in Chemical Engineering from Cooper Union and a Ph.D. in Electrochemical Engineering from the University of California, Berkeley. Over the course of his career, he has been deeply involved in the development of tantalum capacitors, contributing nearly 30 years of technical expertise to this field.

Peter J. Bonitatibus Jr., PhD

Rensselaer Polytechnic Institute - Chemistry
Peter J. Bonitatibus Jr., PhD is an Associate Professor of Chemistry in the Department of Chemistry and Chemical Biology at Rensselaer Polytechnic Institute.

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.

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.

The 2026 Anders Gustaf Ekeberg Tantalum Prize will be awarded at the 67th General Assembly to be held September 13th to 16th 2026, Yinchuan, China.

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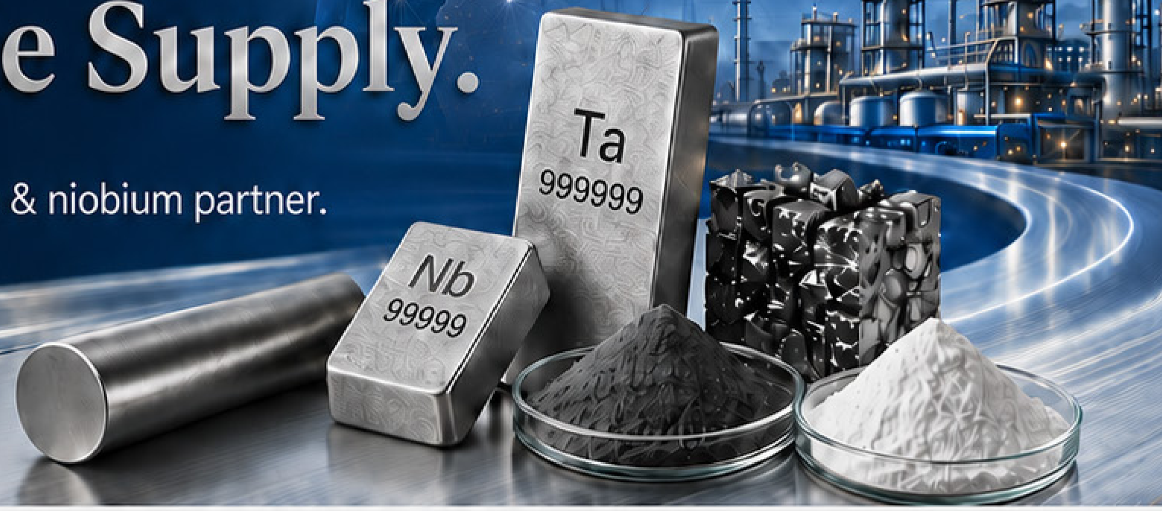

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The Crystallographic Evolution Behavior of Tantalum sputtering blank during Heat Treatment

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Abstract

For semiconductor tantalum sputtering blanks used in integrated circuits, the uniformity of microstructure and texture must be precisely regulated. The proportion of {111} and {100}- oriented grains in the tantalum blanks is the key factor that directly dictates the sputtering rate of the targets. In this work, the crystallographic characteristics of the tantalum sputtering blank after plastic deformation were characterized, and then quasi-in situ EBSD was employed to investigate the recrystallization behavior of {111} and {100}-oriented grains during annealing. The results show that most grains tend to nucleate near the {111} deformed matrix at the {111}-{100} interfaces in the early stage of recrystallization. The {111}-oriented matrix is consumed preferentially. The pole figure shows a trend of initial intensity decrease followed by an increase, while the intensity of {100}-oriented grains increase. However, the intensity of {100}-oriented grains significantly decrease at the end of recrystallization. With their lower dislocation density, {100}-oriented grains mainly migrate towards the higher dislocation density of {111}-oriented grains through a strain-induced grain boundary migration mechanism. The {111}-oriented grains possibly nucleate via a sub-grain coarsening mechanism. As temperature rises, some {100}-oriented grains are easily engulfed by {111}-oriented grains, leading to the aggregation of {111}-oriented grains.

1. Introduction

Tantalum, with its high melting point, high density, excellent room-temperature ductility, and corrosion resistance, has been widely used in various industrial fields [1-4]. In semiconductor integrated circuits, tantalum metal films, which do not react with Cu or Si substrates, serve as barrier layers to effectively inhibit the diffusion of Cu atoms into Si storage units [5]. However, as chip manufacturing processes evolve toward higher densities, stricter requirements are placed on the stability of barrier layer films. Therefore, to produce high-quality films, fine, uniform grains and a random grain orientation distribution must be present in tantalum blanks [6]. During the deformation of high-purity tantalum, two types of fiber textures, {100}<uvw> and {111}<uvw>, are formed. After the final annealing treatment, it exhibits a strong {111}<uvw> texture and a weak {100}<uvw> texture. Therefore, improving the existing processing techniques and optimizing the related annealing schedules to control the microstructure is crucial.

Research on controlling the microstructure and texture uniformity of tantalum sputtering blank has made significant progress [7-13]. By altering the strain path and employing 135° circumferential rolling instead of unidirectional rolling, the distortion energy differences between {111}-oriented grains and other orientations can be reduced, thereby enhancing the uniformity of the recrystallized structure [8]. In addition to deformation texture, the recrystallization texture is also affected by the intensity and rate of the temperature field applied during subsequent processing. Fan et al. [12]investigated the effect of temperature on grains with different orientations and found that high-temperature short-term annealing favors the formation of a {111} texture, while low-temperature long-term annealing promotes the formation of a {001} texture. This indicates that annealing temperature significantly influences the recrystallization behavior of tantalum sputtering blank in an orientation-dependent manner.

In our previous work, we examined the evolution of stored energy and texture distribution along the thickness direction during cold rolling and annealing of tantalum sputtering blank. The texture distribution of {111} and {001}-oriented grains followed a wave-like variation with increasing temperature [14-17]. Therefore, studying the evolution of {111} and {100} -oriented grains during recrystallization nucleation and growth is critical for achieving a uniform recrystallization texture.

The crystallographic characteristics of the tantalum sputtering blank after plastic deformation were characterized, and then a quasi-in situ Electron Backscatter Diffraction (EBSD) system was employed to track the growth process of {111}- and {100}-oriented grains during recrystallization in this work. Combined with the EBSD data obtained before and after recrystallization, the difference in dislocation density between the two texture components was calculated and discussed, and the nucleation differences between {111}- and {100}-oriented grains were clarified. These differences lead to the formation of distinct texture components. The results of this study provide experimental basis for optimizing the preparation process of tantalum sputtering blank.

2. Experimental

High-purity tantalum ingots (purity > 99.9999 wt.%) prepared by electron beam melting (EBM) were used in this study. The billets underwent vertical and horizontal forging followed by vacuum annealing to achieve a fully recrystallized microstructure. Cylindrical samples (20 ± 5 mm thickness, 160 ± 10 mm in diameter) were then subjected to 135° circumferential rolling at room temperature—achieved by rotating the rolling direction by 135° each pass—to a final thickness of 2 mm (≈90% reduction), without lubricants.

To investigate the evolution of special-oriented grains during recrystallization, quasi in-situ EBSD observations were performed on the 90% deformed samples. EBSD scans were conducted at the same location on the same sample after rolling and after successive annealing steps. Two sets of annealing experiments were carried out. The first set focused on the early recrystallization stage, with sequential annealing at 825, 835, 845, 865, and 875 °C for 10 min each. The second set targeted the late recrystallization stage, with annealing at 950, 1000, and 1050 °C for 10 min. All quasi in-situ annealing procedures followed the same method as the first set.

For EBSD analysis, deformed samples were cut into 8 mm × 6 mm × 2 mm pieces, ground, mechanically polished, and electrolytically polished. Vickers hardness indents were used to mark the observation area. Samples were vacuum-sealed in quartz tubes (1×10^{-3} MPa) during annealing and air-cooled afterwards. A thin oxide layer formed was removed by electrolytic polishing in a sulfuric and hydrofluoric acid mixture (9:1 vol), with tantalum as the anode and graphite as the cathode. After each annealing step, EBSD scans were performed at the same RD-ND surface location.

3. Results and discussion

3.1 Microstructure and texture of plastic deformed tantalum sputtering blank

Fig. 1(a) illustrates that the deformation texture of the tantalum sputtering blank is predominantly characterized by {001} and {111} orientations, which constitute approximately 37.5% and 26.95% of the total area fraction, respectively. A through-thickness microstructural examination reveals an alternating arrangement of {111}- and {001}-oriented grains from the top surface to the bottom. The deformed grains exhibit a typical fibrous morphology, with their long axes aligned substantially parallel to the rolling direction (RD).

In the central region of the deformed tantalum sputtering blank, the high-angle grain boundaries are relatively straight and almost parallel to the rolling direction (RD), whereas those near the top and bottom regions exhibit undulations and fluctuations (Fig.1(b). Correlating Fig.1(a), it is found that regions with a low density of low-angle grain boundaries primarily consist of {001}-oriented grains. In contrast, a higher density of low-angle grain boundaries is observed within the {111}-oriented grains. This disparity in substructure suggests that the stored energy accumulated during deformation is greater in grains with a {111} orientation compared to those with a {001} orientation. KAM map (Fig.1 (c)) provides further evidence for this orientation-dependent stored energy. {111}-oriented grains possess higher KAM values and, consequently, a higher density of geometrically necessary dislocations (GNDs). It is clearly observed from the KAM map that the GND density is also influenced by crystallographic orientation.

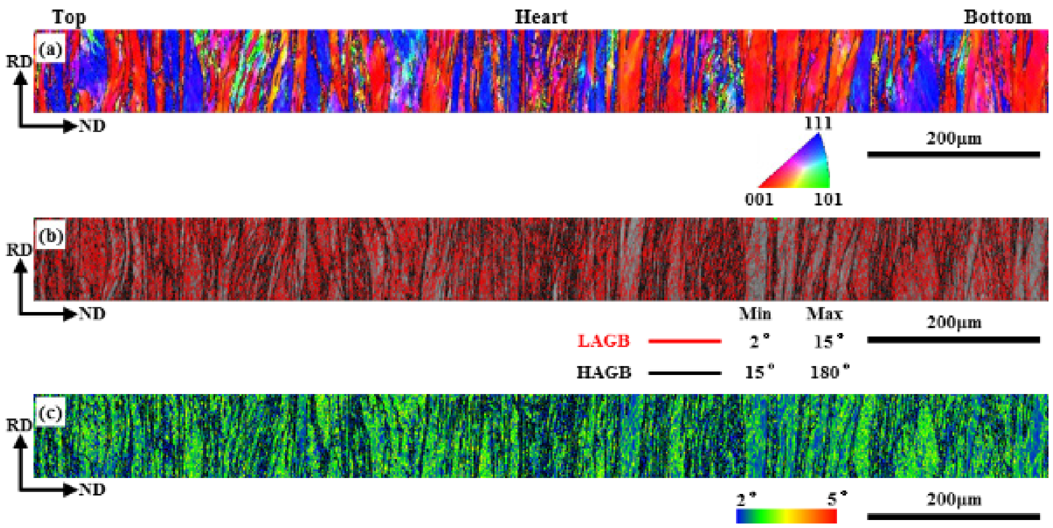

Fig.1 Orientation imaging map (a), grain boundary map (b) and the corresponding kernel average misorientation (c, KAM) of deformed tantalum sputtering blank

3.2 Crystallographic evolution in the early stages of recrystallization

The grains in the cold-rolled state are fibrous and generally aligned with the rolling direction, as shown in Fig. 2a. The main texture components are {111}<uvw> (γ fiber, 57.7%) and {100}<uvw> (θ fiber, 23.5%). In the test area, {111}- and {100}-oriented grains are alternately arranged. Regions near grain boundaries exhibit more pronounced orientation splitting compared to grain interiors. As shown in Figs. 2(b-f), the deformation texture is largely retained after the onset of recrystallization, with pole figures indicating that the peaks are mainly concentrated around the {111} texture. However, the intensity of both {111} and {100} textures fluctuates with increasing temperature. As shown in Figs. 2(b) and (c), after annealing at 825-835°C, a significant number of recrystallization nuclei appear near the {111}-{100} interfaces, close to the {111}-oriented deformed matrix (white elliptical frame in Fig. 2(a)). The microstructure at this stage consists of deformed grains and a small number of fine recrystallization nuclei. The partial consumption of the {111}-oriented matrix leads to a corresponding decrease in the intensity of {111} grains in the polar diagram. As the annealing temperature gradually increases to 845-875°C (Figs. 2(d-f)), most deformed grains begin to recrystallize and grow, and fibrous grains are gradually replaced by recrystallized grains. However, at {100}-oriented grain aggregation sites in the rolled state (white dashed box in Fig. 2(a)), some {100}-oriented grains remain fibrous even at 875°C. The corresponding pole figures show that with increasing temperature, the intensity of both {111}- and {100}-oriented grains gradually increase.

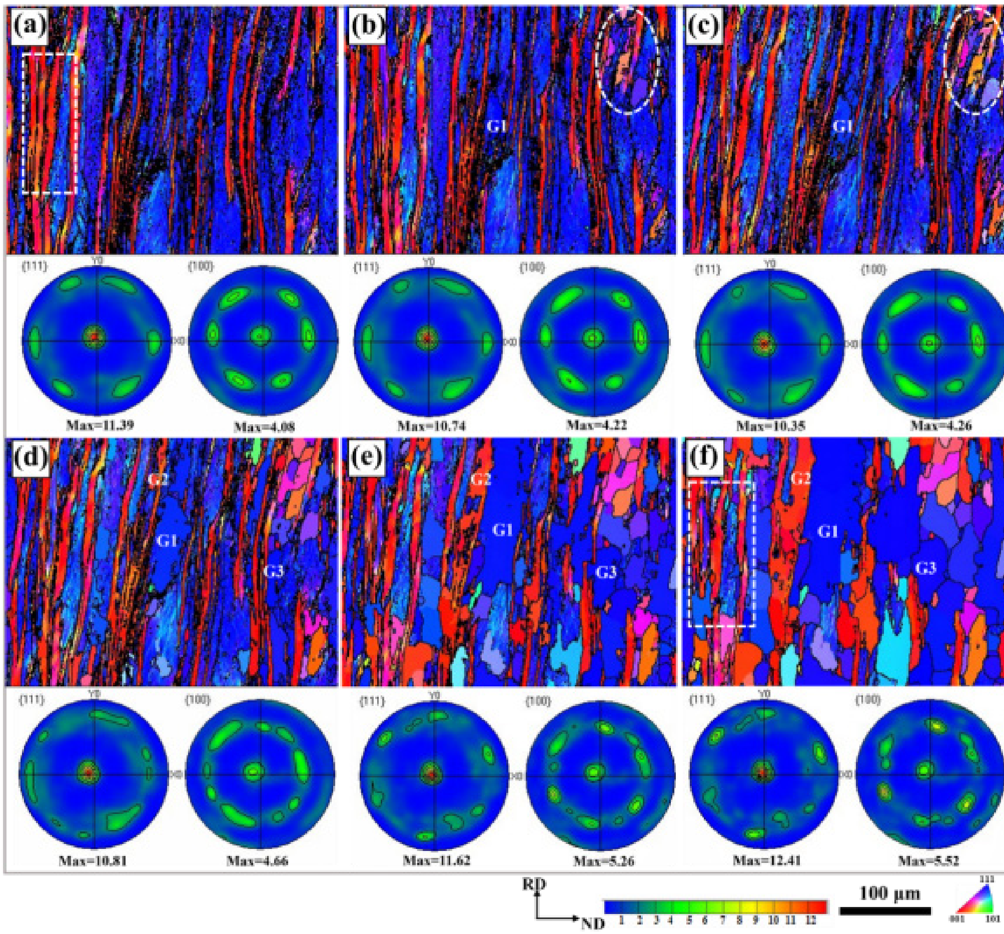

Fig. 2 Orientation imaging maps and corresponding pole figures of tantalum sputtering blank at increasing temperatures: (a) Rolled state, (b) 825°C, (c) 835°C, (d) 845°C, (e) 865°C and (f) 875°C.

To further investigate the nucleation behavior of grains during the annealing of tantalum sputtering blank, the recrystallization evolution of {111}- and {100}-oriented grains in samples annealed at 825°C, 845°C, 865°C, and 875°C was analyzed. Grain Orientation Spread (GOS) is an important method for distinguishing between deformed matrix and recrystallized grains, as well as for quantifying the area fraction of recrystallized grains [18]. As shown in Fig. 3(a-d), in the GOS maps, the color intensity represents the degree of lattice distortion, with red indicating regions of higher dislocation density. Grains with a GOS < 2° are considered recrystallized [19]. These grains were extracted and highlighted, and their corresponding orientation images at different temperatures are shown in Fig. 3(e-h).

As the temperature increases, the red high-distortion regions are gradually replaced by blue regions. Most of the recrystallized grains are oriented primarily in the {111} and {100} directions. Combined with the grain area fraction map in Fig. 4, it is observed that as the temperature rises from 825°C to 875°C, the proportion of recrystallized grains increases to 69.3%. Among these recrystallized grains, those with {111} and {100} orientations account for 45.1% and 12.7%, respectively. In contrast, the fractions of the {111}- and {100}-oriented matrix decrease from 55.1% and 23.9% to 10.4% and 11.2%, respectively. These results indicate that the recrystallization behaviors of {111}- and {100}-oriented grains differ significantly, with the recrystallization rate of the {111}-oriented matrix being much higher than that of the {100}-oriented matrix.

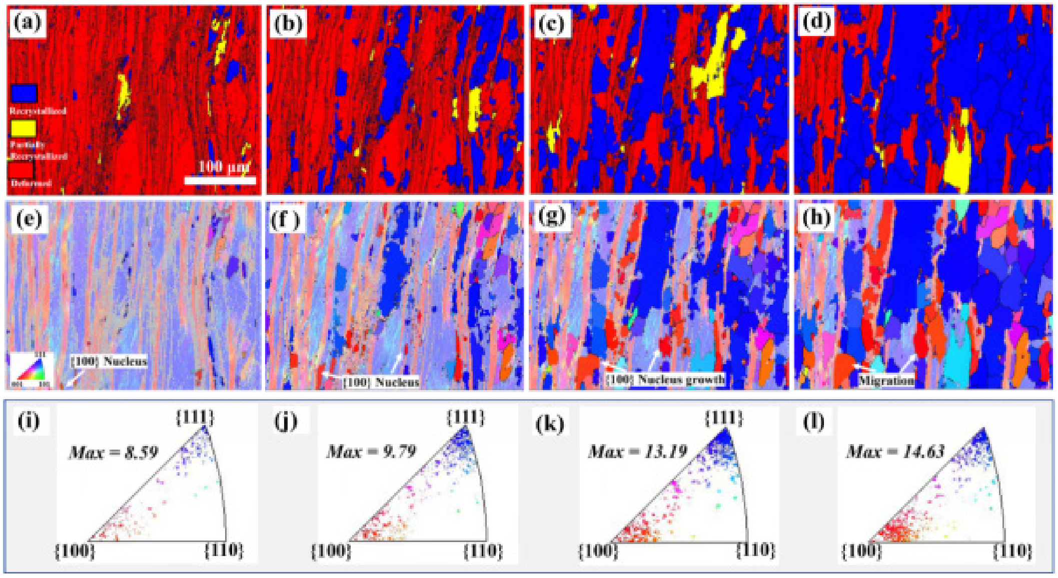

Fig. 3 GOS maps and recrystallized grain orientation imaging maps with corresponding inverse pole figures at increasing temperatures: (a)(e)(i) 825°C, (b)(f)(j) 845°C, (c)(g)(k) 865°C and (d)(h)(l) 875°C.

The quasi-in-situ annealing experiments indicate that during the 825-875°C annealing process, some {100}-oriented grains (marked in white in the figure) nucleate at {100} grain boundaries and migrate toward the {111}-oriented deformed matrix. Meanwhile, {111}-oriented grains nucleate via in-situ recrystallization (with the same orientation as the neighboring parent matrix) at γ/θ grain boundaries and grow along the {111} deformed matrix, exhibiting orientation inheritance during nucleation. As the temperature increases to 875°C, numerous {111}-oriented grains nucleate and grow, forming clusters of {111}-oriented recrystallized grains.

Furthermore, by projecting the orientations of the newly formed grains onto inverse pole figures (Figs. 3i-l), it can be seen that their orientations are not randomly distributed but are concentrated around {111} and {100} orientations. With increasing temperature, the pole density values in the inverse pole figures gradually rise, reaching a maximum of 14.63, indicating the development of a strong {111} texture in the annealed microstructure.

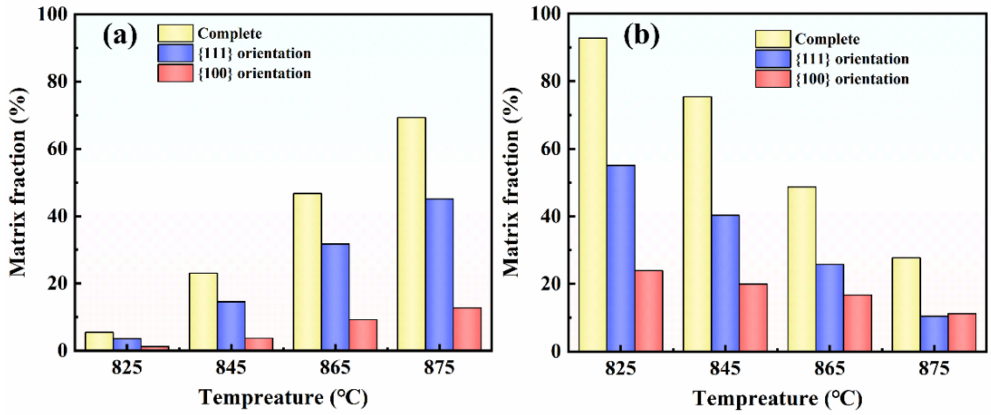

Fig. 4 Grain Proportion Statistical Chart: (a) Recrystallized Grains and (b) Deformed Grains

3.3 Crystallographic evolution in the final stage of recrystallization

Fig. 5 presents the quasi-in-situ orientation imaging maps of high-purity tantalum obtained within the temperature range of 950-1050°C, together with the corresponding {111} and {100} orientation pole figures and overall grain size distribution maps at each temperature. At the final stage of recrystallization, the {111} texture becomes significantly strengthened, with its peak pole density increasing from 12.66 at 950°C to 17.13 at 1050°C. In contrast, the texture intensity of the {100}-oriented grains gradually decreases with increasing temperature, and their peak pole density decreases from 9.65 at 950°C to 5.71 at 1050°C. Notably, as the temperature increases, the maximum size of the G4-{111}-oriented grains in Fig. 5 grows11 increases from 85.064 μm to 133.450 μm.

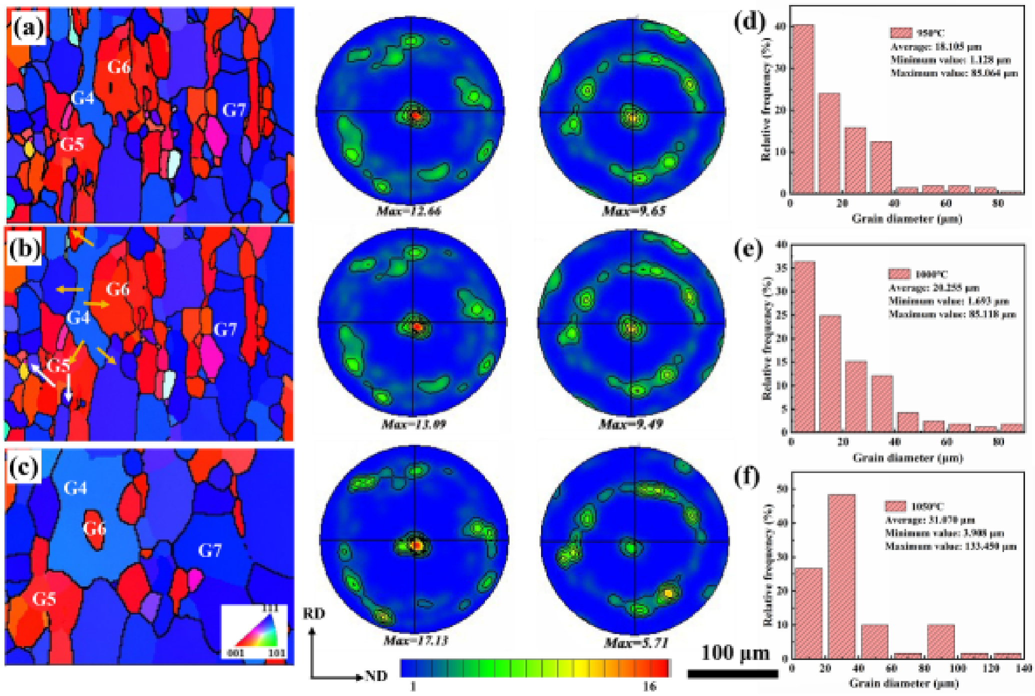

Fig. 5 Orientation imaging maps at the final stage of recrystallization with increasing temperature, along with corresponding {111} and {100} pole figures and grain size distribution maps: (a)(d) 950°C, (b)(e) 1000°C and (c)(f) 1050°C

The larger G5-{100}-oriented grains primarily grow by consuming smaller surrounding grains, with the grain boundaries migrating toward the centers of curvature (as indicated by the white arrows). During the growth of the G4-{111}-oriented grains, they further incorporate the relatively smaller G6-{100}-oriented grains, and their initially curved interfaces gradually straighten (as indicated by the yellow arrows), eventually forming larger {111}-oriented grains (Fig. 5c) with an overall equiaxed morphology. However, another notable phenomenon is that the other {111}-oriented grains adjacent to G4-{111} are not consumed during its growth. This may be because, when a growing grain encounters neighboring grains with similar orientations, its growth advantage is significantly reduced—a phenomenon also observed in the growth of G7. In this context, Juul Jensen's [20] "orientation pinning" hypothesis and Doherty's [21]"variant suppression" concept provide reasonable explanations for this behavior.

4. Application

The results of this study have been applied to the development of 6N high-end sputtering tantalum blank products for semiconductors at Ningxia Orient Tantalum Industry Co., Ltd., facilitating advancements in the company's preparation technology and supporting product upgrades. To date, the company has achieved large-scale market application of 6N high-end sputtering tantalum blanks for 300 mm wafers. The technological evolution of high-end sputtering tantalum target blanks at Ningxia Orient Tantalum Industry Co., Ltd. is illustrated in Fig. 6.

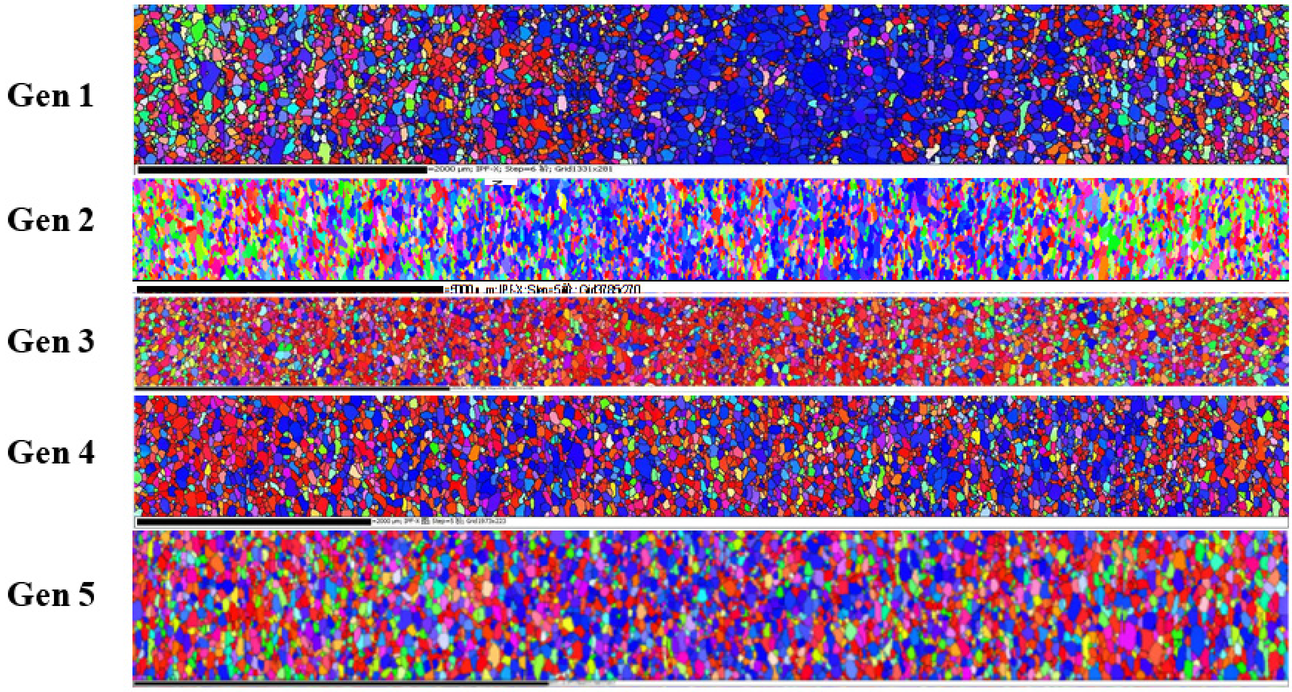

Fig. 6 Technical evolution of high-end sputtering tantalum target targets at Ningxia Orient Tantalum Industry Co., Ltd.

5. Conclusions

This study used quasi-in-situ Electron Backscatter Diffraction (EBSD) to investigate the recrystallization behavior of {111} and {100} oriented grains during both the early and final stages of recrystallization. The primary conclusions are summarized as follows:

(1) The stored energy distribution through the deformed tantalum thickness is heterogeneous, with the greatest difference between top and bottom and a consistent gradient in the transition region. Orientation-dependent analysis reveals that {111} grains consistently store more energy than {001} grains across all regions, indicating a strong crystallographic dependence.

(2) During the early stage of recrystallization, as the temperature increases, the intensity of {111} oriented grains first decrease and then increases, while the intensity of {100} oriented grains gradually increase. Most grains tend to nucleate near the {111} deformed matrix at the {111}-{100} interface, with the {111} oriented matrix being preferentially consumed.

(3) At the end of recrystallization, the stored energy has been largely consumed. As the temperature increases, large {111} oriented grains tend to engulf smaller {100} oriented grains, primarily driven by grain boundary migration induced by high-temperature grain boundary curvature. However, when {111} oriented grains meet other {111} grains, their growth advantage significantly weakens.

Acknowledgement

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References

1. D.F. Luo, P. Ning, F. Zhang, Y. Zhou, H.M. Zhang, T. Fu, Hydrothermal calcification surface modification of biomedical tantalum, Rare Met. 40 (2021) 928-933.
2. X.J. Ni, Q.B. Sun, J.X. Wang, D.C. Zhang, X. Jin, Q. Yang, L.Y. Chen, J.Z. Yang, Y.L. Hong, Development and characterization of minimal surface tantalum scaffold with high strength and superior fatigue resistance, J. Mater. Res. Technol. 36 (2025) 1226-1239.
3. J.X. Chang, D. Wang, T. Liu, L.H. Lou, J. Zhang, Role of tantalum in the hot corrosion of a Ni-base single crystal superalloy, Corros. Sci. 98 (2015) 585-591.
4. M. Gopinath, P. Deanna, G. Kent, G. Kent, C. Shell, O. Andreas, S. Robert, A comprehensive review of biological and materials properties of Tantalum and its alloys, J. Biomed. Mater. Res. A. 110 (6) (2022) 1291-1306.
5. L.Y. Yang, D.H. Zhang, C.Y. Li, P.D. Foo, Comparative study of Ta, TaN and Ta/TaN bi-layer barriers for Cu-ultra low-k porous polymer integration, Thin Solid Films. 462 (2004) 176-181.
6. C.A. Michaluk, Correlating discrete orientation and grain size to the sputter deposition properties of tantalum, J. Electron. Mater. 31 (1) (2002) 2-9.
7. G.S. Choi, J.W. Lim, N.R. Munirathnam, I.H. Kim, J.S. Kim, Preparation of 5N grade tantalum by electron beam melting, J. Alloys Compd. 469 (1-2) (2009) 298-303.
8. J.L. Zhu, S.F. Liu, D.D. Long, D. Orlov, Q. Liu, Pass number dependence of through-thickness microstructure homogeneity in tantalum sheets under the change of strain path, Mater. Charact. 160 (2020) 110076.
9. Q.Q. Zhu, Y.H. Liu, K.X. Song, Y.J. Zhou, X.K. Yang, S.F. Liu, Quasi-in-situ study on the crystallographic lattice rotation of tantalum during compression deformation, J. Mater. Res. Technol. 19 (2022) 858-865.
10. J.L. Zhu, S.F. Liu, D.D. Long, S.Y. Zhou, Y.H. Liu, O. Dmytro, Enhancing the {100} grain subdivision in high-purity tantalum sheets by asymmetric cross rolling, Mater. Charact. 166 (2020) 110439.
11. J.L. Zhu, S.F. Liu, S. Yang, Y. Zhang, J. Zhang, C.G. Zhang, C. Deng, The Effect of different annealing temperatures on recrystallization microstructure and texture of clock-rolled tantalum plates with strong texture gradient, Metals. 9 (3) (2019) 358.
12. H.Y. Fan, S.F. Liu, C. Deng, X.D. Wu, L.F. Cao, Q. Liu, Quantitative analysis: How annealing temperature influences recrystallization texture and grain shape in tantalum, Int. J. Refract. Met. Hard Mater. 72 (2018) 244-252.
13. S.F. Liu, J.L. Zhu, D.D. Long. Asymmetric cross rolling: a new technique for alleviating orientation-dependent microstructure inhomogeneity in tantalum sheets. Journal of Materials Research and Technology, 9 (3) (2020) 4566-4576.
14. L.Y. Miao, A.J. Wang, Z.B. Li, M. Qi, P.T. Li, The orientation dependence of stored energy and the evolution of texture of through-thickness tantalum targets during heating, Mater. Charact. 201 (2023) 112969.
15. P. Zhao, A.J. Wang, Z.B. Li. Quasi-in situ EBSD study of the recrystallization behavior of high-purity tantalum. Materials Characterization, 2025, 230: 115764..
16. M. Qi, A.J. Wang, Z.B. Li,. Evolution of microstructure and grain boundaries during annealing of high-purity tantalum materials. International Journal of Refractory Metals and Hard Materials, 2024, 121: 106664.
17. P.T. Li, A.J. Wang, Z.B. Li, M. Qi, et al. Microstructure evolution and deformation mechanism in nanocrystalline superior deformed tantalum[J]. Nanoscale, 2024, 16: 4826.
18. D.L. Ge, A.J. Wang, Z.B. Li. Effect of {112} metastable oriented grains on the deformation behavior of high-purity tantalum. International Journal of Refractory Metals and Hard Materials 2025, 128 : 106999.
19. Y. Tang, X. Guo, Role of deformation temperature and strain rate on microstructural evolution of hot compressed Nb-Si based ultrahigh temperature alloy, Intermetallics. 119 (2020) 106719.
20. D.J. Jensen, Growth rates and misorientation relationships between growing nuclei/grains and the surrounding deformed matrix during recrystallization, Acta Metall. Mater. 43 (11) (1995) 4117-4129.
21. R.D. Doherty, D.A. Hughes, F.J. Humphreys, J.J. Jonas, D.J. Jensen, M.E. Kassner, W.E. King, T.R. McNelley, H.J. McQueen, A.D. Rollett, Current issues in recrystallization: a review, Mater. Sci. Eng. A. 238 (2) (1997) 219-274.

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