EXECUTIVE SUMMARY

TITANIUM USA 2025

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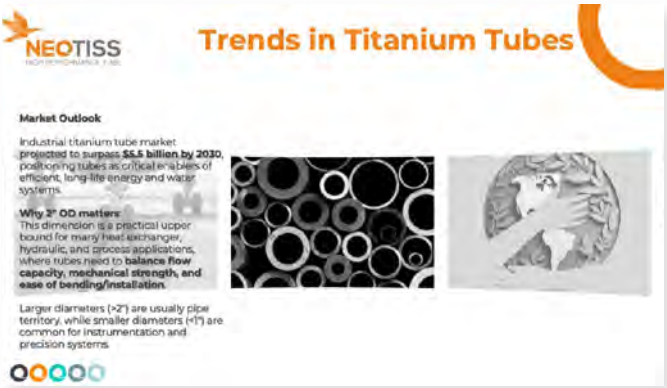
TITANIUM USA 2025 — Executive Summary

By Michael C. Gabriele

The TITANIUM USA 2025 Conference and Exhibition, held in Boston Sept. 28-30, organized and hosted by the International Titanium Association (ITA), drew over 800 titanium industry professionals and observers to exchange ideas on current business conditions and offer projections on future trends. The mood was upbeat as speakers shared specific information, especially on the flight path of the all-important aerospace market and strides to enhance the global supply chain, which was upended by the not-so-long-ago Covid-19 pandemic.

Global Industrial Trends; Demand and Supply

Ricardo Silva, executive vice president, Americas for Neotiss Inc., Morristown, TN, tracked the outlook for "Trends in Industrial Titanium Tubes." Silva said global demand for titanium tubes is projected to expand at an impressive 8 to 10 compound annual growth rate (CAGR) through 2030. The demand will be fueled by three powerful growth drivers: the aerospace sector's ongoing push for light weighting and fuel efficiency; the nuclear industry's shift toward advanced Gen IV reactors and small modular reactors (SMRs); and the rapid scaling of global desalination capacity—set to exceed 120 million cubic meters per day by 2030—where titanium's unmatched corrosion resistance is indispensable.



The titanium tube industry is advancing through a strong technological push, with the adoption of next-generation alloys offering more than 20-percent higher strength and the integration of automated orbital welding systems to improve precision and reliability. At the same time, Industry 4.0 applications—ranging from real-time process monitoring to predictive analytics—are expected to cut production scrap rates by 15 to 20 percent, driving both efficiency and cost competitiveness across global supply chains.

The industrial titanium tube market is projected to surpass $5.5 billion by 2030, positioning tubes as critical enablers of efficient, long-life energy and water systems. The 2-inch outer diameter (OD) dimension is a practical upper bound for many heat exchanger, hydraulic, and process applications, where tubes need to balance flow capacity, mechanical strength, and ease of bending/installation. Larger diameters (larger than two inches) are usually pipe territory, while smaller diameters (smaller than one inch) are common for instrumentation and precision systems.

The U.S. nuclear energy policy is setting an ambitious path forward, aiming to expand capacity from about 100 GW today to 400 GW by 2050, with 10 new large reactors and five GW reactors planned by 2030. To accelerate deployment, licensing reform is underway to streamline the U.S. Nuclear Regulatory Commission (NRC) decisions into an 18-month window, while three advanced reactor pilot projects are targeting criticality by mid-2026. On the fuel side, more than 20 tons of HALEU (high-assay low-enriched uranium) have been allocated, with efforts ramping up to expand

supply chains, recycling, and reprocessing. At the same time, workforce development is a priority, with programs focused on apprenticeships, education, and enhanced lab access to ensure the skilled talent needed for this next era of nuclear growth.

In 2024, the United States maintained its position as the global nuclear leader, producing 823 TWh (terawatt hours) of electricity—nearly 30 percent of the world's nuclear output. China followed with 451 TWh, or 16percent of the global share, while France contributed 381 TWh, representing 13.5 percent. Russia, South Korea, and Canada completed the top six, together accounting for almost 17 percent of worldwide nuclear generation. Notably, the United Arab Emirates posted the fastest growth among major producers, expanding generation by 17.6 percent as new reactors came online, underscoring the momentum of nuclear energy's global resurgence.

The world's largest nuclear power–producing countries in 2024 (TWh): U.S. remains the nuclear powerhouse at 823 TWhor 29.2 percent of global nuclear electricity generation; China ranks second at 451 TWh (16 percent), followed closely by France at 381 TWh (13.5 percent); Russia, South Korea, and Canada round out the top six, collectively making up nearly 17 percent of world nuclear generation.

The UAE saw the fastest growth among major producers, up 17.6 percent year-over-year as new Latest U.S. import tariffs for titanium tubes, coils, strips, and similar articles, based on current Harmonized Tariff Schedule (HTSUS) classifications:

- Titanium Tubes, Pipes (HTS 8108.90.60.6060)
- General tariff rate: 15 percent ad valorem;
- Special (preferential) rate: Duty free for select countries (e.g., Australia, Chile, South Korea, Singapore, etc.).
- Titanium Plates, Sheets, Strips, Foil (HTS 8108.90.60.6045)
- General tariff rate: 15 percent ad valorem
- Special (preferential) rate: Duty free for the same set of eligible trade partners
- Other Titanium Articles – "Articles of Titanium" (HTS 8108.90.30), Includes items such as castings, bars, rods, profiles, and wire
- General tariff rate: 5.5 percent ad valorem
- Special (preferential) rate: Duty free for qualifying partner countries (source: hts.usitc.gov) reactors ramped up.

According to Silva, titanium materials used in artificial intelligence (AI) data centers are mostly about thermal management, corrosion-proof cooling systems, and advanced energy storage/distribution infrastructure: Titanium tubing and plates are used in heat exchangers, chillers, and condenser systems, where corrosion resistance and long service life are critical. High-efficiency power distribution and backup systems (transformers, rectifiers, turbines for on-site generation) use titanium alloys in tubing, housings, and fasteners where strength and temperature resistance matter; racks and enclosures needing high strength with reduced weight; battery cooling systems—titanium tubing is used in thermal management loops due to non-reactivity; fuel cell integration—titanium serves as a corrosion-resistant bipolar plate or tubing material; heat transfer and cooling reliability; condenser tubing, steam generator tubes, and seawater cooling systems; thermal efficiency, long-term durability, corrosion resistance, and low lifecycle cost.

Silva also discussed upbeat forecasts for the medical market, aerospace and defense, heat exchangers, and desalination plants.

Peter Zimm, principal, Charles Edwards Management Consulting, reported on his group's aerospace titanium outlook. He began with the big picture by saying total aircraft production value was $158 billion in 2024; total maintenance, repair and overhaul (MRO) value was $245 billion. Total aircraft production value rose 7.5 percent to $158 billion in 2024; commercial air transport fell 5 percent. Zimm noted build slowdowns and persistent supply chain constraints at Airbus. The military market grew a staggering 32.4 percent, primarily driven by fighter jets and trainers, adding that 2023 was an artificially low year for fighter and trainer deliveries. Business and General Aviation (BGA) delivered robust growth of 15.3 percent, with modest production increases across various segments.

The first few weeks of President Donald Trump's second term saw a "plethora of significant economic changes, such as tariffs on Mexico and Canada. Suppliers are taking a wait-and-see attitude toward tariffs; others are shifting production or are trying to split the cost with customers," he said. "How are suppliers dealing with tariff and trade uncertainty? Most are just waiting to see how the trade and tariff picture shakes out. Some production and logistics are being shifted to avoid tariffs. Some are incurring tariffs. It varies as to how much they are able to pass on to the next tier. Some simply don't have much exposure."

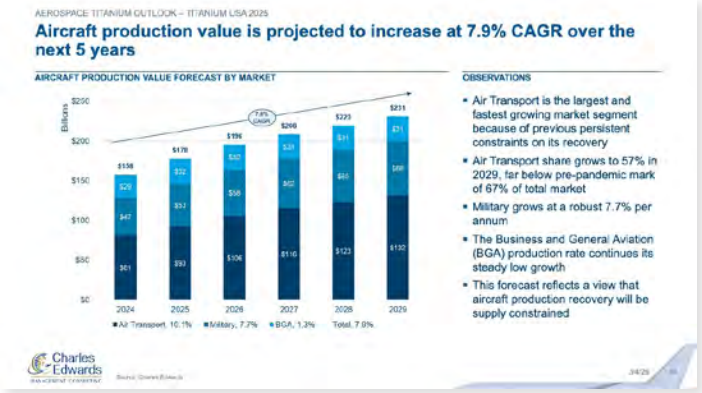
Zimm noted that the SPS Fasteners fire introduced unknowns and there may be sudden shortages. On

February 17, a fire broke out at the SPS Fasteners facility in Abington, PA, destroying most of the complex. It was one of the largest aerospace fastener facilities in the world, which was vertically integrated and sole source for many parts, and puts more demand on an already constrained aerospace fastener supply chain. SPS's parent PCC moved internally threaded parts to other facilities but are making externally threaded parts at SPS. Relatively low level of orders compared to prior years is not a concern in the face of large backlogs.

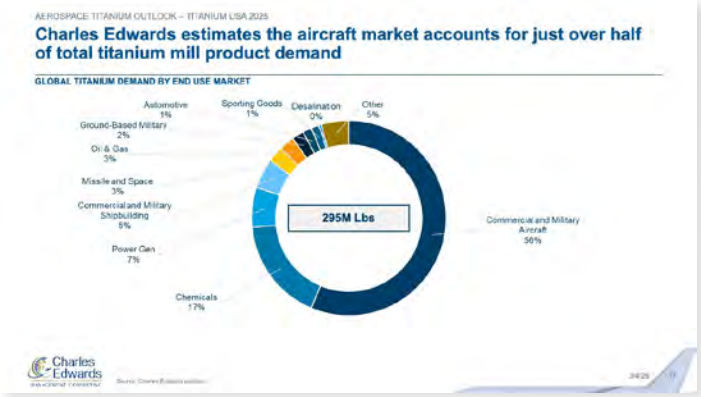
"Paris 2025 (air show) garnered more orders than Farnborough 2024. All announced large commercial transport orders went to Airbus. Boeing and GE reduced their presence (they didn't announce orders, didn't hold an investor day, etc.) due to the Air India crash. Trump's Middle East trip garnered some large orders for Boeing in May. The only aircraft needing orders was the A220 (three years of backlog)—all other backlogs are 5 to 10 years."

"Suppliers are upbeat (particularly about Boeing MAX build rates), but visibility to supplier schedule harmonization remains limited. What is supplier sentiment about OEM build rate aspirations? Suppliers are upbeat. Boeing (especially MAX program) seems to be getting back on track. Airbus continues to increase its build rates (except for A350). Is there a line of sight to harmonizing the schedules of individual suppliers? It's still coming into focus, however constraints persist in key areas (engine forgings and castings, seats). There is not yet a line of sight to harmonization. Will there be an impact from the SPS fire? We still expect fastener constraints in the fourth quarter. Fastener lead times remain long. Some amount of supply is coming from overseas, but may be subject to tariffs."

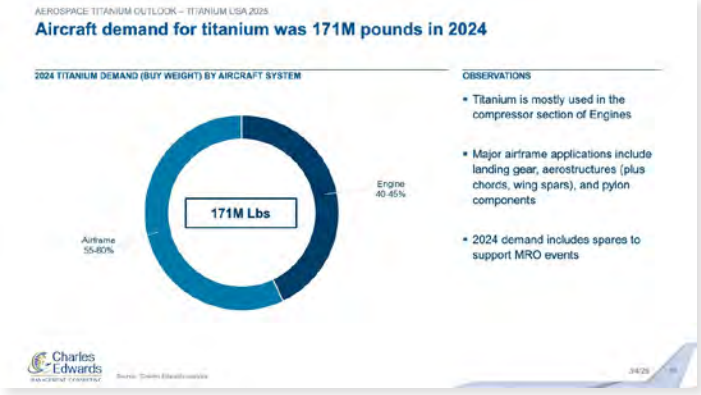
Aircraft production value is projected to increase at 7.9 percent CAGR over the next five years, according to Zimm. Air Transport is the largest and fastest growing market segment because of previous persistent constraints on its recovery. Air Transport share grows to 57 percent in 2029, far below pre-pandemic mark of 67 percent of total market. Military grows at a robust 7.7 percent per annum. The Business and General Aviation (BGA) production rate continues its steady low growth. This forecast reflects a view that aircraft production recovery will be supply constrained.



Regarding the titanium aerospace outlook, Charles Edwards estimates the aircraft market accounts for just over half of total titanium mill product demand. Global titanium demand by end-use market, 295 million pounds, with commercial and military aircraft, accounted for 56 percent of the total.



Aircraft demand for titanium was 171 million pounds—airframes, 55 to 60 percent; engines, 40 to 45 percent. Titanium is mostly used in the compressor section of jet engines. Major airframe applications include landing gear, aerostructures (plus chords, wing spars), and pylon components. The demand includes spares to support MRO events.



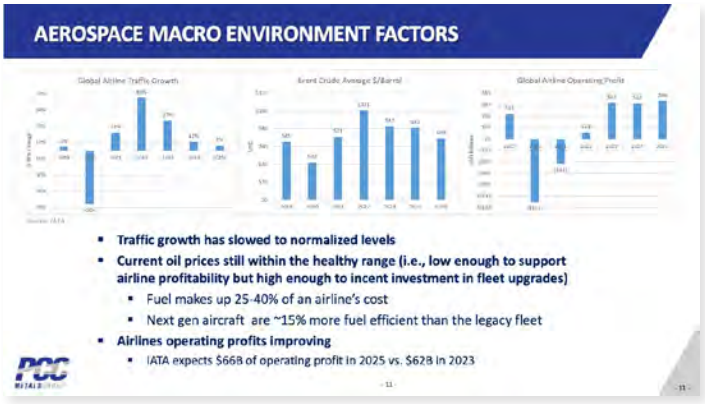
Jeff Easto, vice president of supply chain for Titanium Metals Corp. (TIMET), presented information on "Global Demand Trends, Aerostructures." Considering the aerospace duopoly performance in 2024, deliveries fell 12 percent due to Boeing quality issues and strike. Airbus growth was up 4 percent with growth restricted by supply chain challenges. Boeing down 34 percent due to quality challenges (MAX 9 door plug blowout in January and three-month strike beginning in September).

▪ *(Continued on page 22)*

Regarding the duopoly performance so far in 2025, deliveries as of July 31 were up 13 percent year to date (YTD). Airbus, 373 YTD (down 7 percent) due to supply challenges. The A320 is down 10 percent due to a lack of engine supply. Airbus wide-body jets are down 11 percent on supply constraints, while the A220 is up 31 percent. Boeing is at 328 (up 50 percent) on initial recovery from operational challenges. The 737 is up 45 percent; the 787 is up 61 percent and the 777 is up 175 percent.

An aggressive production ramp up is still expected, according to Easto. "Demand remains ahead of supply. Order flow continues to be strong, particularly for wide bodies. Key programs are sold out into 2030s. Targets continue to slide to the right on supply challenges. Production/deliveries will be paced by supply chain and Boeing's operational improvement. Backlogs are well above pre-pandemic levels, particularly for wide bodies. The current backlog represents nearly 10 years of narrow-body jet production and more than 10 years of wide-body production.

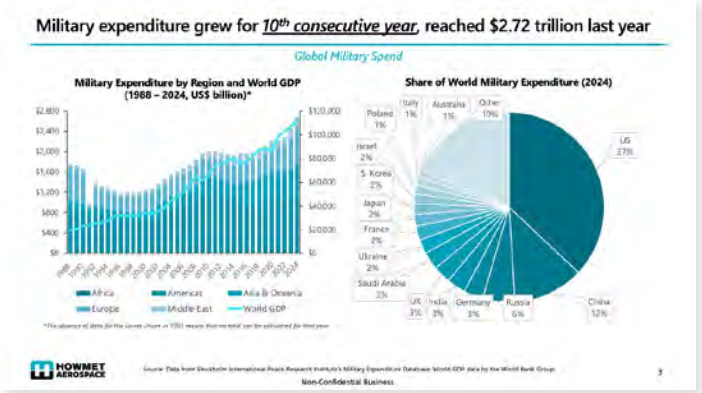
Easto said global airline traffic growth has slowed to normalized levels. Current oil prices still within the healthy range (i.e., low enough to support airline profitability but high enough to incent investment in fleet upgrades). Fuel makes up 25 to 40 percent of an airline's cost. Next Gen aircraft are about 15 percent more fuel efficient than the legacy fleet. Airline operating profits are improving. The International Air Transport Association (IATA) expects $66 billion of operating profit in 2025 compared with $62 billion in 2023.

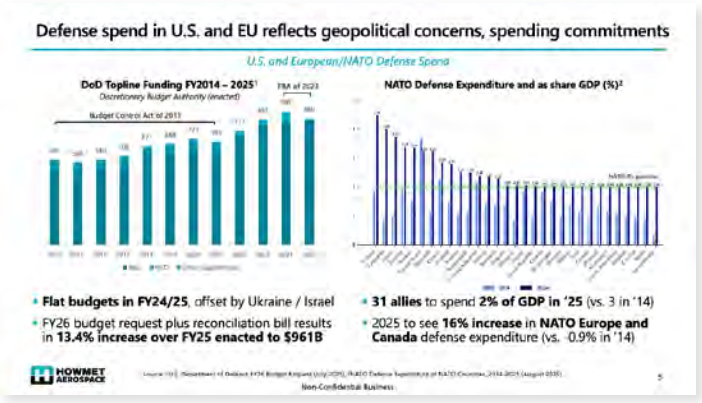


"Titanium recovery (in aerospace) is holding steady, but every layer of the supply chain depends on a strong focus on quality, with a relentless focus on a zero defects mindset."

In summary, Easto said steady deliveries, ongoing order momentum, and a solid backlog point to the realization of long-term commercial aviation forecasts. "Strong airline performance is reflected in RPKs (Revenue Passenger Kilometers), ASKs (Available Seat Kilometers), and macro indicators, despite lingering operational challenges. With strong growth in titanium demand, it's on us as suppliers to rise to the challenge. Expansion efforts, notably in the United States, are gaining momentum. Technology, sustainability, and supply chain shifts will drive aerospace innovation. Solving the challenges ahead will be exciting. The industry's commitment to quality demands attention across all levels of the supply chain."

Ben Squires, head of government affairs, Howmet Engineered Structures, a division of Howmet Aerospace Inc., examined "Titanium Demand Trends in Defense Aerostructures." Squires said military expenditures grew for 10th consecutive year, reaching $2.72 trillion in 2024, noting that "defense spending in the United States and the European Union reflects geopolitical concerns and



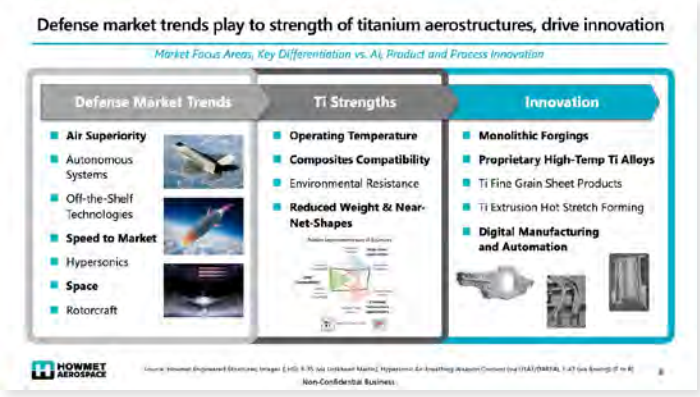


spending commitments."

Despite political changes, trend lines continue regarding defense spending policy. For example, in the United States, there was $156 billion for new spending in reconciliation bill, with 81 percent going to research and development procurement. The focus includes sixth generation fighters (F-47 and F/A-XX), F-35, F-15EX, B-21, loyal wingman, hypersonics, missile and "space air" defense and shipbuilding.

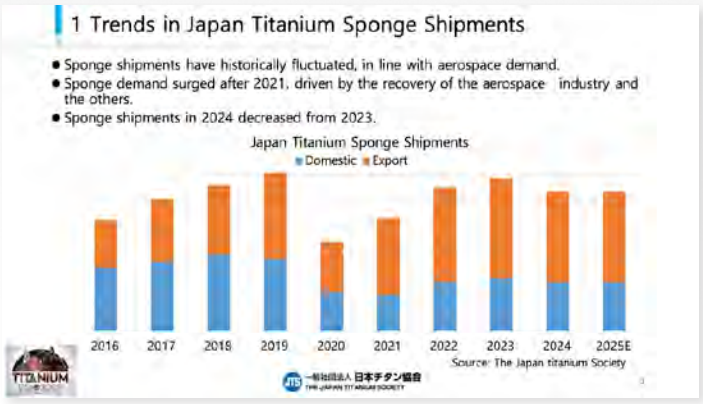
The current tariff/industrial base policy focuses on-shoring (IEEPA, Section 232, etc.), investment in domestic supply chains and stockpiling, and continued use of export controls to restrict access to sensitive technology. "Military spending is the key to trade negotiations with allies and partners, with a continued focus on streamlining defense export regulations."

"The U.S. fiscal year 2026 budget request and reconciliation offer a clear view of administration priorities," Squires said. "Defense market trends play to strength of titanium aerostructures and drive innovation."

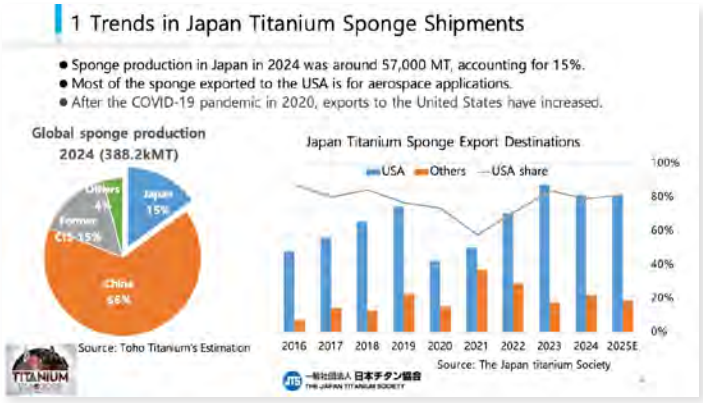


According to information posted online, Howmet Engineered Structures was formerly known as Arconic Inc. before it split into two companies in 2020. The division manufactured high-engineered structural components, including airframes and defense systems, using titanium and aluminum.

Ryosaku Kadowaki, chairman of the Japan Titanium Society and executive officer of Kobe Steel, Ltd., spoke about the "Outlook on Current Titanium Trends in Japan." Kadowaki said sponge shipments have historically fluctuated, in line with aerospace demand. Sponge demand surged after 2021, driven by the recovery of the aerospace industry and the others. Sponge shipments in 2024 decreased from 2023.



Sponge production in Japan in 2024 was around 57,000 metric tons. Most of the sponge exported to the United States is for aerospace applications. After the Covid-19 pandemic in 2020, exports to the United States have increased.



The shipment volume of mill products has not returned to the 2019 level since the Covid-19 pandemic. Sixty percent of shipments have been for overseas market. Demand for high-quality titanium sponge for aircraft applications is growing, and the global titanium supply chain is being restructured since the conflict between Ukraine and Russia. Countries, including Japan, are designating titanium as "specified products" for national supply security. With Japanese government's support, Japanese titanium sponge industries sustain to play a role to contribute to the growth of the global aerospace industries by suppling in good quality and quantity.

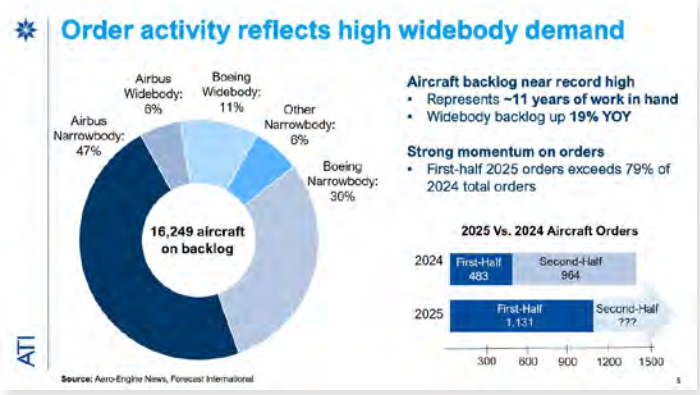
Large titanium forgings for aircraft applications also have been designated as specified products under the

Economic Security Promotion Act, and efforts are being made to ensure their stable supply. Japan Aeroforge (J Forge) plays a key role in production of large titanium forgings by performing die forging, a core process. J Forge manufactures large titanium forgings for aircraft using one of the world's largest 50,000-ton presses. These forgings include engine discs, airframes, and landing gear components. J Forge is an affiliated company of Kobe Steel, Ltd.

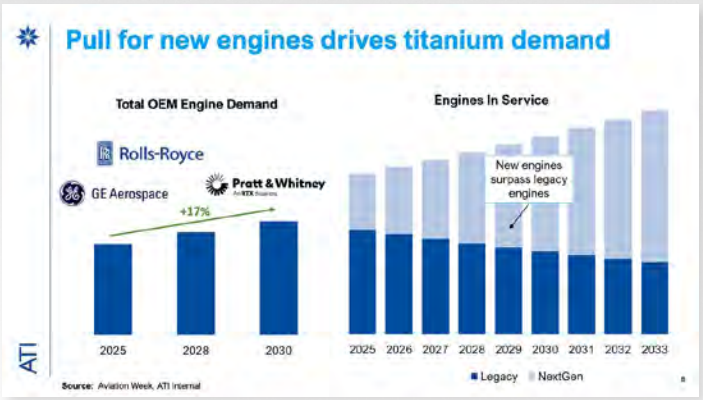
Kadowaki said the Japan Titanium Society is committed to promoting the expansion of new applications in titanium and to nurturing the next generations of leaders who will shape the future of our industry. "We believe that these activities will contribute to the growth of titanium demand and industry, leading to the progress and well-being of humanity."

Marty Pike, vice president, global commercial strategy for ATI, offered details on "Commercial Aero-Engine Trends and Demands." Strong travel demand lifts passenger revenue. Air travel demand exceeded pre-pandemic levels in 2025. RPKs are up 5.8 percent from 2024. Passenger Load Factor (PLF) is expected to reach record-high of 84 percent this year. Long-term, air travel expected to double by 2053 at 3 percent CAGR.

Pike said airline profits remain stable, but fragile. Profitability continues as year-over-year revenues (+1.3 percent) are rising faster than expenses (+1 percent) Asia Pacific region sees largest improvement. Order activity reflects high wide-body demand, and the aircraft backlog is at a near record high. Wide-body backlog is up 19 percent, year over year. There's a strong momentum on orders, as first-half 2025 orders exceed (by 79 percent) of 2024 total orders.



New engine MRO is expected to grow at a 15.3 percent CAGR through 2033. Narrow-body and wide-body platforms are expected to create roughly equal MRO demand. Narrow-body engine MRO demand for the CFM56 and V2500 are top drivers of MRO activity



through 2034. LEAP and GTF are in the first cycle of MRO scheduled activity. Wide-body engine MRO demand for the GE90 and CF6 provide steady ongoing spares. TRENT and GENX activities are projected to double over next decade.

Pike said titanium demand will grow and stay robust, and he identified titanium demand drivers:

- Engine fleet expanding
- Ramping build rates of current generation programs will increase titanium demand
    - Premium quality titanium is the foundation of engine part performance
    - Engine MRO surging with lasting strength
    - Legacy programs with defined titanium content will see consistent demand
    - Learning cycle of new programs are driving near-term MRO demand
    - Future engine designs enter service in 2030s
    - Titanium remains mission critical to new applications

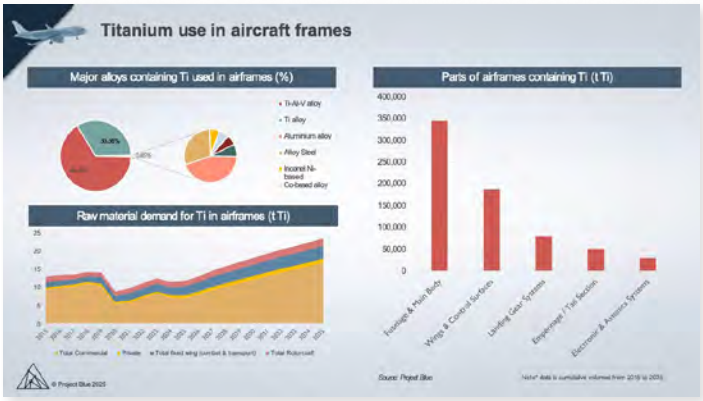
A representative from **Project Blue,** London, provided and outlook on "Trends and Forecast in Aerospace and Defense Applications; a Titanium Case Study." Project Blue provides independent, premium market intelligence on 30 critical material supply chains, enabling a deep understanding of industry dynamics. This coverage spans "mine to market, enabling a full understanding of the impact of demand-side developments on upstream markets. Our research services contain a suite of analysis documents, data sets, interactive tools and customer support."

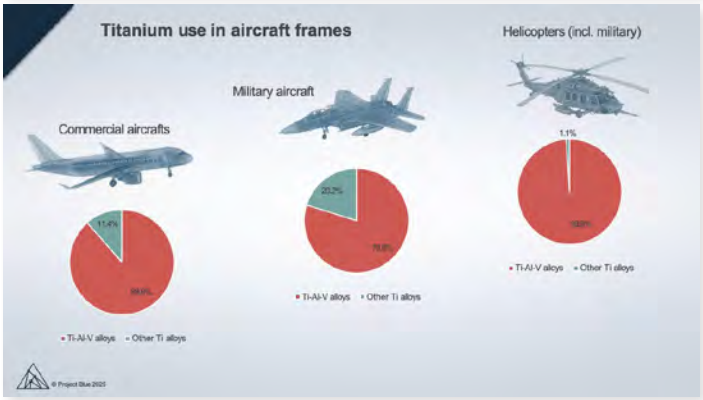
An overview of Project Blue's aerospace modelling includes aircraft model deliveries data and forecast: Monthly Airbus and Boeing delivery data and forecast guidelines; Quarterly OEM reporting by jet engine

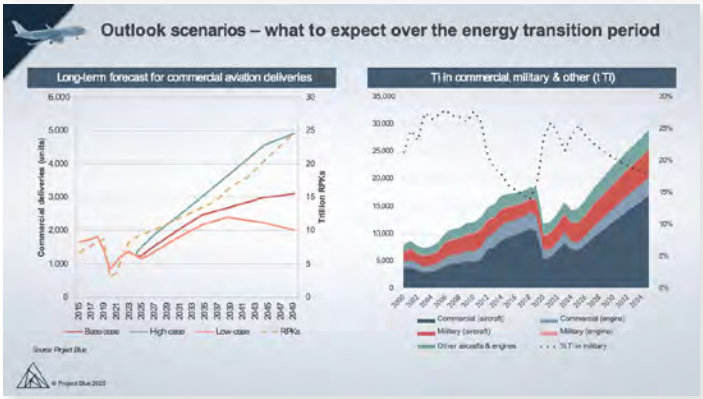
manufacturing; Engines linked to aircraft models; Feedback loop analysis to estimate private and military sector.

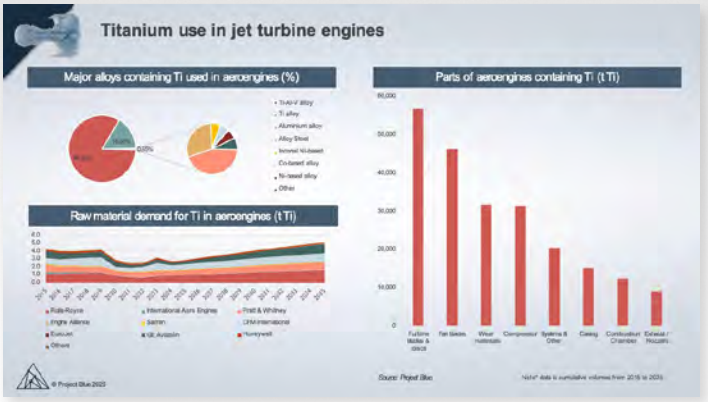
For a superalloy demand outlook, the analysis includes: Over 110 superalloy types broken down by part; Raw material end-use demand; Analysis of buy-to-fly ratios by part (to be completed); Annual raw material demand and recycling feedstock.

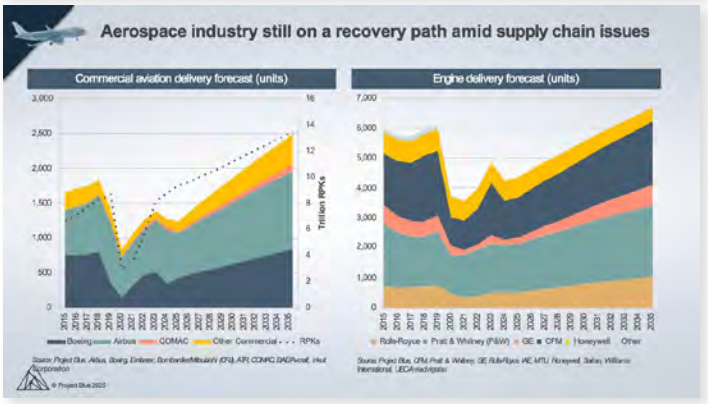
Frame parts analysis for over 450 aircraft models includes: Engine parts analysis of over 110 engine models; Break down of over 80 groups of parts, split by commercial, private and military categories; Estimated use of superalloys, ferroalloys and composites per part; Breakdown of alloy type requirements by OEMs.





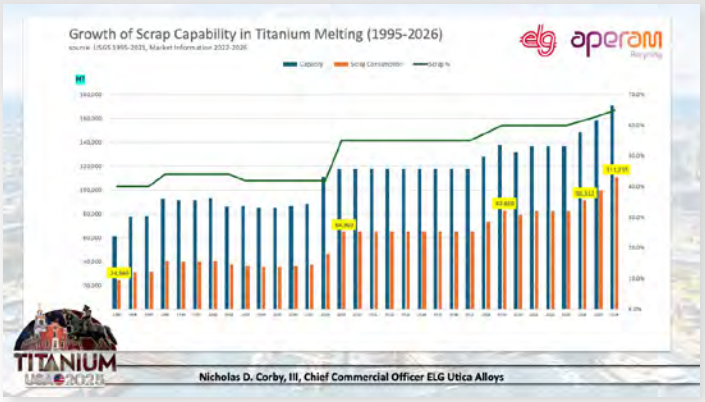


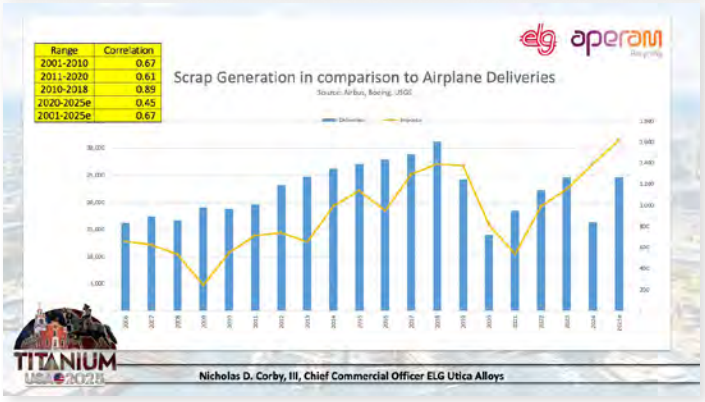




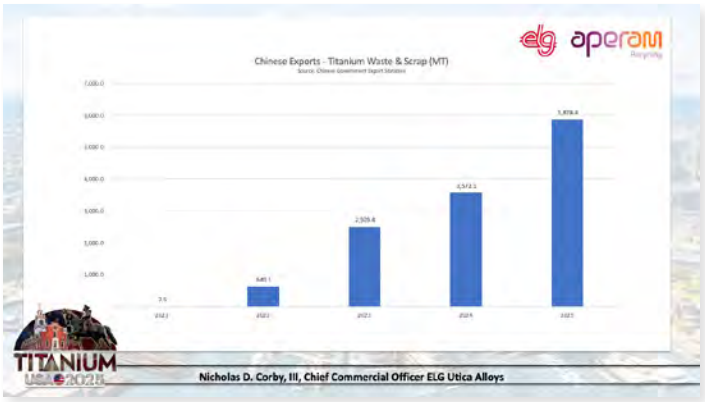
Nicholas D. Corby, III, chief commercial officer, ELG Utica Alloys, presented a paper on "Titanium Scrap Trends—Demand, Supply, and Variation." ELG Utica Alloys is one of the business units of ELG's global operations and focuses on the recycling of titanium, superalloys and special metals, with processing capabilities located in the United States and Europe, while the global supply network is leveraged.

ELG examined the growth of scrap capability in titanium melting (1995-2026), tracking titanium scrap capacity, consumption and percentage. Scrap consumption is expected to reach 111,215 metric tons in 2026, compared with 91,512 metric tons in 2024 and 2025.



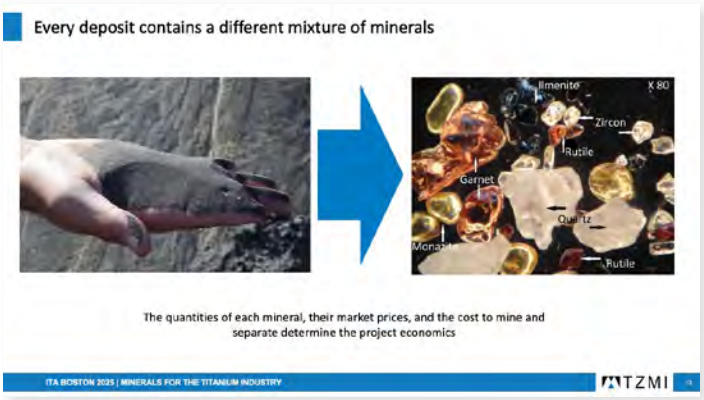


Chinese exports of titanium and scrap will total over 5,800 metric tons in 2025, compared with over 3,500 metric tons in 2024 and 2,500 metric tons in 2023.

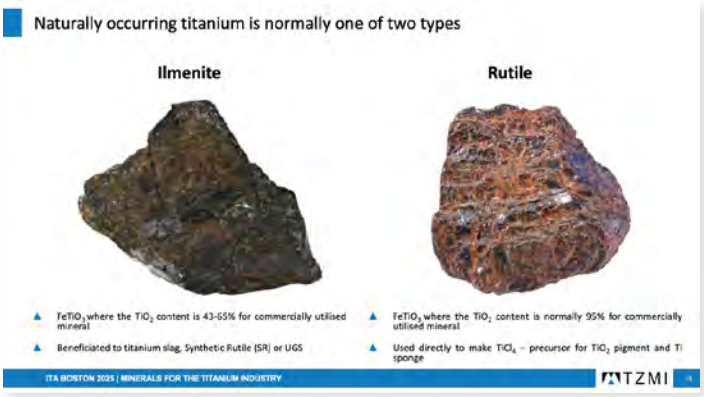


David McCoy of TZMI Minerals International, Australia, examined "Minerals for the Titanium Industry." TZMI is an independent consulting company, operating since 1994, that works with a wide range of global clients to provide insight and expert advice on opaque mineral, metal and chemical sectors. Clients range from the world's 500 largest companies through to mid-sized companies and small businesses. TZMI regularly releases market reports and periodicals on relevant subject matters which support its primary consulting activities with up-to-date, high-quality and comprehensive data, analysis and information. TZMI has continued to grow and expand over the years by adding business units operating in Shanghai, China (TZMI Management Consulting (Shanghai) Co., Ltd) and Houston (TZMI, Inc.) as well as taking full ownership of Allied Mineral Laboratories Pty Ltd (AML) based in Perth, Western Australia.

McCoy asked the question: where does titanium come from?; milled products?; wrought products? ingot and slab?; sponge? No, he said titanium comes from the ground: hard rock mining and alluvial sand mining.

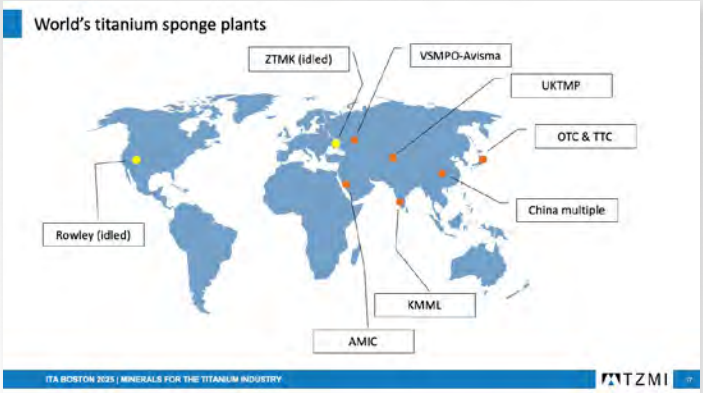


Every deposit contains a different mixture of minerals. The quantities of each mineral, their market prices, and the cost to mine and separate determine the project economics.



Naturally occurring titanium is normally one of two types: ilmenite and rutile. Titanium minerals all contain different amounts of TiO2. Titanium is a part of the critical minerals strategy of many countries.

He identified the world's major titanium sponge plans, some of which have been idled, and stated that Africa is becoming one of the largest suppliers of titanium minerals. He identified facilities in South Africa, Madagascar, Mozambique, Sierra Leone. Senegal, Egypt



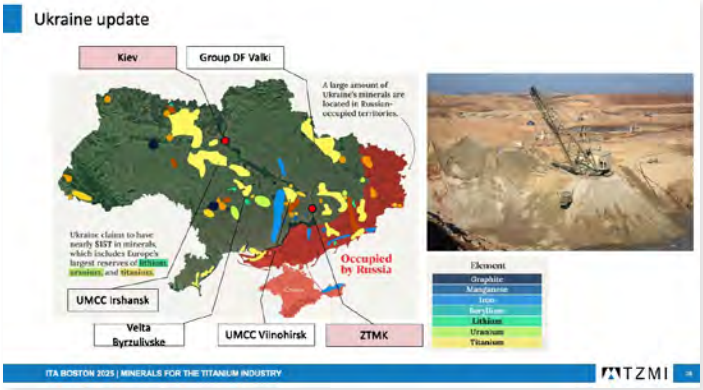
and Nigeria.

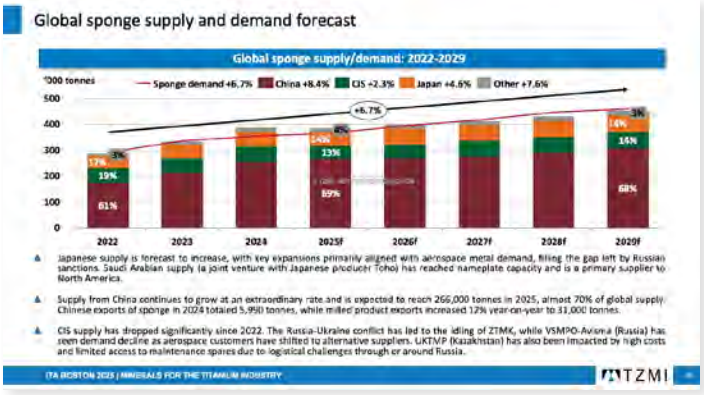
Mine construction began by QIT Madagascar Minerals (80 percent Rio Tinto (via QIT-Fer et Titane, its Canadian subsidiary and 20 percent Government of Madagascar) in 2025.First production of ilmenite began at the Mandena deposit was in 2009. 40-year life span with over $1 billion invested. Sierra Rutile was established in 1971 although mining was occurring some years earlier. By 1993, the mine was the largest producer of rutile in the world, but the 1995 civil war saw the mine abandoned.

From 2005-2007 the mining operations were restarted and the plant was refurbished. In 2016, Australian company Iluka took control but spun off the operation in 2022. In Senegal, evaluations of resources started in the 1950s. In 2004 Australian company MDL started project definition and evaluation. In 2011 MDL and Eramet formed TiZir Limited, a 50/50 joint venture. MDL was acquired by Eramet in 2018 and currently sells ilmenite to the INEOS titanium smelter in Norway under a long-term supply agreement from 2023.

He displayed a slide of other projects in Africa, Along with a slide that showed an update of operations in Ukraine.

He also showed bar charts of global sponge supply and demand forecast and demand for titanium feedstock to the metal industry.

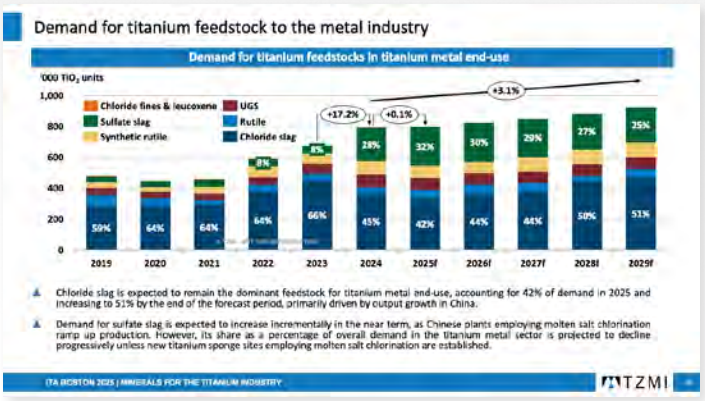




McCoy gave a rundown of bullet-point items regarding significant global business trends:

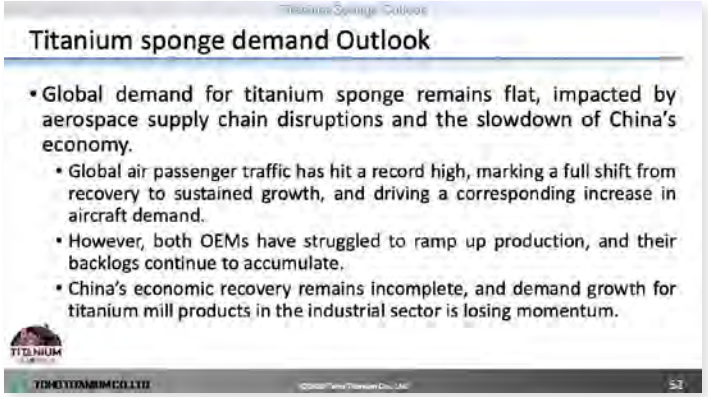
- Japanese supply is forecast to increase, with key expansions primarily aligned with aerospace metal demand, filling the gap left by Russian sanctions. Saudi Arabian supply (a joint venture with Japanese producer Toho) has reached nameplate capacity and is a primary supplier to North America
- Supply from China continues to grow at an extraordinary rate and is expected to reach 266,000 tons in 2025, almost 70 percent of global supply. Chinese exports of sponge in 2024 totaled 5,990 tons, while milled product exports increased 12 percent year-on-year to 31,000 tons
- CIS supply has dropped significantly since 2022. The Russia/Ukraine conflict has led to the idling

of ZTMK, while VSMPO-Avisma (Russia) has seen demand decline as aerospace customers have shifted to alternative suppliers. UKTMP (Kazakhstan) has also been impacted by high costs and limited access to maintenance spares due to logistical challenges through or around Russia



- Chloride slag is expected to remain the dominant feedstock for titanium metal end-use, accounting for 42 percent of demand in 2025 and increasing to 51percent by the end of the forecast period, primarily driven by output growth in China
- Demand for sulfate slag is expected to increase incrementally in the near term, as Chinese plants employing molten salt chlorination ramp up production. However, its share as a percentage of overall demand in the titanium metal sector is projected to decline progressively unless new titanium sponge sites employing molten salt chlorination are established.

Takeshi Nakashima, managing executive officer, Toho Titanium Co. Ltd. of Japan, provided a "Titanium Sponge Outlook." Nakashima said global demand for titanium sponge remains flat, impacted by aerospace supply chain disruptions and the slowdown of China's economy. Global air passenger traffic has hit a record high, marking a full shift from recovery to sustained growth, and driving a corresponding increase in aircraft demand. However, both OEMs have struggled to ramp up production, and their backlogs continue to accumulate. China's economic recovery remains incomplete, and demand growth for titanium mill products in the industrial sector is losing momentum.



As for titanium sponge demand in the aerospace sector, Nakashima pointed out that supply chain disruptions in the aerospace sector are limiting growth in titanium sponge demand. Delays in non-titanium components have slowed Airbus production, causing Titanium inventory to build up. The Boeing strike last year continues to suppress demand for aerospace applications. The timing of sponge demand recovery remains uncertain. Given the mounting backlogs at the two OEMs, titanium sponge demand in the aerospace sector is expected to rise by 2027. For now, however, supply chain requirements for titanium applications remain relatively weak, resulting in subdued demand for sponge.

The aerospace sector appears to have secured sufficient sponge for its supply chain for now. However, it remains unclear how long the current supply-demand balance will hold. Historically, sponge titanium demand in the aerospace supply chain has fluctuated significantly, and similar volatility may occur in the near future. Future sponge demand is influenced by various factors like: OEMs' preference for sponge supply stability over cost competitiveness; Raw material management in the aerospace supply chain; Taxation and tariff policies under the Trump administration; Efforts by sponge suppliers to expand capacity to the aerospace sector.

Significant growth in titanium sponge demand for general industrial sector is not expected, according to Nakashima. Domestic demand in China remains sluggish due to the prolonged economic slowdown. Industrial demand in other regions also shows limited growth prospects. New demand is emerging in areas such as mobile applications, but overall domestic consumption has seen only modest growth. Competitive Chinese mill products are gaining ground globally, supported by domestic sponge oversupply. As a result, mill suppliers outside China are losing industrial market share.

Regarding the overall titanium sponge supply outlook, Nakashima reported that Osaka Titanium has reduced the operating rate of its sponge plant from 90 percent to 80 percent this year, reflecting a temporary dip in demand. VSMPO plans to cut output to 17K tons this year and the next, potentially influenced by shifts in procurement strategies among French customers. Chinese sponge suppliers rarely export to the United States due to high additional tariffs this

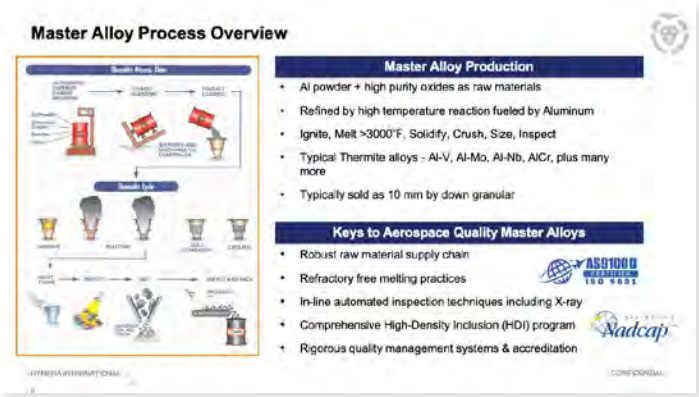
year. Declining industrial demand among non-Chinese suppliers is expected to shift more sponge supply toward the aerospace sector. "For now, the aerospace sector has access to sufficient sponge supply."

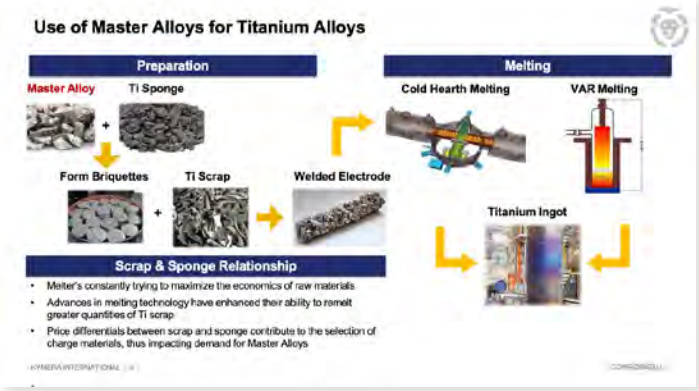
The oversupply of titanium sponge in China is unlikely to be resolved in the near future. Despite the current oversupply, several Chinese sponge producers are pursuing capacity expansion plans, backed by secured funding. Structural excess liquidity in the Chinese economy continues to exert pressure toward oversupply across industries. Chinese sponge remains cost-competitive due to oversupply. Chinese sponge producers need to sell their entire output to maintain cash flow. Sponge oversupply is benefiting Chinese mill suppliers and may open opportunities to expand their share in the aerospace sector.

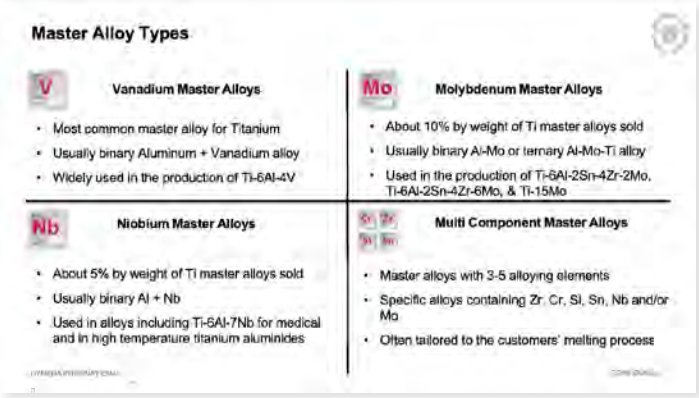
Regarding the titanium sponge outlook, Nakashima said the risk of a titanium sponge shortage persists, despite adequate current supply. "Sponge suppliers have begun adjusting production to match current demand, which may slow their response to any sudden increase. Further expansion of sponge capacity for the aerospace sector remains uncertain. Sponge suppliers hesitate to expand capacity amid declining demand and unstable supply chain priorities. The aerospace supply chain could secure sponge supply by assuring stable sponge demand and favorable contract terms."

Michael Wilkes, director of aerospace and medical sales, Kymera International, presented an overview of "Titanium Master Alloys and Material Trends." Kymera has facilities in Research Triangle Park, NC and other locations in North America and throughout the world. Wilkes defined master alloys for titanium melting as a combination of two or more metals in a metallurgically alloyed form, added with base metals into a melt charge to achieve desired final ingot chemistry. Master alloys are available in various forms, such as powders, granules and aggregates.

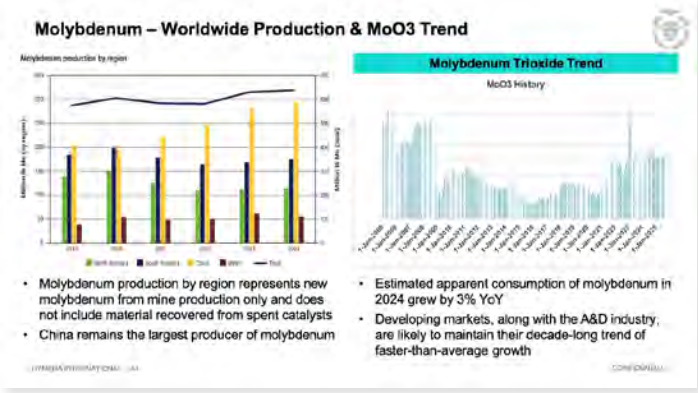
He displayed slides of the master alloy process, the use of master alloys, basic master alloy types and oxides for titanium master alloys.

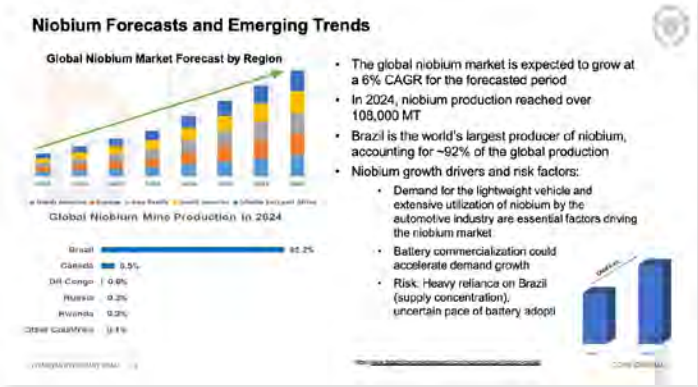






The global vanadium pentoxide market is expected to grow at a CAGR of 8.8 percent, driven by two large end markets: steel alloying and energy storage (vanadium redox flow batteries, VRFBs). Delays to projects could keep the market tight. Vanadium is an important alloying agent for titanium. Wilkes also provided a slide that showed molybdenum worldwide production trends. "China remains the largest producer of molybdenum. Regarding molybdenum end-use structure, market research estimates over 2.5 percent CAGR in the forecasted period. Aerospace, defense and energy sectors in North America will drive the fastest growth rates."



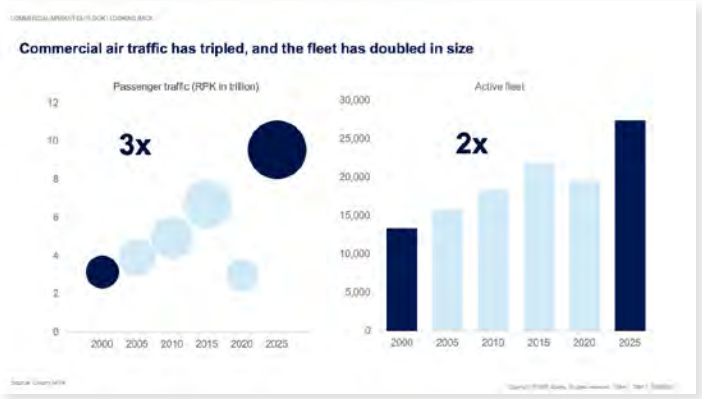


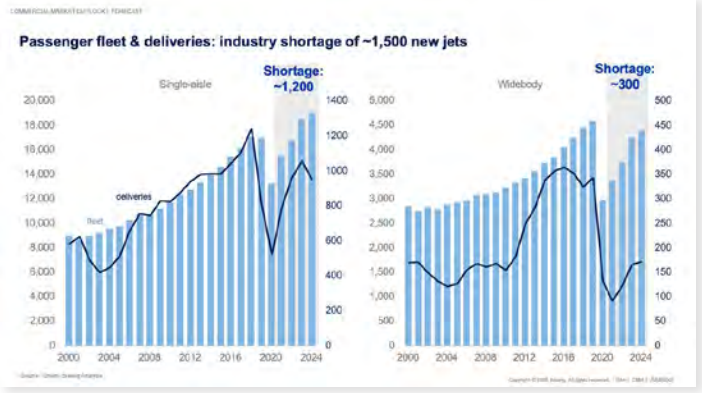
Niobium forecasts and emerging trends show that the global niobium market is expected to grow at a 6 percent CAGR. Niobium production reached over 108,000 metric tons in 2024. Brazil is the world's largest producer of niobium, accounting for 92 percent of global production.

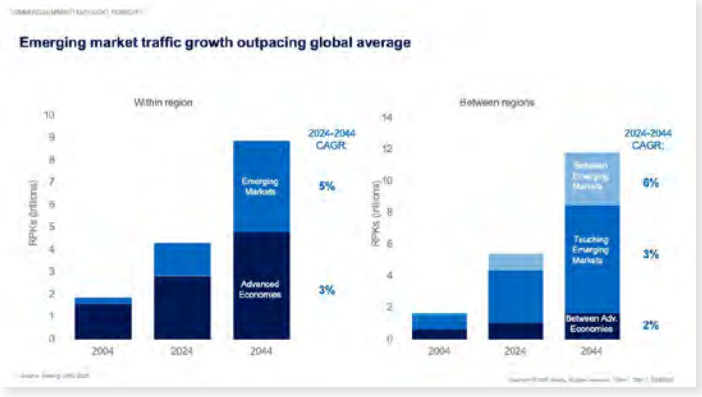
"Short-term demand dynamics for master alloying elements will be influenced by titanium scrap used in melting, inventory levels throughout the global supply chain and geopolitical situations. Continued supply surges and dips in the global steel industry, led by China, will drive dynamics. Continuous risk management is recommended."

Commercial Aerospace Trends

Jeff Carpenter, vice president, supply chain structures for Boeing Commercial Airplanes, gave a business update and titanium perspective for his group. He began by saying commercial air traffic has tripled, and the fleet has doubled in size. For passenger fleet and deliveries, there

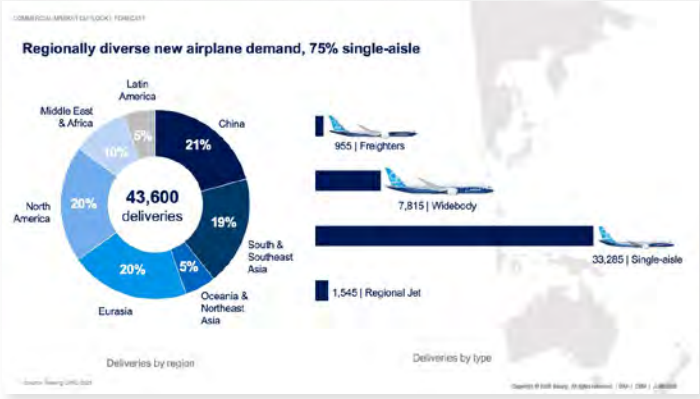






is an industry shortage of about 1,500 new jets. Emerging market traffic growth is outpacing the global average.

Carpenter then turned to regionally diverse new airplane demand, which is 75 percent single-aisle. Growth is expected in the global commercial wide-body fleet; a fleet of 4,400 in 2024 growing to a fleet of 8,320 in 2044. Air cargo plays a vital role in the global economy.



"Commercial aviation is a growth industry, with a demand for 43,600 new deliveries through 2044," he stated. "We have identified suspect documentation, learned about sources, identified material properties, replaced parts in our factory, developed training material for the supply base, and identified opportunities to strengthen supply chain integrity. We are implementing process improvements, refining and enhancing requirements, requiring AS9100/AS9120 for distributors, and establishing new language and intervals for periodic testing, all with increasing oversight. We ask industry support of enhanced certification of conformity, embrace systems/technology-based solutions and to add spec requirements addressing any gaps with participation in Boeing Raw Material Strategy (BRMS)."

Regarding Boeing's titanium strategy inventory summary, Carpenter said that participant forecast data indicates inventory burndown for titanium will continue through 2030. There's delayed consumption of work in progress in 2025 impacting 2026/2027. Boeing suspended purchasing of titanium from Russia in 2022, with conservative inventory burn to mitigate risk. Product mix continues to change as supply chain evolves.

Carpenter then explained the importance of titanium scrap to Boeing's Raw Material Strategy (BRMS). "Why is scrap important to Boeing commitments to mills and melters? To minimize cyclical costs of alternative input materials, to provide access to alternative input materials, which have shifted globally. There's been a dramatic increase in scrap utilization for melt operations; increased reclamation enables capacity."

"What are we doing? BRMS participants have existing commitments to Boeing, conducting on-site audits of machine shops, re-baselining expectations on projected scrap volumes, and updating scrap rate percent's on older BRMS agreements Segregating scrap by alloy type is critical." He said Boeing has made progress since 2024, with an 18-percent increase in participant collection rates and a 36-percent increase in scrap recovery. "We need your help. Experiencing issues with scrap collection? Please contact us."

Olivier Maillard, vice president, metallic material procurement for Airbus, offered his company's "Titanium Demand Forecast." First, he noted that there will be a demand for 43,420 passenger and freighter aircraft by 2044, with 16,750 planes already in backlog. The fleet will almost double in the next 20 years, and a higher proportion of new deliveries (about 44 percent) will replace older, less fuel-efficient aircraft.

The A321XLR has been in service since October 2024. According to information found online, the A321XLR is a narrow-body, extra-long-range commercial aircraft that enables airlines to open new transatlantic routes by connecting secondary cities. Key features include a range of up to 4,700 nautical miles, a rear center fuel tank for extended range, reinforced landing gear, and new passenger amenities like larger overhead bins and charging ports.

As for the "Titanium Revert Loop" program, Airbus is shifting from a linear economy approach to a "circular" economy approach, with the objective to ensure that scrap generated throughout its industrial system is recovered and reverted to support Airbus programs and Airbus sustainability objectives. He said all Airbus manufacturing plants are already feeding Titanium Revert Loop, with progressive deployment throughout supply chain. The first partners were "on-boarded" in the third quarter of 2025. "The Step One objective is to ensure more than 50 percent of scrap generated by Airbus programs are reverted for Airbus. Additional revert opportunities are initiated with material from end-of-life aircraft. First parts have been recovered and remelted for Airbus applications."

Maillard summed up his remarks by saying that global air traffic has had a strong rebound and continued growth is "projected to nearly double the in-service fleet by 2044, driving demand for 43,420 new aircraft deliveries, with a strong emphasis on more fuel-efficient, new-generation aircraft and expanded network opportunities. Airbus leadership and strong order backlog is calling for a robust production ramp-up to the highest rates in the Aerospace

history until 2030 and beyond. The Airbus titanium demand has recovered 2019 volumes in 2024 and, despite adjustments in 2025 and 2026, is set for further growth according to our target rates. This robust demand is an opportunity but will call for anticipation and resilience. Long-term planning is key, especially in a geopolitically unstable environment. Circularity and sustainability are also a priority."

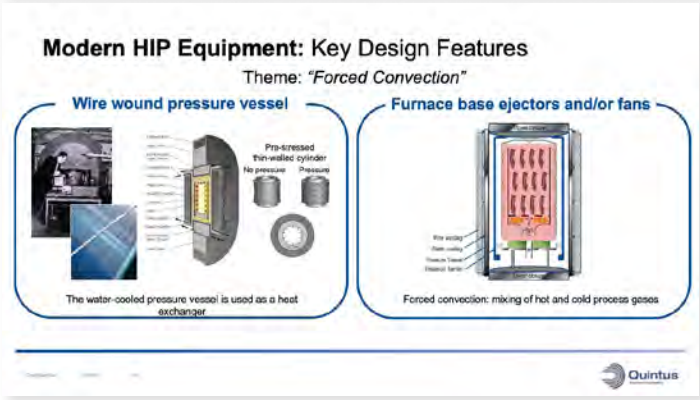
Manufacturing Technology

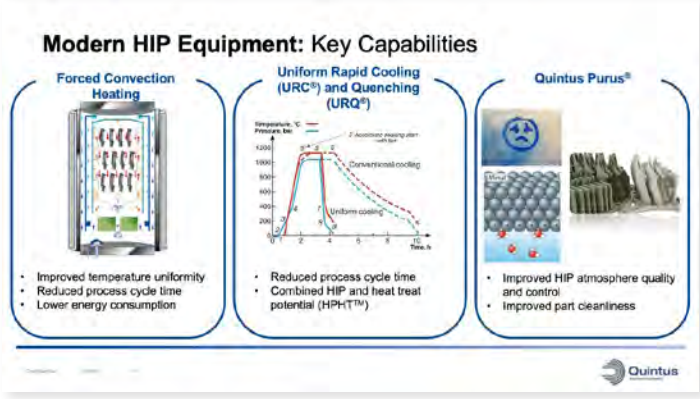
James Kurzawa, business development manager for Quintus Technologies LLC, Lewis Center, OH, provided manufacturing technology information on "HIP and High Pressure Heat Treatment Strategies for Optimized Mechanical Properties of LB-PBF Ti-6Al-4V." Kurzawa reviewed the advantages of Quintus' Hot Isostatic Pressing (HIP):

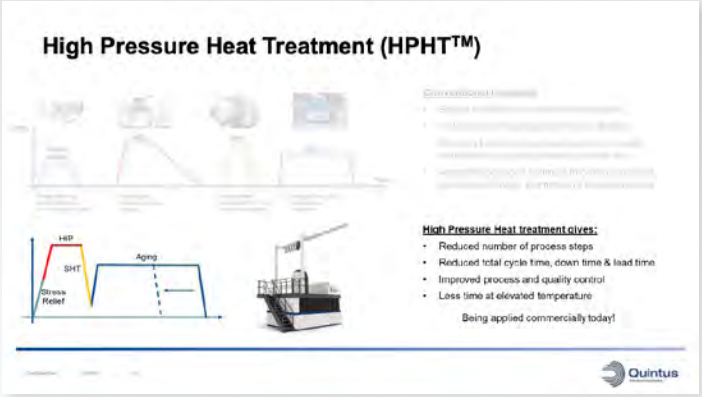
- Elimination of internal defects
- Elimination of stress concentrations and crack initiation points
- Superior material properties
- Drastically increased fatigue life 10 to 100x
- Increased ductility and fracture toughness
- Better creep properties
- Reduced property scatter
- Natural variation in defects for a component is eliminated
- More predictive material properties
- Improved machined/polished surface quality
- Increased corrosion resistance
- Sealing performance
- Optical/aesthetic properties.

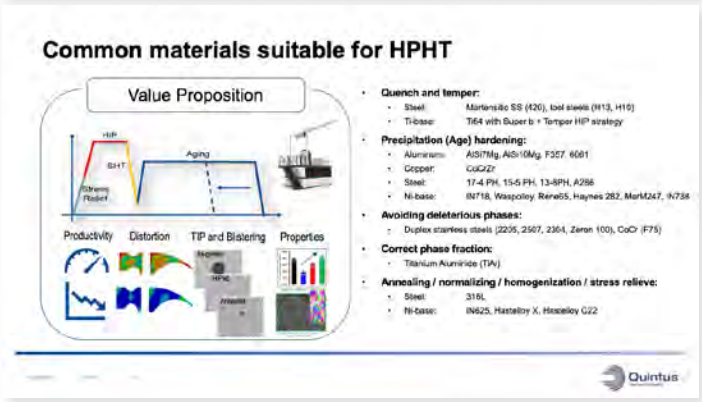
He then reviewed slides of a modern HIP system and its capabilities:

Kurzawa explained the Quintus Application Center offers in-house training application research and development and education on HIP equipment for new customers. Customers can gain knowledge about equipment in operation over time and are exposed to research and development collaborations with the most prominent universities, institutes and global companies. The high pressure heat treatment (HPHTTM), compared with conventional HIP systems, reduces the number of process steps, reduced cycle time, down time and lead time, improved process and quality control and less time at elevated temperature, according to Kurzawa.



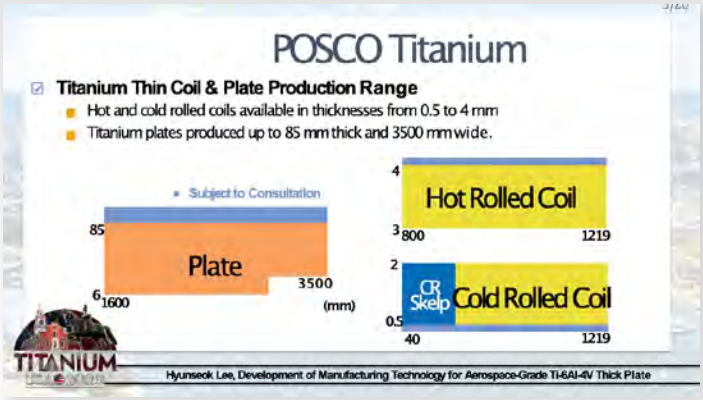






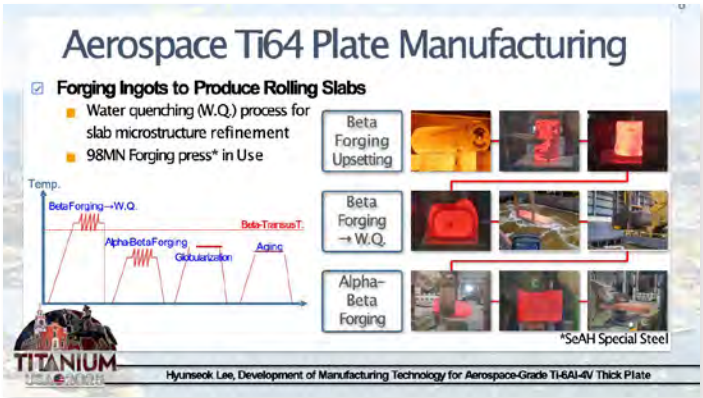
Kurzawa concluded his presentation by saying HIP closes internal porosity in cast and printed materials, improving performance and reliability. Advancements with HIP technology improve control of the process. HIP optimization and HPHT has been of significant focus on additive manufacturing materials, including Ti64.

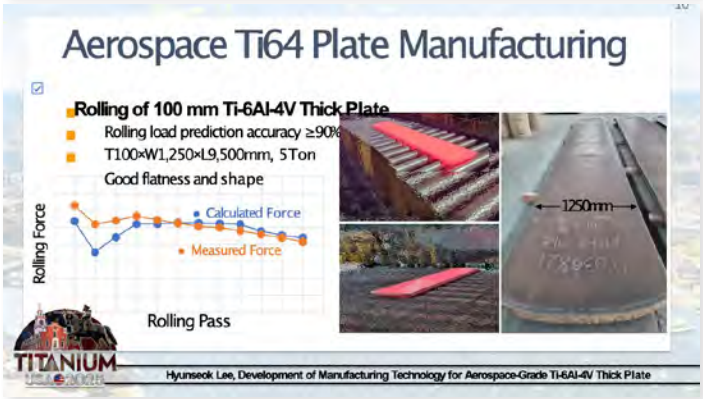
Hyunseok Lee of the Research Institute of Industrial Science and Technology (RIST), Pohang, South Korea, presented information on the "Development of Manufacturing Technology for Aerospace-Grade Ti-6Al-4V Thick Plate." Posco, a global steelmaker producing over 40 million tons annually, which generated about $60 billion in revenue in 2024, founded RIST in 1987 as a "practical technology institute."



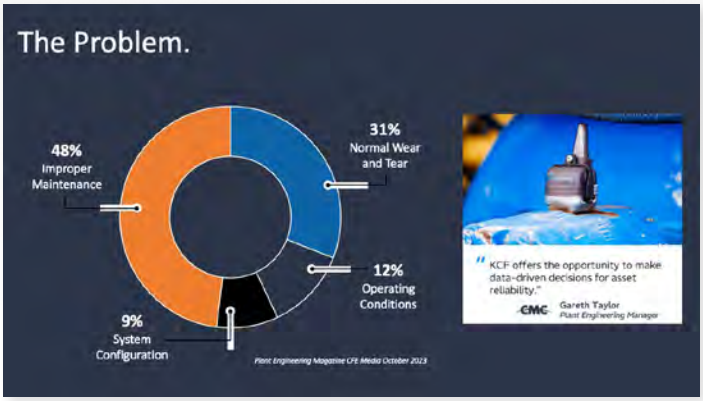
Posco, founded in 1968, with headquarters in Pohang and Seoul, South Korea, is "engaged in steel, green materials, hydrogen, energy, batteries, and infrastructure." RIST drives the growth of the POSCO Group, promoting strong collaboration between industry, academia, and research. Posco is involved in titanium thin coil and plate production.

Lee outlined the group's aerospace Ti64 plate manufacturing, forging ingots to produce rolling slabs.





Dave Krauth, senior director of sales, manufacturing, for KCF Technologies Inc., reviewed "Leveraging AI and Analytical Efficiency for Next-Generation Predictive Maintenance." Krauth began with a pie chart that identified the problems regarding production maintenance and offered a customer quote that said "KCF offers the opportunity for data-driven decisions for asset management."



Krauth said the industry seeks real-time visibility, comparing assets, facilities, and different operators to know exactly how they are always operating at peak performance. Another goal is preventing failures from occurring that require emergency repair, reducing safety incidents and extending the life of critical equipment. A third goal is to undershoot capital spending by equipping teams from the shop floor to the C-suite with insight into the health of assets enterprise wide.

Comprehensive and scalable AI-powered predictive maintenance can significantly reduce production downtime by removing the "blind spots." The "right data" provides high-resolution, real-time data; the right analysis offers AI-powered insights processed from over 1.2 billion data points per month; and the right action means analytics delivered into workflows for smarter, faster decisions.

Using KCF diagnostic tools mean "the right data should be easy. Say goodbye to route-based maintenance." PDM sensor suite provides high-definition vibration and temperature sensors. Wirelessly collect high-definition sensor data across your facility creates a mesh network. Data is securely stored and uploaded to the cloud, where AI transforms it into actionable insights.

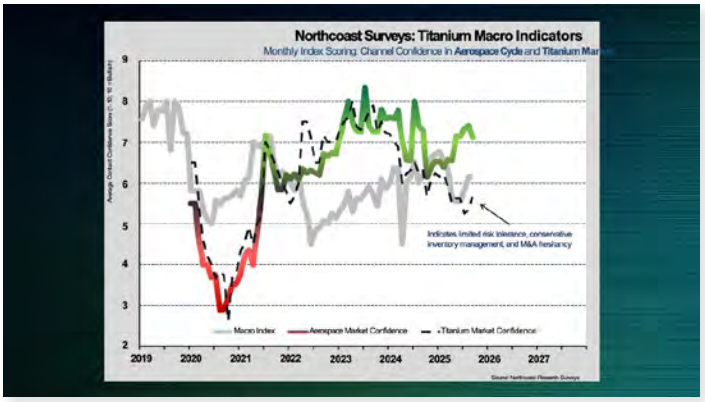
Military and Defense Trends

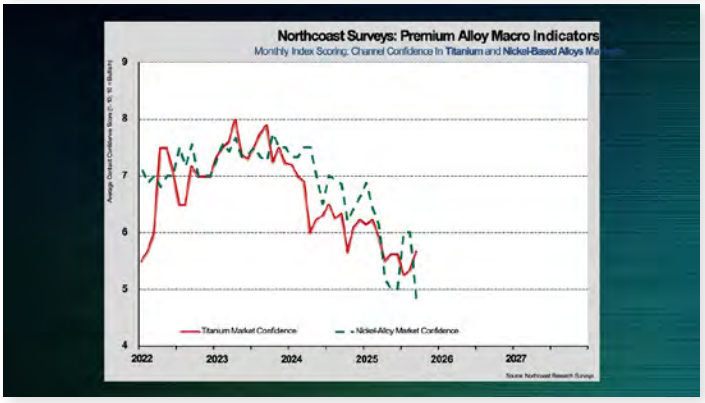
Chris Olin, senior research analyst for Northcoast Research, delivered his "Military and Defense Macro Outlook: One of the Few Bright Spots for Titanium." Olin said quarterly "channel checks" by Northcoast "indicate a surprising level of demand weakness throughout the global titanium market, largely driven by aggressive aero inventory draw down efforts, and macro/import tariff uncertainty. Supplier sentiment recently hit a three-year low."

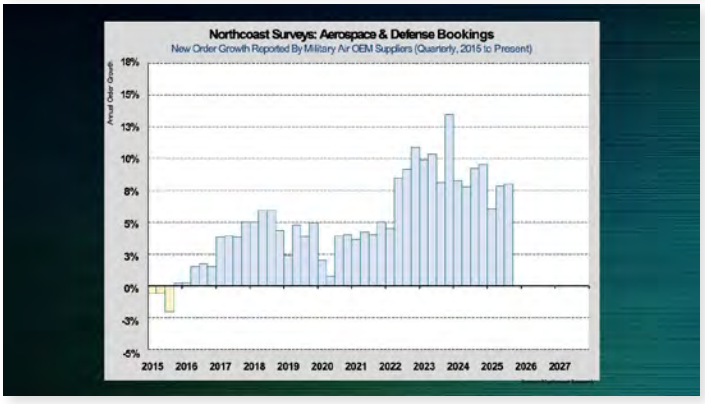
Based in Cleveland, Northcoast Research is an independent, full service institutional equity research firm providing value to clients through a unique research process, as stated on the organization's website.

"Military/defense demand trends have been steady for the past two years, with titanium suppliers highly levered to military-OEM and/or military-MRO market activity outperforming the survey peer group. We expect companies to chase defense business going forward, reacting to excess internal supply and solid military demand visibility (12 to 18 months)," Olin said.

"The U.S. Department of Defense (DoD) spending outlook should add fuel to the military demand "fire," with President Trump requesting Congress approve a $962-billion funding outlay (up 12 percent, year to year) for fiscal year 2026. Increased foreign defense spending initiatives complement this growth. We assume mid-to-high single-digit Western World military consumption growth through 2027. Yet we are watching a few early developments that might derail the opportunity for most titanium suppliers."

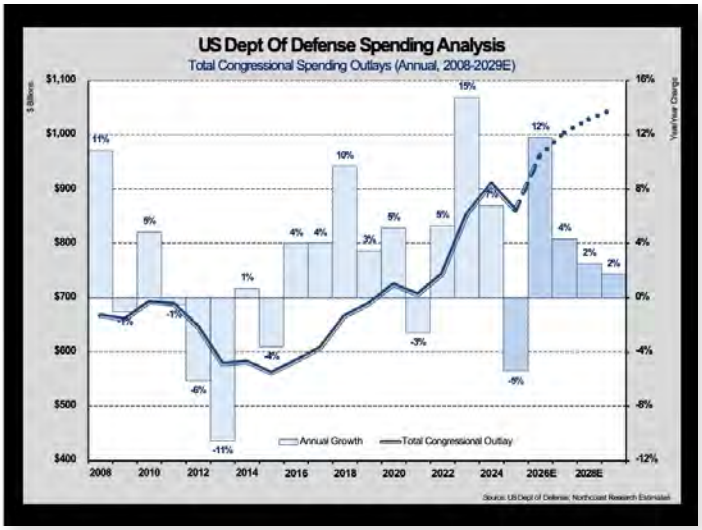


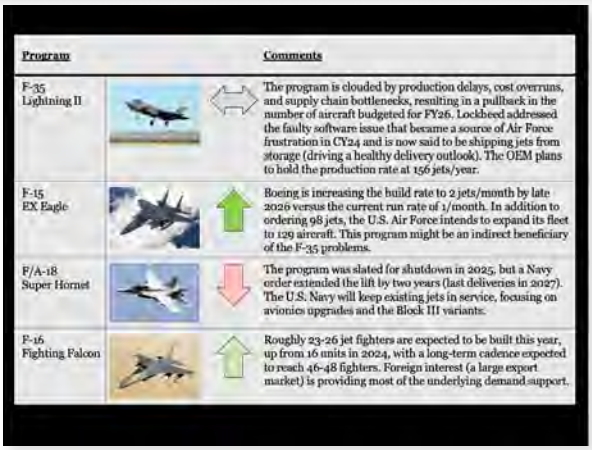


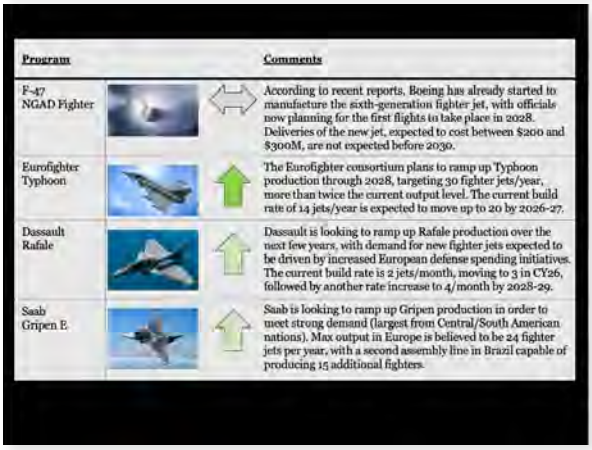


Olin said the U.S. defense budget was set at $860 billion for fiscal year 2025, which implies a 5-percent Congressional spending outlay drop versus 2024. "However, the new number is somewhat misleading, given that the prior year spending plan included supplemental funding for Ukraine and Israel support."

The requested DoD budget for fiscal year 2026, $962 billion, represents 12-percent growth versus fiscal year 2025 (up 72 percent versus the 2015 trough). The presidential spending plan assumes a $113-billion contribution from the reconciliation bill. Underlying objectives highlighted in the FY26 budget include: (1) re-establishing deterrence, (2) rebuilding the military, (3) restoring the "warrior ethos," and (4) reform and optimization. The DoD spending budget is likely to surpass $1 trillion by FY27. The medium-term focus will likely shift towards new technologies and "Global Dome" investments, according to Olin.

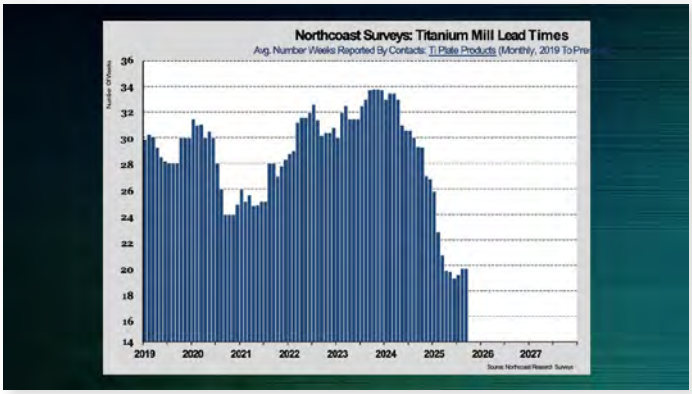






He said there are other things to consider in modeling assumptions. "A future Department of Defense spending bias toward cyber systems, hypersonic munitions, nuclear infrastructure, long-range weapons, advanced missile systems, drone technology, autonomous or remotely controlled aircraft, and space may eventually limit funding for legacy U.S. defense programs (fighters, tankers, etc.). The military investment alternatives are less titanium-intensive, which implies mill product shipment growth will lag changes in military/defense spending."

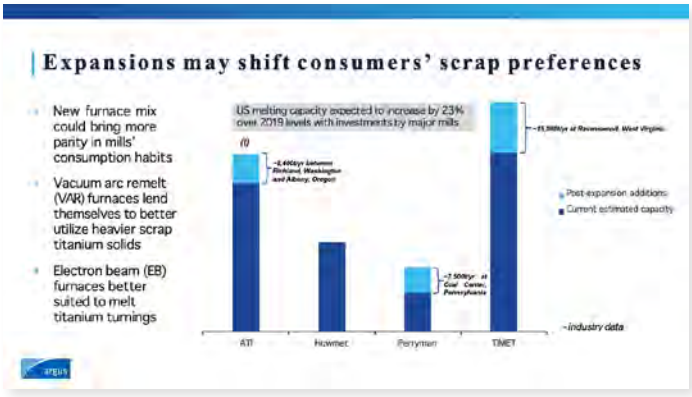
Olin pointed out that there's a substantial backlog of prospective submarine, destroyer, and battleship production programs related to coordinated efforts to restore the U.S. Navy. "As such, we expect the titanium group to realize expected better-than-expected naval/marine orders throughout 2026 and 2027. Factories dedicated to defense-related production could stay offline for the rest of 2025, eventually leading to lost business for the titanium supply chain. Import tariff-related inflation has not yet fully worked into the defense markets."



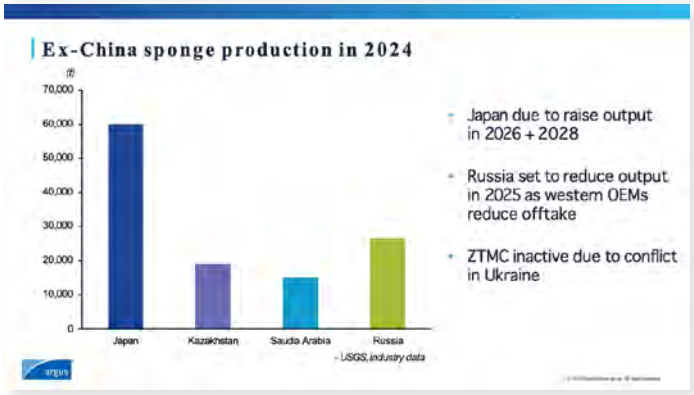
Argus representatives presented "Titanium and Defense, Reshaping Raw Material Flows." According to Argus, U.S. titanium scrap markets are primed for a rebound. Scrap demand is expected to increase in 2026 on new melt capacity. More imports will be needed to supplement domestic generation. Supply chain bottlenecks and inventory overhangs could delay recovery.

Headquartered in the United Kingdom, Argus has over 1,300 staff working in 29 offices in the world's principal commodity trading and production centers. Argus publishes more than 42,000 daily and weekly spot and forward price assessments, along with commentary, news and analysis for global commodities and energy markets.

New furnace mix could bring more parity in mills' consumption habits. Vacuum arc remelt (VAR) furnaces lend themselves to better utilize heavier scrap titanium solids. Electron beam (EB) furnaces better suited to melt titanium turnings. U.S. melting capacity expected to increase by 23 percent over 2019 levels with investments by major mills.

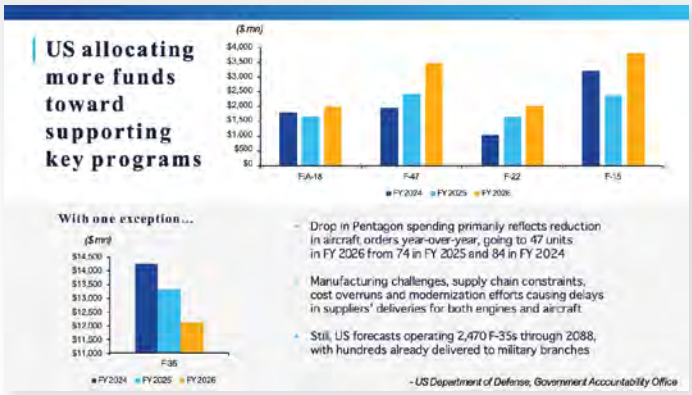


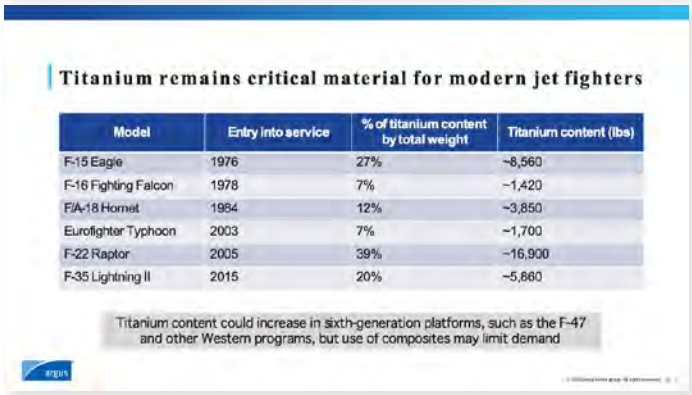
Chinese sponge supply has increased sharply since 2019. Expansions could extend China's oversupply. China increasingly competing in global industrial markets, such as steel additives (TG-Tv sponge) and plate heat exchangers (CP/TA grade). Market split on whether the United States will allow Chinese supply in defense applications but agrees that adoption in other end markets will free up approved supply.



The United States is allocating more funds toward supporting key programs. The drop in Pentagon spending primarily reflects reduction in aircraft orders year-over-year, going to 47 units in fiscal year 2026 from 74 units in fiscal year 2025 and 84 units in fiscal year 2024. Manufacturing challenges, supply chain constraints, cost overruns and modernization efforts causing delays in suppliers' deliveries for both engines and aircraft.

Still, U.S. forecasts operating 2,470 F-35s through 2088, with hundreds already delivered to military branches. Titanium remains critical material for modern jet fighters.



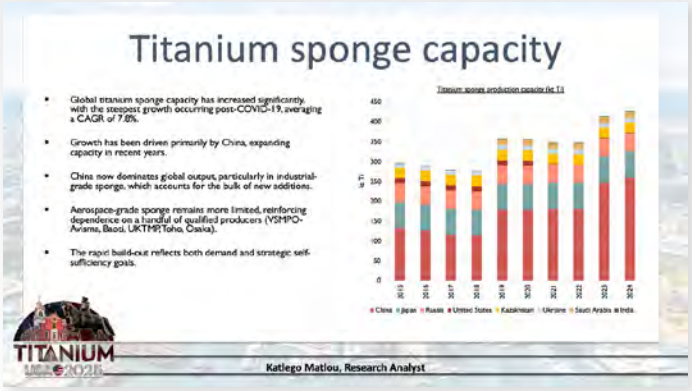


Greater investment in defense capabilities globally will provide a tailwind for titanium consumption in 2026 and beyond. Mills' capacity expansions to drive increase in scrap imports to supplement domestic generation rates. Consumers' input preferences could shift based off new furnace mix in the United States. Adoption of Chinese sponge in non-critical applications to free up approved supply for defense industry. Trade barriers, tariff uncertainty and supply chain constraints pose a risk to recovery in upstream raw material markets.

Industrial Markets

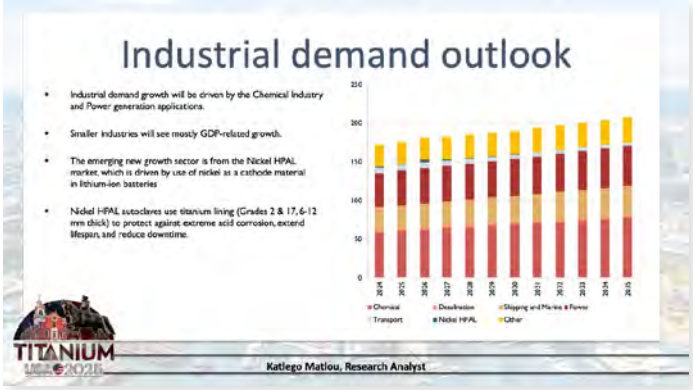
Katlego Matlou, research analyst for London-based Project Blue, reviewed "Industrial Titanium Metal Markets: Outlook and New Growth Sectors." Matlou said global titanium sponge capacity has increased significantly, with the steepest growth occurring post-Covid-19, averaging a CAGR of 7.8 percent. Growth has been driven primarily by China, expanding capacity in recent years. China now dominates global output, particularly in industrial-grade sponge, which accounts for the bulk of new additions. Aerospace-grade sponge

remains more limited, reinforcing dependence on a handful of qualified producers (VSMPO-Avisma, Baoti, UKTMP, Toho, Osaka). The rapid build out reflects both demand and strategic self-sufficiency goals.



As for a titanium market outlook, Matlou said that, on average, industrial applications account for over 65 percent of titanium metal demand, followed by aerospace at around 23 percent. The other comes from medical, consumer electronics, and others, which together make up roughly 12 percent of the market.

"The aerospace sector is projected to expand at a faster pace with a CAGR of 5 percent, while industrial applications are expected to grow more modestly at a CAGR of 1.3 percent. Demand from the aerospace sector is forecast to grow at a CAGR of about 5 percent over the next decade, underpinned by rising aircraft production and fleet modernization."

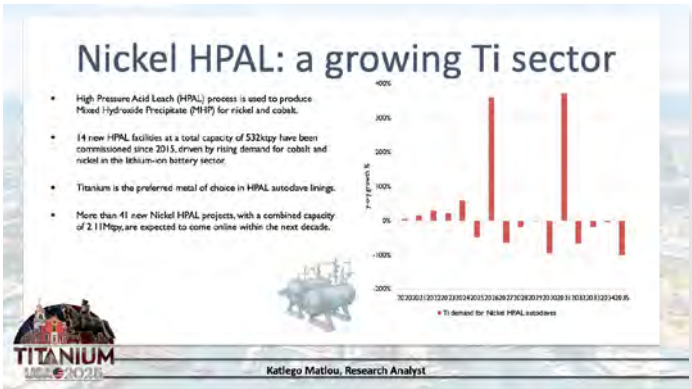


Industrial demand growth will be driven by the chemical industry and power generation applications, according to Matlou. Smaller industries will see mostly GDP-related growth. "The emerging new growth sector is from the nickel high-pressure acid leach (HPAL) market, which is driven by use of nickel as a cathode material in lithium-ion batteries. Nickel HPAL autoclaves use titanium linings (Grades 2 and 17, 6 to 12 mm thick) to protect against extreme acid corrosion, while providing extended lifespan and reduced downtime.

The growth in chemical applications will be dominated by chlor-alkali and the petrochemical industries. Chlor-alkali and petrochemical production are exhibiting respective CAGRs of 2.7 percent and 2.8 percent between 2024 and 2035. Much of this demand will be driven by emerging economies, while large-scale capacity growth is under development in China.

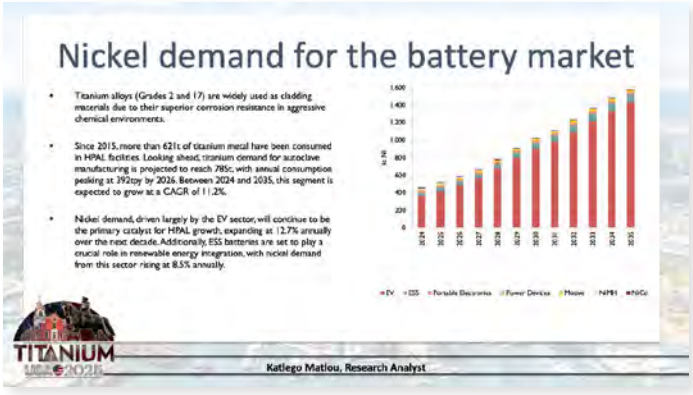
For the power generation sector, new investments will be the main driver of demand in the transition to clean energy. Clean energy investment will result in the steady growth of titanium demand in renewable and nuclear power generation applications, with most nuclear projects planned in Asia. "Titanium used in gas processing will see continued growth due to the large-scale LNG projects currently under development. Overall, titanium demand related to power generation is expected to exhibit a CAGR of 1.5 percent between 2024 and 2035."

Nickel HPAL is a growing titanium sector. The HPAL process is used to produce Mixed Hydroxide Precipitate (MHP) for nickel and cobalt. Fourteen new HPAL facilities at a total capacity of 532 kilotonnes per year (ktpy) have been commissioned since 2015, driven by rising demand for cobalt and nickel in the lithium-ion battery sector. Titanium is the preferred metal of choice in HPAL autoclave linings. More than 41 new Nickel HPAL projects, with a combined capacity of 2.11 mtpy, are expected to come online within the next decade.



Regarding nickel demand for the battery market, titanium alloys (Grades 2 and 17) are widely used as cladding materials due to their superior corrosion resistance in aggressive chemical environments. Since 2015, more than 621 metric tons of titanium metal has been consumed in HPAL facilities.

Looking ahead, Matlou said titanium demand for autoclave manufacturing is projected to reach 785 metric tons, with annual consumption peaking at 392 tpy by 2026. Between 2024 and 2035, this segment is expected to grow at a CAGR of 11.2 percent. Nickel demand, driven largely by the electric vehicle sector, will continue to be the primary catalyst for HPAL growth, expanding at 12.7 percent annually over the next decade. Additionally, energy storage system (ESS) batteries are set to play a crucial role in renewable energy integration, with nickel demand from this sector rising at 8.5 percent annually.

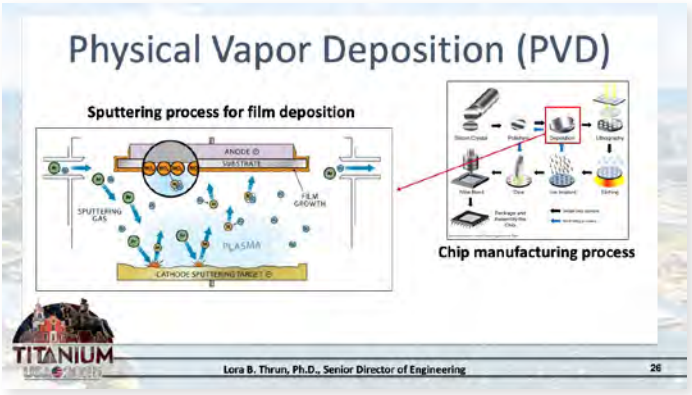


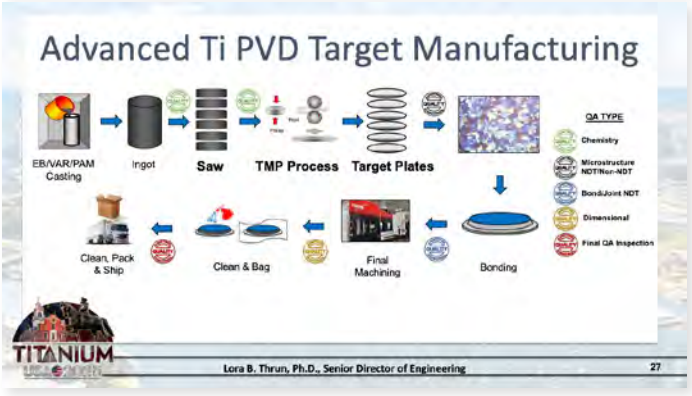
Titanium usage in shipbuilding and marine projects is projected to increase at a CAGR of 2.7 percent between 2024 and 2035. Strict international regulations and guidelines are focusing on energy efficiency and technological advances in ship design. This has increased the focus on titanium applications in the shipping industry.

Matlou concluded by saying the aerospace sector remains the fastest-growing market for titanium metal consumption, but the industrial application remains the main driver of the titanium metal demand, accounting for over 65 percent of the world's titanium metal demand. "China has recently doubled its titanium sponge output, and the majority of this increase is in industrial-grade sponge. Titanium's indirect demand is rising, driven by its critical role in nickel HPAL autoclaves for processing nickel laterite ores. The rapid expansion of battery manufacturing is reinforcing this trend, providing an outlet for much of China's growing titanium production capacity."

Lora B. Thrun, Ph.D., senior director of engineering of Tosoh Corp., discussed "Automated Manufacturing and Statistical Process Control of High Purity Titanium Sputtering Targets for Advanced Semiconductors." Founded in 1935, Tosoh is a global enterprise involved in three core areas: basic chemicals, petrochemicals and specialty materials. Tosho had net sales in fiscal 2025 of $7.1 billion, across 106 group companies worldwide. The company has research facilities in Grove City, OH, and Japan.

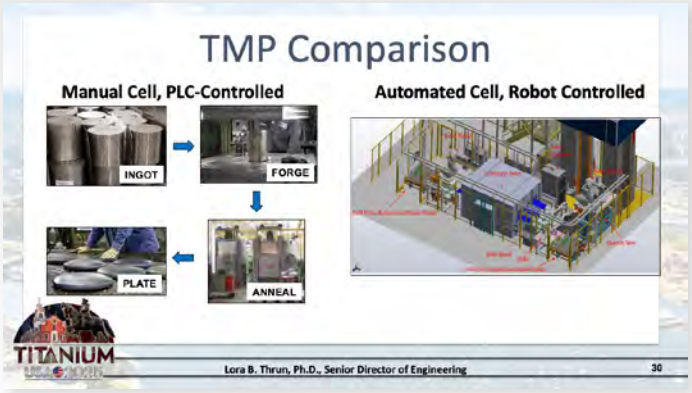
Thrun displayed two slides that illustrated Tosoh's Physical Vapor Deposition (PVD) used in the sputtering process for film deposition and computer chip production, along with Advanced Titanium PVD Target Manufacturing.

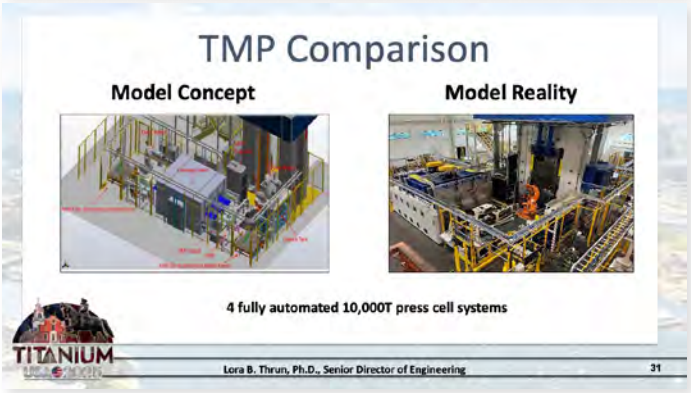




Regarding Advanced Titanium PVD Target Manufacturing, Thrun said thermo-mechanical processing (TMP) is a key step in target manufacturing and the focus of this work. TMP imparts the microstructure required for uniform film deposition. Titanium thin films, used as diffusion barriers, consist of 10nm thick Ti/TiN layers with more than 3 percent NU and deposition rates within plus or minus 1 Å/sec. In this work, process improvements and automation yielded improvements in process consistency, manufacturing efficiency, and cost reduction. Automation and machine learning (ML) is the path forward for future advanced

titanium targets. Thrun displayed two slides that showed a TMP comparison.





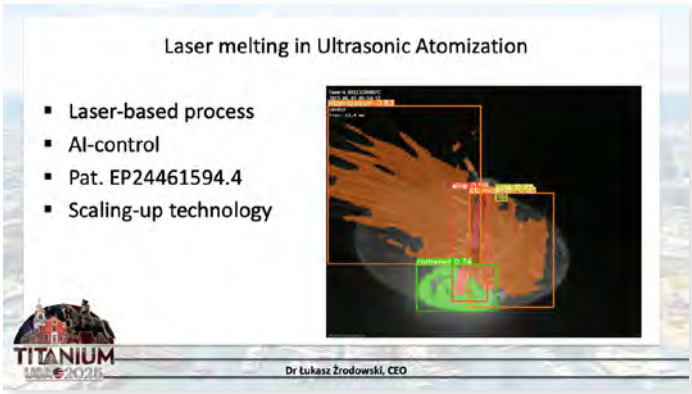
Thrun said developing metastable pure titanium microstructures for improved sputtering performance (patent pending) represents a future advancement. Tight deformation and temperature control process is required for this development. Collaborating with customers and suppliers to increase recycled/remelt content to support sustainability initiatives Tosoh is open to collaboration efforts for non-semiconductor applications.

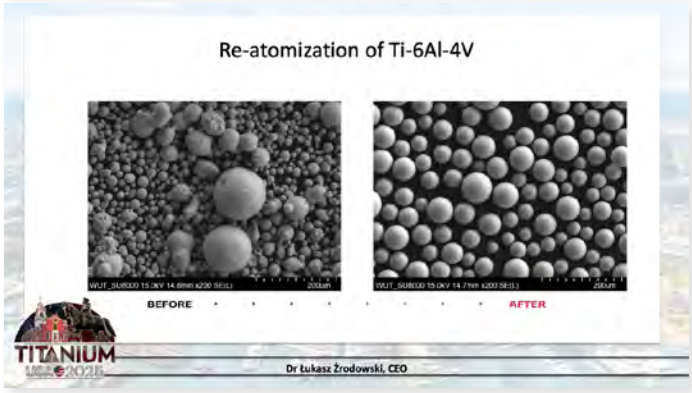
Dr. Lukasz Zrodowski, CEO of AMAZEMET, Warsaw, Poland, presented information on the "Alloy Development of Titanium-Based Systems via Ultrasonic Atomization." Zrodowski said "AMAZEMET provides know how in the area of materials science, 3D printing process, metal powder materials, ultrasonic technology, post processing, and other methods and technologies connected with metal 3D printing and materials development."

AMAZEMET, a 2019 spin-off from Warsaw University of Technology, specializes in providing and developing advanced ultrasonic atomization devices for tailored powder manufacturing and compact high-vacuum furnaces for post-processing and heat-treatment applications. Laboratory-scale solutions like "rePOWDER" and "inFURNER" support leading researchers worldwide in additive manufacturing and beyond.

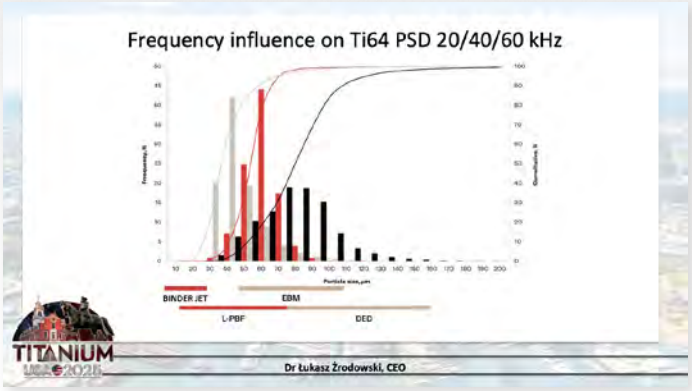
Building on its expertise in materials science, Zrodowski said AMAZEMET has expanded its operations to include the production of custom metal powders tailored to specific requirements. Additionally, it offers production and engineering services such as welding, CNC machining, metal 3D printing, for demanding small and medium production runs. Rooted in academia, AMAZEMET actively collaborates on research projects to develop innovative materials for AM, maintaining strong ties with scientists and academic institutions all around the globe.

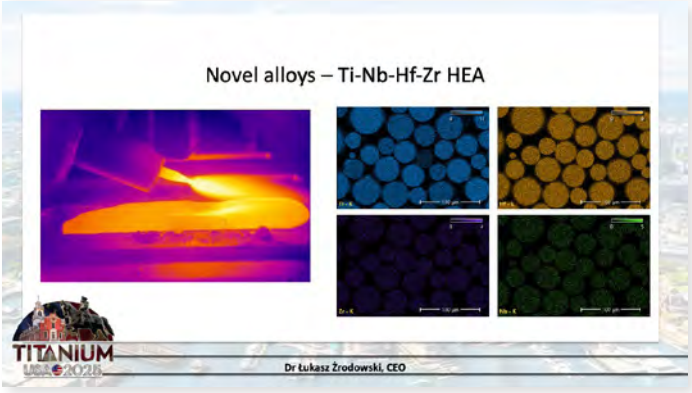
Zrodowski displayed slides of laser melting in ultrasonic atomization, and did a "before and after" microscopic comparison of the re-atomization of Ti-6Al-4V particles.





He displayed a bar chart that illustrated frequency influence on Ti64 PSD 20/40/60 kHz, along with microscopic images of novel titanium alloys such as AM-Ti-Zr-Cu-S; Ti-Nb-Hf-Zr HEA.





He then showed a photo comparing a 1965 compact ultrasonic atomizer with 2025 equipment.

Finally, he listed bullet points that declared his company is open for research and development collaborations:"

- EIC Pathfinder (AM2SoftMag) - Additive manufacturing of amorphous metals for Soft Magnetics
- POLTUR (3D-BioMg) - Development of additive manufactured magnesium-based biodegradable scaffolds and implants for orthopedic applications
- M-ERA.NET (IronWorkCoat) - Development of high-manganese steels for coating systems by work hardening for sustainable wear protection applications
- Research Fund for Coal and Steel (New AIMS) - New approach to additive manufacturing of microstructurally optimized steels
- Clean Energy Transition Partnership (Sunflower) - Sustainable near-net-shape fabrication of low environmental impact receiver materials
- HORIZON-CL4-2023-TWIN-TRANSITION-01 (GlobalAM)- Enabling laser powder bed fusion for large scale production of multi-material components
- EIC Pathfinder (BIOMET4D) - Smart 4D biodegradable metallic shape-shifting implants for dynamic tissue restoration
- Clean Energy Transition Partnership (Core-H2storage) - Resource-efficient storage of hydrogen at ambient temperature (HEAs – TiVZrNbHf).

Medical Technologies

Representatives from **GfE Metalle Gmbh** and **AMG Titanium** explored the "Technology of Energy Savings" using Novel Ti-Zr-Nb-Ta based alloys for medical implants. The discussion involved seeing "the EIGA Process in a new light." According to online information, the electrode induction melting inert gas atomization (EIGA) process is used "to create high-purity spherical titanium powders by melting a pre-alloyed rod with an induction coil and then atomizing the molten metal stream with a high-pressure inert gas."

GfE's focus is on using a Ti-Zr-Nb-Ta based alloy for medical implants. The process involves:

Alloy development:

- Evaluated alloy-compositions from Elemental space Ti-Zr-Nb-Ta for VEC (Valence electron configuration,

resulting gridstructure and published Young's-Modulus)

Feedstock production:

- CIP and sintered powder mixes
- Feedstock production methods allows for powder recycling

Powder characterisation

- Chemical specifications and homogeneity

Screening of powder

- Screening to 45 to 150µm

Processing through EB-PBF and SPS

- Parameters for dense, crack free samples

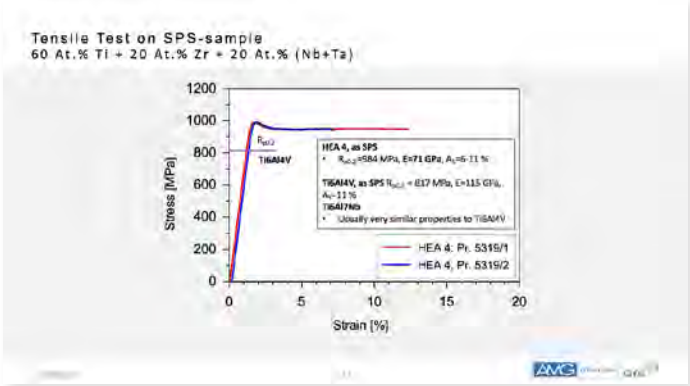
HIP (for EB-PBF samples)

- Parameters for dense samples, avoiding excessive grain growth

Mechanical testing

- Tensile tests
- Fatigue tests
- Biocampatibility tests
- Cytotoxic tests.

One graphic charted the tensile test.



In summary, the company provided the following information:

AMG Titanium Powder Solutions

- Lightweight applications
- Medical applications
- High-temperature applications

Alloy Development:

- Composition: Ti – 20 Zr – 10 Nb – 10Ta (at percent)
- $Rp_{0.2}$ yield strength: 985 MPa (as SPS)
- Young's modulus: 71 GPa (as SPS)
- Elongation to fracture: 6 to 11 percent

Comparison with Conventional Alloys

- Higher $Rp_{0.2}$ than Ti-64 ELI at significantly lower Young's modulus

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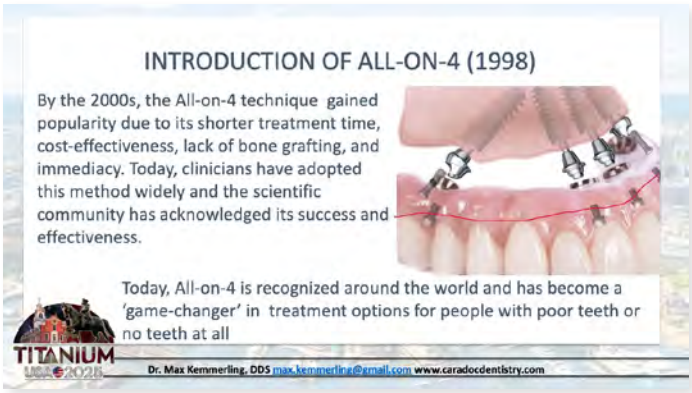
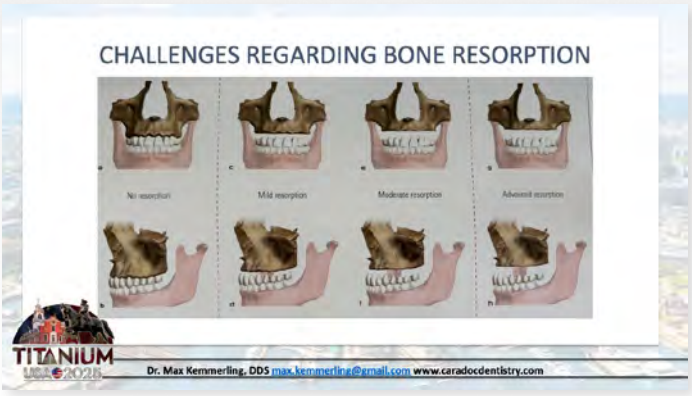
Dr. Max Kemmerling, DDS, of Caradoc Dentistry, Strathroy, Ontario, Canada, presented information on "All-On-4:" the use of titanium to rehabilitate smiles using digital and guided implant surgery. Kemmerling said the history of the procedure involves "Dr. Per-Ingvar Brånemark, a Swedish physician and professor, who inadvertently discovered the concept of osseointegration in 1952. He was studying blood circulation in rabbit bone when he found that a titanium cylinder/implant had fused with the bone. This discovery led to the development of dental implants using titanium, a process Brånemark named 'osseointegration.' Brånemark's first successful dental implant took place in 1965 when he inserted titanium implants in a patient who had complete edentulism. This was the first milestone in dental implantology where osseointegration was first applied in a human."

The introduction of the All-On-4 concept was pioneered by Dr. Paulo Malo in Portugal. "He introduced this concept in 1998 to provide patients with a fixed set of teeth using only 4 implants to support a complete arch

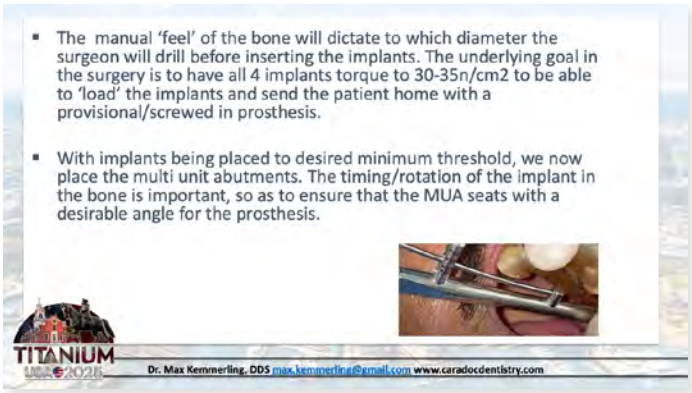


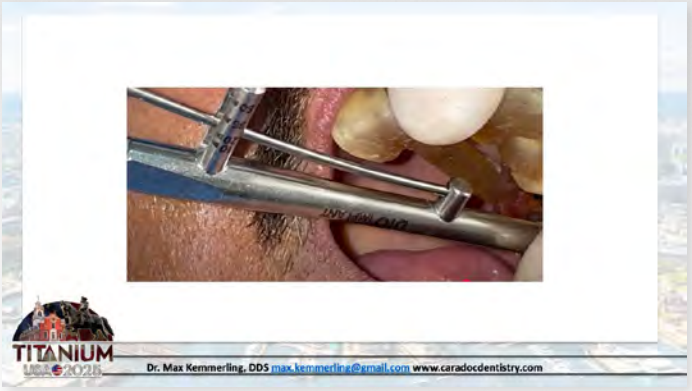
of prosthetic teeth. His approach was very beneficial for patients with limited bone density, as it utilized the available bone more efficiently."

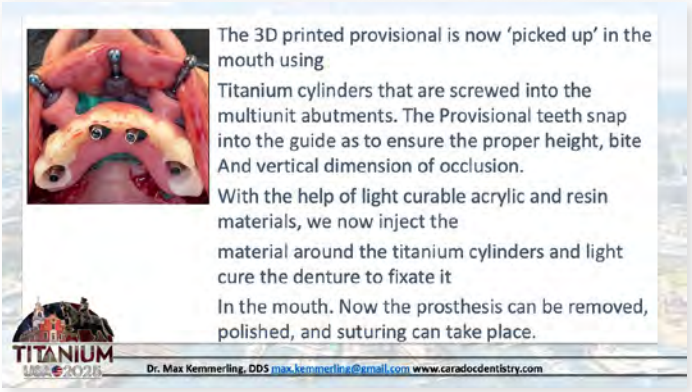
Two slides illustrated the challenges of bone resorption and the mandible.



The concept of the maxilla/upper arch treatment involves "posterior implants that are tilted distally at a 17 to 30-degree angle and placed parallel to the anterior wall of the maxillary sinuses. The two anterior implants can be straight (axially placed) or slightly tilted as necessary to gain more length. The tilted implants in the maxilla increase the antero-posterior distance for support while circumventing the need for major sinus lifts and bone grafts."







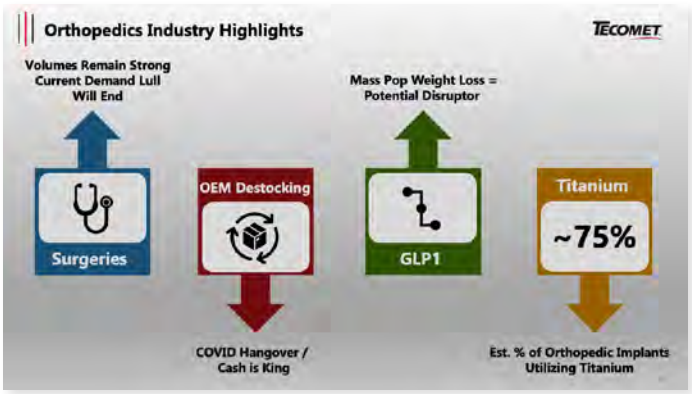
"For the duration of three months, the provisional is not removed to allow for osseointegration and taking into account the stability dip. The fixed provisional: provides functionality, esthetics, good speech, and confidence during the healing process. After three months of healing, a radiograph is taken to verify osseointegration, and clinically the implants can be torque tested. A new tissue level digital scan is taken to capture the healed tissue. This ensures that the final milled prosthesis adapts tightly to the tissue for optimal speech, chewing and esthetics. Choosing a milled zirconia (monolithic vs layered) prosthesis provides balance, function, longevity, with incredible strengths (1000-1100 mPa). Modern multi-layer blocks allow for even more natural appearance, and translucencies."

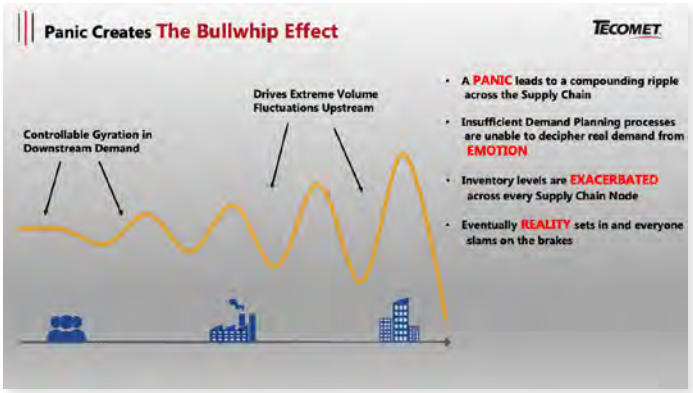
Jeremy Rogers, director, global supply chain for Tecomet, addressed the topic of "Driving Supply Chain Agility in an Unpredictable Market." Tecomet is a global contract manufacturer founded in 1963, serving the orthopedics and medical markets. Product offerings include medical implants, surgical instruments and trays and cases. As a diversified metals processor, Tecomet utilizes titanium, cobalt chrome, nickel and steel.

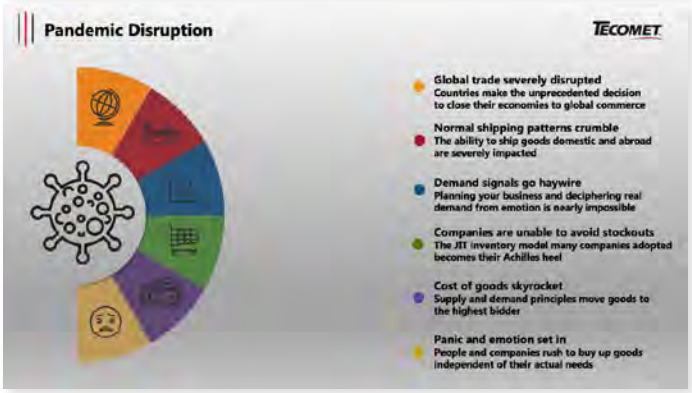
Slides illustrated that state of the orthopedics industry and the aftermath of the Covid 19 pandemic disruption to the supply chain:

Two other slides illustrated how "panic creates a bullwhip effect" on the supply chain:

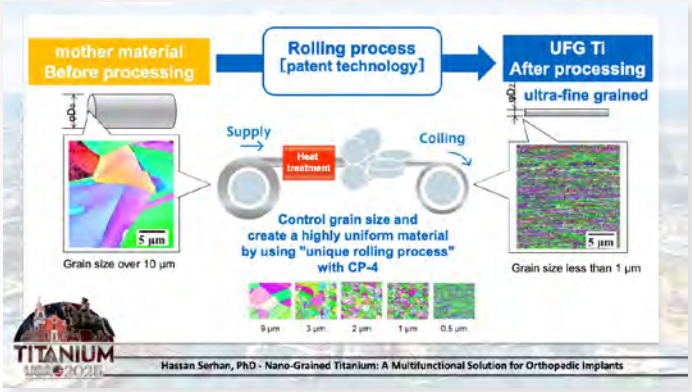
In conclusion, Rogers outlined Tecomet's efforts to "drive agility" in the supply chain, with a focus on demand planning, operational excellence, financial commitments and establishing strategic partnerships. Individual points included establishing an "agile" workforce, investments in supply chain "visibility," and creating sustainability via partnerships with suppliers.

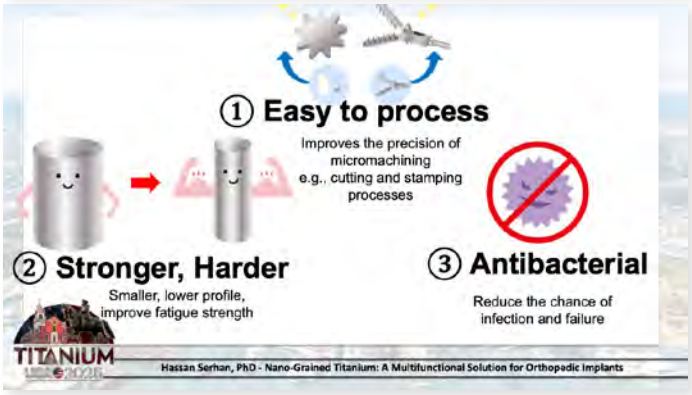






Hassan Serhan, Ph.D., representing Rosies Base, a subsidiary of Komatsuseiki Kosakusho Co., Ltd., discussed "Nano-Grained Titanium: A Multifunctional Solution for Orthopedic Implants." Serhan provided slides that illustrated the company's UFG titanium processing:





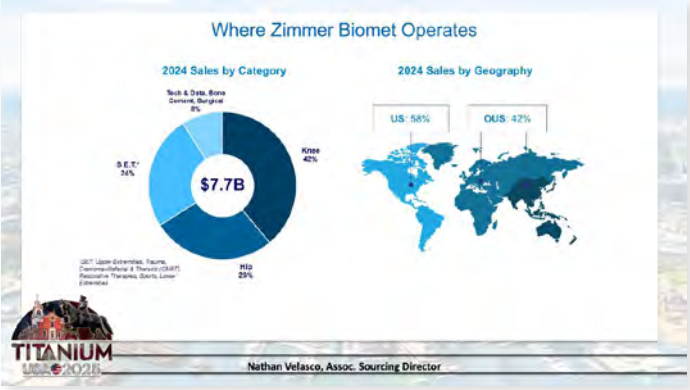
According to information posted online, UFG titanium refers to "ultra-fine-grained" titanium, produced by "severe plastic deformation that has a much finer grain structure, which significantly increases its strength and hardness compared to conventional titanium. This makes it a promising material for biomedical application such as implants, because it can provide the strength of alloys like Ti-6Al-4V without the potential toxicity of alloying elements like aluminum and vanadium."

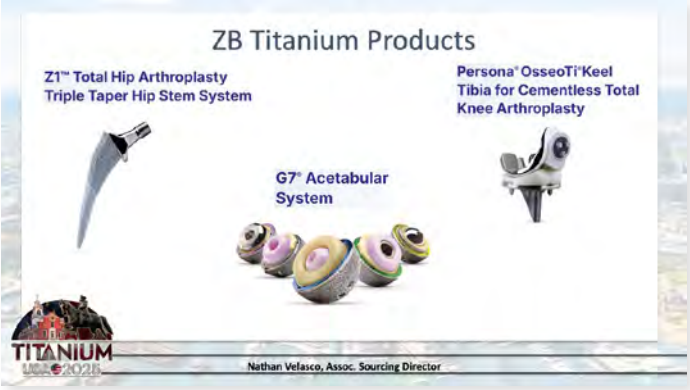
Serhan listed some of the advantages of UFG titanium:

- Enhanced Mechanical Properties: Superior strength, hardness, and fatigue resistance compared to their conventional counterparts, without altering chemical composition => FDA acceptance
- Inherent Biocompatibility: Maintains the excellent biocompatibility of the base material
- Novel Antimicrobial Potential: Their unique surface characteristics can inherently resist bacterial adhesion and biofilm formation => challenging FDA claims.

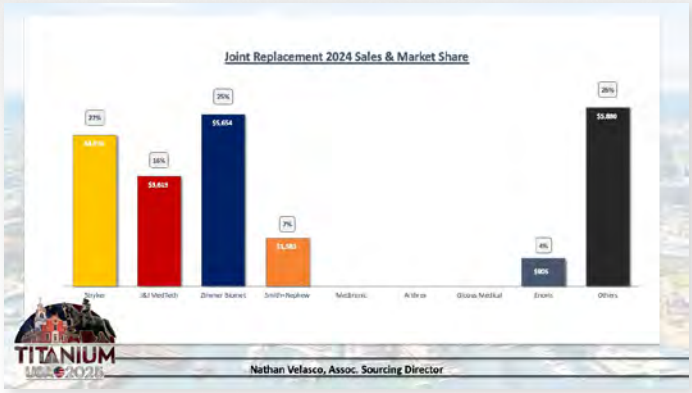
He also pointed out that UFG titanium's inherent antibacterial properties go "beyond strength," saying that, unlike traditional methods that rely on antibiotic coatings (which can lead to resistance and cytotoxicity), "UFG materials possess inherent antibacterial properties due to their unique surface topography. The heterogeneous surface with nanoscale grain is hypothesized to disrupt bacterial adhesion and proliferation, mimicking natural structures like cicada wings or shark skin. Incorporating UFG materials in the manufacture of orthopedic implants or medical devices could uniquely balance antibacterial properties with biocompatibility, making them highly suitable for these applications."

Nathan Velasco, associate sourcing director, metals, with Zimmer Biomet, talked about his company's profile and activities in the orthopedic market. Zimmer Biomet is a "mission-centric" global technology Fortune 500 organization, which recorded $7.7 billion in revenue in 2024. "We have 17,000 team members generating sales in more than 100 countries and from more than 25 locations." He then listed three of Zimmer Biomet's orthopedic titanium products.





Velasco displayed three slides that offered bar charts that compared joint replacement (2024) sales and market share among the major medical companies:



He concluded by describing what Zimmer Biomet values in a business partner, a list that includes relationship accountability, value-added collaboration, flexibility and commercial terms, and cross-commodity/ portfolio synergies.

SAVE THE DATES:

Titanium Europe 2026 will be held April 15-16, 2026, in Toulouse, France with the Fundamentals of Titanium workshop offered on the 14th.

Exhibition hall, General Session, and Special Thanks to our partners at Airbus for hosting the A321 Final Assembly Line (FAL) tour on Thursday, April 16th

Register today to save your seat for the Tour as we have limited availability.

Early Registration Rates end March 13, 2026.

October 4-6 • Caesar's Palace
Las Vegas, Nevada USA

Titanium USA 2026 will be held October 4-6, 2026, at Caesar's Palace in Las Vegas. 100 exhibitors, 2 full days of presentations, lots of networking opportunities. Call for abstracts' deadline June 30th. Visit event website today to learn more.

Members and Non-Members alike are invited to attend or submit abstracts.

The ITA, (website: https://titanium.org/) is a membership based international trade association dedicated to the titanium metal industry. Established in 1984, the ITA's main mission is to connect the public interested in using titanium with specialists from across the globe who may offer sales and technical assistance.

Working through its extensive membership resources, the ITA seeks to expand the knowledge base for the metal, providing technical literature and sponsoring seminars and conferences. For nearly three decades the ITA has instructed thousands of professionals in all aspects of titanium usage. The ITA looks to educate engineers, designers and business executives on titanium's superior properties and explain how those properties can be exploited to enhance products and services. The ITA also strives to advance ideas in research, design, metallurgy and engineering, and serve as the leading forum to cultivate the exchange of ideas and support a diverse, dynamic, global industry. Current ITA membership is comprised of more than 140 organizations and over 1,500 individual members worldwide.