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Welcome to Titanium Today

As I’m sitting here on the airplane, on my way to the TITANIUM EUROPE 2015 show in Birmingham, England UK, I look up in my seat pocket to find the latest edition of the *United Hemispheres* magazine where ITA was fortunate enough to advertise in time for the Offshore Technology Conference in Houston, Texas this month. We were also privileged to be included in a mini interview *United Hemispheres* conducted on behalf of their Energy Supplement.

Do I think hosting an ad in an airline magazine will draw mass attention to the titanium industry? You bet I do and I think the ITA is doing a great job in getting recognized all over the world as the international trade group dedicated to promoting titanium metal on behalf of our Member organizations. I still cringe if I’m at a trade show or industry related event and someone says “I didn’t even know there was a trade association for titanium.” While I’m pleased to always make a new business connection, it’s my primary goal to make sure one day, we won’t hear those types of comments because the International Titanium Association will be well known worldwide as the “go to” to learn more about using titanium metal.

You will see more mentions, more editorial, and more advertising in a variety of magazines and online blogs in the future from the Association. ITA is making every effort to connect with prospective users of titanium metal and make certain our Members are promoted, recognized and found in the Titanium Resource Center.

The International Titanium Association’s Committee for Industrial Applications, led by Rob Henson, Manager Business Development for VSMPO – Tirus, US, continues to work on soliciting budgetary bids to complete their evaluation on what it would take to revise the Grade 12 MRO NACE Standard on behalf of the industry.

The committee will host the World Corrosion Organization’s Director General, George Hays as a distinguished guest speaker at the upcoming TITANIUM USA 2015 Conference this October in Orlando, Florida, and they are currently seeking candidates to nominate for the $20,000 Titanium Applications Development Award, which will be presented at the October meeting.

The committee was represented at the Offshore Technology Conference, Electric Power, and Topsides, Platforms & Hulls trade shows where the ITA exhibited and disseminated information about our Members and titanium. Lots of new connections and introductions were made.

For those of you joining us here in Birmingham, England for the TITANIUM EUROPE 2015 Conference this week, welcome and thanks for your participation.

Do you have an idea for the Industrial Applications committee? We would love to hear from you.
MEET THE ITA

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A&D  Baoji Titanium Industry Co., Ltd. (Baoti) is the largest titanium manufacturer and supplier in China, also the only titanium supplier in China that have obtained complete quality & process qualification by NORSOK, including plates, bars, pipes and castings of titanium. As one of the world leading professional titanium alloy producers, Baoti own a complete titanium industry chain, the products have been used in application such as chemical processing, oil and gas, power generation, metallurgy, marine engineering, geothermal engineering, refrigeration engineering and automotive industries.

B  Photo courtesy of T.I. is the global leader in performance metal solutions for the aerospace, medical, industrial and oil & gas markets. Holding the world’s most complete inventory of performance metals across a global service center network. T.I. delivers supply chain solutions through its Materials Management brand at all levels of sophistication and complexity. With a globally experienced and technically driven team that now includes wholly owned subsidiary Pierce Spafford Metals, Inc. T.I. has been providing dependable, quality driven solutions to customers since 1972. www.titanium.com.

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E  Solar Atmospheres Vacuum Heat Treats Ti Manifold for Orion Spacecraft - One of the tricky parts of launching humans into space is deciding what to do if something goes wrong while riding on top of a controlled explosion for nine minutes. New to all future “human present” rockets will be the Launch Abort System (LAS). This critical part of the safety system was vacuum heat treated by Solar Atmospheres of Western PA. The large manifold housing made from 6Al 4V titanium is designed to rapidly propel astronauts away from the main rocket in case of a catastrophic explosion or any other unexpected event. Once fired, the LAS will accelerate the astronauts away from the main rocket at forces up to 10 to 15 g’s. Visit Solar Atmospheres at www.solaratm.com.

F  The Makino T1 5-axis horizontal machining center, equipped with its ADVANTiGE™ technologies provides manufacturers the ability to efficiently machine a wide variety of parts on a single machine. The key to the T1’s flexibility is its 12,000-rpm spindle. It tackles titanium with 1,000 Nm of duty-rated torque from spindle start to 1,000 rpm. Visit their website at www.makino.com.
Corrosion Awareness Day was April 24. The annual date has been set aside to focus global attention on the costly and sometimes dangerous problems associated with corrosion and its effects on infrastructure, industry and daily life. For the titanium industry, it’s an opportunity to distinguish itself and become part of an international dialogue to highlight the superior corrosion-resistant properties of titanium as a potential solution to these problems.

George Hays, the executive director of the New York-based World Corrosion Organization (WCO), in an open letter posted on the group’s website (www.corrosion.org), wrote that Corrosion Awareness Day intended “to educate the public, industries and government agencies of the deleterious effects of corrosion on our infrastructures worldwide.”

How big a problem is corrosion? According to Hays, corrosion represents an annual worldwide cost of $3 trillion for infrastructure and industry—the cost to repair, replace and maintain critical systems. Here in the United States, Hays said the cost for corrosion control and repair represents about 3.3 percent of annual gross domestic product (GDP) or well over $300 billion.

More than simply flag problems and the soaring costs associated with corrosion, Hays, during a recent telephone interview, said Corrosion Awareness Day also is intended to inform the public, governments and industry leaders about practical solutions, saying that “corrosion is a phenomenon that can be controlled using existing technologies and better design and engineering practices.” He estimated that it would be possible to reduce that global $3 trillion cost by one-third.

Rob Henson, the chair of the International Titanium Association’s (ITA) Industrial Committee and the manager of business development for VSMPO-Tirus U.S., said titanium has made strides in recent years to become a meaningful voice in the international corrosion conversation. However, he also acknowledged the titanium industry still has a considerable amount of work to do when it comes to educating people on the benefits of titanium, as well as dispelling lingering myths. In many corners, in industry and government, he said titanium is still seen as “an exotic, expensive material that’s difficult to handle. We need to continue our efforts to education people, on a much broader scale, about titanium.”

Regis Baldauff, director, industrial marketing, Titanium Industries Inc., Rockaway, NJ, in a recent presentation at a TITANIUM conference, supported Henson’s assessment of titanium as a material of choice for corrosion resistance, saying it has demonstrated “years of trouble-free seawater service in chemical, oil refining and desalination systems,” and is “immune to microbiologically induced/influenced corrosion.” Baldauff also said titanium, in comparison with competing materials such as stainless steel or copper/nickel alloys, provides life-cycle cost advantages.

Eugene Liening, a member of the WCO’s board of administrators, said the correct approach to address corrosion issues should always start with proper design. He said design is the key for industrial projects as well as municipal infrastructure. “It starts with design using the correct materials,” Liening said. “It includes developing corrosion-control strategies, faithfully executing those designs and strategies, and then maintaining a commitment for inspection and repair.”

The International Titanium Association’s committee for Industrial Applications will host the World Corrosion Organization’s Director General, George Hays as a distinguished guest speaker at the upcoming TITANIUM USA 2015 Conference this October 4-7th in Orlando, Florida USA at the Association’s annual US conference & expo.

“Bringing Director Hays to the annual TITANIUM meeting”, said Henson, “will provide members with a high level view of the global cost of corrosion which is estimated at 3% of global GDP”. The role of titanium in the construction of reliable process equipment for power generation, municipal water supply, waste water treatment and air quality management systems is well known to only a small segment of the global engineering community. To achieve broader awareness of the role of titanium in robust infrastructure projects we are working to assure titanium is included in this global conversation on corrosion. More details of Director’s Hays’ message will be forthcoming and all members interested in the industrial applications of titanium are encouraged to attend.

Contact Jennifer Simpson, executive director of the ITA located in Denver, Colorado by telephone at 1-303-404-2221 or visit website (www.titanium.org) for more details on the Association’s involvement with the WCO in coming months.
Interaction of Titanium, Oxygen Critical for Understanding Welding Technology

Introduction and overview:
Understanding the interactions of oxygen and titanium is a necessary first step in understanding the titanium welding process. Titanium’s surface oxide is responsible for its remarkable corrosion resistance. A thickening of the transparent oxide is responsible for a repeating rainbow of brilliant surface colors. An oxygen rich surface layer on the metal leads to low surface ductility and is a primary cause of cracking in forming and drawing. Oxygen present in all grades of titanium metal itself is a strengthening element. However, excess oxygen in welds that have been improperly shielded is a primary cause of embrittlement.

Titanium oxide provides corrosion resistance
Titanium is a reactive metal that will readily combine with many elements or break down many compounds. Titanium exposed to air, water or other oxygen sources rapidly forms a tenacious, hard, continuous, non-porous, transparent, and self-healing surface oxide. The stable and chemically inactive titanium dioxide (TiO2) surface is the source of titanium’s resistance to corrosive and chemical attack.

On thick sections, even where the oxide film is ruptured, titanium surface is stable at oxygen concentration below about 35 percent (air is an example) at all pressures. Titanium is stable in pure oxygen at atmospheric pressure up to 1200°F (650°C) or up to about 100 psi up to 600°F (315°C) and at about 350 psi, room temperature may be sufficient to cause violent ignition. Titanium powders, fines from dry sanding of titanium surfaces, and light chips from machining operations, all of which have a high surface to volume ratio, will burn in air if ignited. Care in generating, handling, and storing these materials is required. The reaction allows titanium to be cut with oxygen, like carbon steel, although the resulting contaminated surface must be removed.

**Figure 1: Titanium Surface Oxide**

<table>
<thead>
<tr>
<th>State</th>
<th>Oxide</th>
<th>% O</th>
<th>Valence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>TiO2</td>
<td>59%</td>
<td>Ti+4 (Rutile)</td>
</tr>
<tr>
<td></td>
<td>Ti2O3</td>
<td>52%</td>
<td>Ti+3</td>
</tr>
<tr>
<td></td>
<td>TiO</td>
<td>42%</td>
<td>Ti+2</td>
</tr>
<tr>
<td>Metal</td>
<td>Ti</td>
<td>0.15%</td>
<td>Ti+0</td>
</tr>
</tbody>
</table>

The titanium oxide surface can be visualized as consisting of several layers corresponding to the increasing valence states of titanium.

Oxygen diffusion into underlying titanium
Oxygen diffuses from the surface film into the metal beneath. Diffusion rates are very slow up to 1000 to 1200°F, but as temperature increases, the rate of diffusion increases. The oxygen diffusing (or dissolving) into the metal eventually causes a brittle oxygen rich surface layer, called alpha case in alloys, to form. Prolonged exposure at temperatures above 1200°F (650°C) will result in deeper embrittlement. Hot-forming operations, which may typically be conducted at temperatures of 1750 to 1400°F (950-750°C) typically employ anti-scaling coatings, but still require grinding or other mechanical means to remove the oxygen rich layer and heavy oxide scale.

Oxygen as a Strengthening Element
Oxygen in solution up to about 0.35 percent is an important strengthening element in unalloyed titanium as well as in alloys. Unalloyed titanium gains its strength primarily due to the presence of elemental O, N, and C occupying sites between titanium atoms in the regular metal matrix. These elements are termed interstitial elements, as opposed to “substitute” elements like iron, which replace titanium atoms in the matrix.

Titanium’s surface color associated with welding
Iridescent colors form only on solidified material and are an indicator (and only an indicator) of post-solidification thermal history and exposure to oxygen. Straw, light blue, and even iridescent...
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dark blue color is usually interpreted as surface contamination, accompanied by diffusion of oxygen into the weld metal. This damage can be repaired by removing of few mils of material mechanically.

A gray matte color (and sometimes dark blue) is usually interpreted as exposure to higher temperature and is taken as an indicator that the entire weld is contaminated. A loose yellow and white oxide indicates a complete failure of shielding and requires removal of the weld and some underlying material.

A contaminated weld is remelted under adequate gas protection, it can appear bright and silver, but it will remain hard and brittle. Similarly, a weld which is contaminated by torch gas may well appear bright and silver if it is protected by trailing shielding from oxidation after solidification. These interpretations apply to both front and back surfaces of a root weld pass.

**Weld contamination; extreme oxygen levels in weld metal**

At very high oxygen levels, well above the typical 0.06 to 0.35 wt. percent in commercial grades of unalloyed titanium, hardness increases significantly, and the accompanying lack of ductility is unacceptable for most applications.

While cleaning and other good practice must be observed, inert gas shielding is probably the most important aspect of titanium welding. Shielding of the molten weld pool (both front and back surfaces) is most critical because the weld pool acts like a perfectly mixed reactor. Oxygen that contacts the surface is immediately absorbed and distributed throughout the molten pool. Even a momentary interruption of protection allows large amounts of oxygen to enter the molten weld pool. The effect, as the pool coalesces and freezes, is extreme embrittlement—increased hardness and loss of ductility. The effect can be very localized.

**Oxygen ranges in AWS filler metals**

In 2004, the American Welding Society (AWS) A5.16-2004 Filler Metal Specification added oxygen ranges to all filler metal chemistries (replacing singular upper limits) and adjusted the remaining residual chemistry (iron, nitrogen, carbon) limits to lower levels based on typical levels in commercial filler metals. This was done because oxygen in some grades being produced was so low that the weld deposit would not achieve the desired strength in the absence of significant base metal dilution.

*This article is an edited and condensed version of a technical paper written by James A. McMaster, owner and founder of MC Consulting, an engineering consulting firm based in Huletts Landing, New York. Contact information—phone: 518-499-0331; e-mail: jimmcmaster@msn.com.*

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Figure 2: Titanium Surface Oxide Formed by Heating in Air

Surface preparation 150 grit emery followed by detergent wash and clean water rinse. The first color band is about 1.25” in radius.
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The scrap/revert market for the North American titanium industry has achieved a healthy business balance, a trend that should be sustained for the remainder of this year. Aerospace continues to be the bellwether sector for titanium, helping to overcome more tepid business conditions found in other key markets such as industrial, consumer and medical.

According to information posted by the U.S. Geological Survey (USGS), receipts of titanium scrap for the first three quarters of 2014 totaled 36,700 metric tons (MT). Full-year scrap receipts in 2013 registered 52,600 MT, compared with 48,800 MT in 2012. Titanium scrap receipts are divided into two categories: “home” scrap produced in-house; and purchased scrap bought on the open market from recycling brokers.

Titanium industry sources estimate that the size of the global titanium scrap market is 80,000 MTs for aerospace titanium scrap, and 80,000 MTs for mixed ferro-titanium scrap, which is used in steel production.

Edward J. Newman, senior vice president of United Alloys and Metals Inc., Columbus, OH, an international processor of titanium, stainless steel and superalloy scrap, said that, beginning in early 2014, surging aerospace manufacturing has boosted the titanium market. In recent business conferences, Boeing has forecasted long-term demand for 36,770 new airplanes, valued at $5.2 trillion through 2033. Airbus, with an outlook that runs through 2032, projects demand for over 29,000 new passenger aircraft and freighters, worth $4.4 trillion.

Newman, who also serves on the board of directors for the International Titanium Association, Denver, CO, said ever since the great economic meltdown of 2008/2009 there has been “oversupply of metal at every stage of the titanium market. It took a long time to burn off that inventory. Now inventories are under control and the supply chain has leveled out. Today everyone is happy with business conditions in the titanium scrap market, in terms of volumes and demand.” Sources indicated these positive business trends for titanium scrap should continue through the balance of this year and into 2016.

Other titanium scrap processors and distributors concurred with Newman’s observations. Vasily Semeniuta, president of Grandis Titanium Co., Rancho Santa Margarita, CA, described the titanium scrap market as “in balance. (Scrap) Supply is a bit more than demand, but there is plenty of work and plenty of scrap available,” Semeniuta said. Another West Coast scrap processor, who requested anonymity, said that, thanks to the aerospace sector, the titanium scrap market remains healthy, especially when compared to the current fortunes of the steel and copper scrap markets. He said those markets have sagged in recent months due to oversupply, a strong dollar, and sluggish business conditions in Europe and Asia.

While aerospace continues to be the engine driving the titanium scrap market, other key sectors, such as industrial, medical and consumer goods have lagged. Newman explained the industrial market typically is spotty when it comes to consistently generating demand for titanium, and in turn, scrap volumes. “It goes up and down, big project to big project,” he said, citing chemical processing, heat exchanger and desalination programs as prime examples. Medical and consumer, by comparison, are small, specialty markets for titanium.

Closed-Loop Recycling Systems

There are two factors that have altered the dynamics of the titanium scrap market, according to Newman and other sources. First is the ongoing focus for developing closed-loop revert programs in the aerospace business. It’s a loop that stretches from vendors to original
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Propelled by Aerospace Sector, Titanium Scrap Market Achieves a Healthy Balance

(continued)

equipment manufacturers and includes melting, forging, machining, finishing and assembly facilities.

Boeing Commercial Airplanes has been the primary driver in promoting the closed-loop scrap recycling concept for titanium. During the last three years Boeing executives have emphasized closed-loop recycling as a critical element in the titanium supply chain. When it comes to sourcing titanium, Boeing is looking to achieve a “system balance,” which takes into account demand, inventory levels, and revert volume. It’s a recycling strategy designed to keep aerospace-quality scrap within the aerospace supply chain. In 2013 Boeing’s closed-loop efforts recovered 8 million pounds of titanium and 13 million pounds of aluminum. For 2014, those levels were expected to reach 10 million pounds for titanium and 19 million pounds for aluminum.

Second, upstream consolidation in the titanium supply chain is affecting the flow of scrap. Major titanium producers, in recent years, have purchased titanium casting, forging and assembly operations. Newman said the thrust is for titanium producers to capture the manufacturing resources offered by these acquisitions, thereby expanding their reach in the supply chain. The scrap generated by these acquisitions translates as an important side benefit.

Last November Pittsburgh-based aluminum giant Alcoa finalized its purchase of Firth Rixson, a British producer of seamless titanium and superalloy rolled rings for jet engines. News reports at the time stated Firth Rixson strengthens Alcoa’s aerospace portfolio and “accelerates Alcoa’s transformation to a multi-material enterprise. The acquisition increases its offerings made of nickel-based superalloys, titanium, stainless steel and advanced aluminum alloys.”

Precision Castparts Corp. Portland, OR, has moved aggressively on the acquisition trail, and in early 2013 completed its deal to buy titanium producer Titanium Metals Corp. (Timet). In 2011 ATI purchased the forging and investment casting assets of Ladish Co. Inc. RTI, in 2012, acquired Remmele Engineering Inc., an integrated producer of titanium components.

LIBS Technology

Given the growing importance of scrap in the titanium supply chain, especially as dictated by the aerospace sector, several companies are developing technologies to further enhance the value of the material. One group, VDM Metals GmbH, Werdohl, Germany, will present a technical paper (“Electron Beam Cold-Hearth Remelting of Titanium and Scrap Control by LIBS Technology”) at the TITANIUM EUROPE Conference and Exhibition, which will be held May 11-13 in Birmingham, UK.

Electron beam cold-hearth melting is an established technology that provides superior refining for titanium. VDM Metals has been researching new recycling strategies in collaboration with Leibniz University of Hanover (Germany), and other industrial partners. In its paper, VDM Metals explains that eliminating impurities and inclusions (porosity) from titanium alloy scrap is essential if the scrap is to be used in critical aerospace rotating parts. Titanium is a difficult material to mill (compared with steel or aluminum), which results in high tool wear. Tool material particles represent a source of contamination for titanium scrap. Contamination also can come from other scrap metals, welding electrodes and coolant/lubricant materials.

“The melting of Ti-6Al-4V (a workhorse aerospace alloy) in an electron beam furnace is a challenge,” the paper states. “It has been shown that it’s absolutely necessary to obtain a stable process with a constant melting rate. The scrap should always be free from contamination.”

To meet stringent aerospace specifications, VDM Metals is developing a system designed to provide 100-percent scrap inspection, using a technology known as LIBS (laser-induced breakdown spectroscopy). The project encompasses continuous, inline scrap control with integrated analysis to identify low- and high-density inclusions.

VDM Metals currently is operating a pilot plant to demonstrate the system, with an LIBS unit built by SECOPTA GmbH, Berlin. The technology, if proven effective, would garner significant interest in the North American titanium market. It’s estimated there are at least 14 cold-hearth furnaces operating in the United States. Six new furnaces have come on line during the last seven years, including RTI’s facility in Canton, OH, and Timet’s installation in Morgantown, PA.
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Researchers Develop Nanotechnology for Water Treatment

This article was published in the Dove Press Journal: Nanotechnology, Science and Applications, Jan. 6, 2013. The story, as it appears here, is a condensed version of the original article, edited as an overview of titanium’s role in nanotechnology. Dove Medical Press Ltd. (website: http://www.dovepress.com) is a privately held UK company specializing in the publication of open-access peer-reviewed journals across the broad spectrum of science, technology and especially medicine. Dove’s editorial office is located in Auckland, New Zealand.

Introduction

Important challenges in the global water situation, mainly resulting from worldwide population growth and climate change, require novel innovative water technologies in order to ensure a supply of drinking water and reduce global water pollution. Against this background, the adaptation of highly advanced nanotechnology to traditional process engineering offers new opportunities in technological developments for advanced water and wastewater technology processes.

The long-term development of the global water situation is closely connected to the growth of the world population and global climate change. Constant growth of the world’s population, which is forecasted to be nearly doubled from 3.4 billion in 2009 to 6.3 billion people in 2050, is attended by a predicted needed growth of agriculture production of 70 percent, by 2050. Thus, the demand for fresh water is growing dramatically, in particular for food production, since 70 percent of the world’s freshwater withdrawals are already accounted for by agricultural irrigation. Currently, 64 billion cubic meters of fresh water are progressively consumed each year.

The arid regions of North Africa and nearly half of the European countries (approximately 70 percent of the population) are confronted with a lack of water supply. Even industrialized countries like the United States, providing highly innovative technologies for saving and purifying water, show the difficulty of exhausted water reservoirs. In China, 550 of the 600 largest cities suffer from a water shortage, since the biggest rivers are immensely polluted and even their use for irrigation has to be omitted, not to mention treatment for potable water. Leading climate impact researchers have shown that climate change possibly exacerbates the regional and global water scarcity. They predict that global warming will confront an additional approximately 15 percent of the global population with a severe decrease in water resources and will increase the number of people living under absolute water scarcity (500 m3 per capita per year) by at least another 40 percent compared with the effect of population growth alone.

Heavy rainfall can lead to soil erosion and soil, allowing pathogens to enter water systems along with soil components and nutrients. Increased temperatures in air and raw water can affect the drinking water hygiene in respective storage systems as well as in drinking water pipelines, resulting in harmful infectious illnesses. In both developing and industrialized countries, a growing number of contaminants like micropollutants are entering water systems.

Conventional decontamination processes such as chlorination and ozonation consume a high amount of chemical agents and, furthermore, can produce toxic byproducts. The adaptation of highly advanced nanotechnology to traditional process engineering offers new opportunities for development of advanced water and wastewater technology processes.

Major investments in nanotechnology

Nanotechnology is being promoted as one of the most challenging key technologies of this century. Billions of dollars have been spent on research framework programs intended to promote nanotechnology and to bring novel materials and processes to market. For example, the 2015 federal budget has allocated more than $1.5 billion to the National Nanotechnology Initiative, which has nanotechnology-related activities ongoing in 20 departments and independent agencies.

Horizon 2020, the research framework program in the European Union (EU), provides €10 billion over a period of seven years for research and innovation projects, including €92 million for water innovations and €686 million for nanotechnology in 2014. In order to combine water and nanotechnology, there are joint calls for “low-energy solutions for drinking water production” that involve implementation of novel nanoengineered materials and processes for water applications.

Since every country has its own complex laws and guidelines, the following gives only a rough overview of the way the EU and the United States deal with implementation of novel regulations pertaining to nanomaterials and their exposure in water systems.

The most important general problem with all legal approaches results from the inability to assign nanomaterials with their crossover functions to an individual legal framework. In Europe, nanomaterials are regulated by REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) because they are covered by the REACH definition of a chemical “substance.” REACH is an EU program that regulates production and use of chemical substances and their potential
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impact on both human health and the environment. The European Water Framework Directive, which established a framework for the protection of inland surface waters, transitional waters, coastal waters, and groundwater, refers to REACH for evaluation of priority substances. Due to their close connection, any amendment of REACH related to nanomaterials is automatically implemented in the water directive.

In the United States, the Environmental Protection Agency has permitted limited manufacture of new nanoscale chemical materials through use of administrative orders or significant new use rules under the Toxic Substances Control Act. The developing of corresponding significant new use rules started in 2010 and these are being continually expanded. The agency has also allowed the manufacture of new nanoscale chemical materials under the terms of certain regulatory exemptions, but only in circumstances with severely controlled exposures to protect against unreasonable risk.

**Nanometals and nanometal oxides**

Nanoscale metal oxides are promising alternatives to activated carbon and effective adsorbents to remove heavy metals and radionuclides. As well as having a high specific surface area, they feature a short intra-particle diffusion distance and are compressible without a significant reduction of surface area. Some of these nanoscale metal oxides (such as nanomaghemite and nanomagnetite) are superparamagnetic, which facilitates separation and recovery by a low-gradient magnetic field. They can be employed for adsorptive media filters and slurry reactors.

Nanosilver has been used in the photo development process since the late 1800s, and has been registered with the Environmental Protection Agency for use in swimming pool algacides since 1954 and drinking water filters since the 1970s. Although nanosilver exhibits a strong and broad-spectrum antimicrobial activity, it has hardly any harmful effects in humans. It is already applied to point-of-use water disinfection systems and antifouling surfaces.

Nano-titanium dioxide (TiO₂), featuring high chemical stability and low human toxicity at a cheap price, is utilizable in disinfection and decontamination processes. The main advantage of nano-TiO₂ over nanosilver is the nearly endless lifetime of such coatings, since TiO₂ as a catalyst remains unchanged during the degradation process of organic compounds and microorganisms. The antimicrobial effect of nanosilver is based on the continuous release of silver ions.

After a certain operation period, depending on the thickness and composition of the nanosilver layers, the coating has to be renewed or the complete device, including the bulk material, has to be disposed of, leading to significant replacement costs. However, compared with TiO₂, which needs energy-consuming ultraviolet lamps for activation, nanosilver kills bacteria with no need of additional energy-consuming devices, making nanosilver a favorable disinfectant for remote areas.

**Membranes and membrane processes**

Membrane separation processes are rapidly advancing applications for water and wastewater treatment. Membranes provide a physical barrier for substances depending on their pore size and molecule size. Membrane technology is well established in the water and wastewater area as a reliable and largely automated process. Nanofiltration is one of the membrane filtration techniques and can be defined as a pressure-driven process wherein molecules and particles less than 0.5 nm to 1 nm are rejected by the membrane. Nanofiltration membranes are characterized by a unique charge-based repulsion mechanism allowing the separation of various ions. They are mostly applied for
Researchers Develop Nanotechnology for Water Treatment (continued)

the reduction of hardness, color, odor, and heavy metal ions from groundwater. The conversion of sea water into potable water (desalination) is another prosperous field of application since comparable desalination technologies are very cost-intensive.

Nanocomposite membranes can be considered as a new group of filtration materials comprising mixed matrix membranes and surface-functionalized membranes. Mixed matrix membranes use nanofillers, which are added in a matrix material. In most cases, the nanofillers are inorganic and embedded in a polymeric or inorganic oxide matrix. These nanofillers feature a larger specific surface area leading to a higher surface-to-mass ratio. Metal oxide nanoparticles (Al2O3, TiO2) can help to increase the mechanical and thermal stability as well as permeate flux of polymeric membranes. Antimicrobial nanoparticles, like nanosilver, and (photo) catalytic nanomaterials, like bimetallic nanoparticles, TiO2, are mainly used to increase resistance to fouling.

Specially designed coatings, such as nanosilver and TiO2 layers, prevent fouling of membranes or heat exchangers and/or exhibit a decontamination effect on organic pollutants. Due to their low thickness, such nanoscale functional surface layers require few materials and maintain the surface profile of the bulk material while at the same time immobilizing potentially harmful nanoparticles.

**Photocatalysis**

Photocatalysis is an advanced oxidation process that is employed in the field of water and wastewater treatment, in particular for oxidative elimination of micropollutants and microbial pathogens. Most organic pollutants can be degraded by heterogeneous photocatalysis. Due to its high availability, low toxicity, cost efficiency, and well known material properties, TiO2 is widely utilized as a photocatalyst. When TiO2 is irradiated by ultraviolet light with an appropriate wavelength in the range of 200–400 nm, electrons will be photo excited and move into the conduction band.

Photocatalytic TiO2 benefits from its low price, high availability, inertness, and broad-spectrum effect on the chemical degradation of the majority of organic contaminants and micro-organisms. This makes it an ideal, robust, durable, and effective nanomaterial for chemical-free water and wastewater treatment processes in both large-scale and small-scale treatment plants.

However, up until now, the efficacy of ultraviolet-visible photocatalytic TiO2 in particular has been relatively low compared with similar oxidation processes like ozonation. Nanosilver benefits from its low toxicity, high availability, and well proven bactericidal effect. However, since it is dissolved during the duration of the process, its application is restricted to low feed volumes where a maximum life time can be achieved, for example, with point-of-use devices.

If highly effective nano-TiO2—able to be activated by visible light—can be developed successfully, photocatalysis will become one of the most promising water and wastewater treatment technologies due to its flexible and manifold implementation and easy scalability.

Activation of TiO2 is usually induced by an ultraviolet lamp, but sunlight in addition to artificial light sources is also permitted. KRONO Clean 7000, made by Kronos Inc., Cranbury, NJ, is a...
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**Limitations of nanobased materials**

Commercialization of nanoengineered materials for water and wastewater technology strongly depends on their impact on the aqueous environment. Numerous studies including toxicity tests, life cycle analysis, technology assessment, and pathways and dispersal of nanoparticles in water bodies have been carried out in order to evaluate the health risks of nanomaterials. The results of these studies have led to a better understanding of the behavior of nanoparticles such as TiO₂, and silver nanoparticles in aqueous systems; thus, stakeholders from administration, politics, and industry are supported to create new laws and regulations or modify present ones. However, many studies have yielded contradictory results, since no general standards and conditions for experimental tests and measurements have been determined, which slows down the necessary decision processes.

Nanomaterials in water do not directly affect humans, but there is the possibility of uptake of nanomaterials via consumption of fish, so the impact of nanomaterials on aquatic organisms needs to be taken into consideration. An extensive overview of the miscellaneous effects of TiO₂ nanoparticles on various kinds of aquatic organisms is given in a case study published by the US Environmental Protection Agency in 2010. In that study, different types of nano-TiO₂, different pathways of entry, and different effects on the environment and organisms were shown by comparing several studies of the influence of nanoparticles, exemplified by TiO₂, on different kinds of organisms, including bacteria, algae, invertebrates, fish, and plants. Various acute effects on algae could be demonstrated depending on the type and concentration of TiO₂; however, the median effective concentration depended mainly on the size of the particles.

**Conclusions**

There is a significant need for novel advanced water technologies, in particular to ensure a high quality of drinking water, eliminate micropollutants, and intensify industrial production processes by the use of flexibly adjustable water treatment systems. Nanoengineered materials, such as nanoadsorbents, nanomaterials, nanomembranes, and photocatalysts, offer the potential for novel water technologies that can be easily adapted to customer-specific applications. Most of them are compatible with existing treatment technologies and can be integrated simply in conventional modules.

One of the most important advantages of nanomaterials when compared with conventional water technologies is their ability to integrate various properties, resulting in multifunctional systems such as nanocomposite membranes that enable both particle retention and elimination of contaminants.

However, there are still several drawbacks that have to be negotiated. Materials functionalized with nanoparticles incorporated or deposited on their surface have risk potential, since nanoparticles might release and emit to the environment where they can accumulate for long periods of time. Up until now, no online monitoring systems exist that provide reliable real-time measurement data on the quality and quantity of nanoparticles present only in trace amounts in water, thus offering a high innovation potential. In order to minimize the health risk, several national and international regulations and laws are in preparation.

A technical limitation of nanoengineered water technologies is that they are rarely adaptable to mass processes, and at present are not competitive with conventional treatment technologies.

Despite the many challenges, nanoengineered materials offer great potential for water innovations in the coming decades, in particular for decentralized treatment systems, point-of-use devices, and heavily degradable contaminants.
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**ITA’s Women in Titanium Encourages International Mentoring**

At the Women in Titanium (WiT) meeting held earlier this year in February, plans have been initiated to encourage all ITA Members to become actively involved in mentoring programs.

WiT has elected to support two Mentoring groups in particular: The “MWM” - Million Women Mentors (www.millionwomentutors.org) and the “ITP” - International Tele-Mentor Program (ITP) (www.telementor.org).

Million Women Mentors is an initiative of STEMconnector, a collaboration of over 30 corporate sponsors and 58 partners who reach over 30 million girls and women. This initiative will support the engagement of women and men to serve as mentors for at least 1 Million girls and women by 2018.

MWM supports the engagement of science, technology, engineering and math (STEM) male and female mentors to increase the interest and confidence of girls and women to persist and succeed in STEM programs and careers. Over 200,000 pledges to mentor girls and women in STEM have been received to date.

Managed out of Washington DC, MWM proposes mentors offer 20 hours in mentoring time and they have a published Mentor Action Guide which offers suggested activities for mentoring a girl or women for 20 hours over a 1-year period (less than 2 hours per month).

The International Tele-Mentor Program, managed out of Colorado US, starts with schools comprised of students as young as 12 years old. Through their mentors, they are taught how to map out a STEM-related education and career path, guided by professional networks that help to implement and fine tune these plans over time. David Neils, executive director of ITP, said that professional mentors from over 20 countries have supported over 47,000 students during the last 20 years.

Telementoring is a process that combines the proven practice of mentoring with the speed and ease of electronic communication, enabling busy professionals to make significant contributions to the academic lives of students. Through mentoring by industry professionals, a corporation helps students develop the skills and foundation to pursue their interests successfully and operate at their potential. “Although research shows that face-to-face mentoring programs can have a variety of positive impacts, many top professionals believe they simply don’t have the time to make that kind of commitment. By investing about 30 minutes per week, mentors can help students achieve academic excellence and explore their education and career futures.”

Guided by their mentors, students document the quality of various project outcomes against a rubric or standard. They discuss gaps, if any, between their work and that standard and how they plan to fill the gap. Students also share with mentors how they can leverage the mentor’s help throughout the project and provide insights on how they could have improved as collaborators—a means to continually fine-tune and upgrade the mentoring process.

Speaking on behalf of ITP David Neils explains “the preference is to start the Telementor process at the middle school level, when students are humble, transparent and eager to learn.” The goal is that by the time a student graduates from high school they have in place a continuing education plan, a career plan, and a professional mentoring network. “They’ll know how to recognize high-quality work. These plans are something that should happen for every student.” he said.

In many cases, the mentor/student relationship becomes a long-term, reciprocal program of education and friendship—enriching professional and private lives through the mentoring partnership. It changes the trajectory of lives and serves as a learning experience for both parties. In many ways, the relationship brings to mind an old adage of education: “When I was a student, I learned from my teachers; when I was a teacher, I learned from my students.”

For the titanium industry, both programs complement an ongoing thrust to cultivate students as future engineers, designers, executives, and metallurgists worldwide. The ITA’s WiT committee is pleased to engage in the promotion of mentoring programs available and in attracting students as future leaders of the industry.

More information on both programs will be provided by the WiT group in the coming weeks.
EXECUTIVE PROFILE; WOMEN IN TITANIUM

HOLLY BOTH

Holly Both, the vice president of marketing for Plymouth Tube Co., Warrenville, IL, is a member of the executive committee for the International Titanium Association’s (ITA) Women in Titanium (WiT) group. As a member of the executive committee, Both will help develop and implement plans for the group, which earlier this year held its first meeting.

In her role as vice president of marketing Both’s responsibilities include providing leadership for strategic planning, marketing strategies and communications for all units of the company including Plymouth’s titanium division, Plymouth Engineered Shapes.

She ‘Accidentally’ Fell into the Titanium Industry

Both, quite literally, came to the titanium industry “by accident”; an automotive accident, that is. She had been working in Chicago’s banking and financial industry, as a personal banker and mortgage lender, when she was involved in a car accident. At the time she was living west of Chicago’s in Sycamore, Illinois. After recovering from her injuries, she decided her one-way 72 mile commute was too long, so in 1996 she accepted a marketing position at Plymouth, which was not only more in-line with her career aspirations, but also closer to home.

Plymouth Tube is an international supplier of titanium shapes, tubing and extrusions used primarily in the aerospace sector as well as the power and process industries and heavy equipment and industrial markets.

While initially unfamiliar with the durable manufacturing sector, Both did know that the titanium business had excellent potential for growth and had a strong presence in niche markets such as aerospace. She didn’t have a manufacturing or engineering background when she arrived at Plymouth, but Both described herself as a “process-oriented individual” and was drawn to the rigor and precision of the company’s production operations and its focus on continuous improvement via its manufacturing excellence program.

Her Career ‘Took Shape’ at Plymouth

Upon arriving at Plymouth Tube, Both had questions regarding the marketing department’s overall strategy. The marketing unit, at the time, was a newly defined function for the company. As such, in order to gain a better handle on the business, she first embedded herself into the sales team to understand the company’s customer base and markets served.

Both quickly learned that within Plymouth’s autonomous, decentralized organizational structure, the company has a culture of learning and highly collaborative teamwork. She leveraged this strength to learn about the titanium aerospace market from Plymouth veterans Gary Ezell and Josh Phillips. As her career took root at Plymouth, people like Van Van Pelt, who is now the Chairman of the Board for Plymouth, urged her to continue her education and get an MBA degree which she did in 2010 at a two-year program at Northwestern University’s Kellogg School of Management. She received her undergraduate degree in marketing in 1994 at Northern Illinois

WiT to Meet at TITANIUM EUROPE

Dawne Hickton, the first female president of the executive board for the ITA, announced plans to establish the WiT committee, during the ITA’s 2014 annual industry conference and exhibition, which was held in Chicago last September. WiT held its first official meeting Feb. 27 in Los Angeles, California, and has officially approved the group’s charter, executive committee members, and initial slate of near-term goals. The group will gather again on May 11th in Birmingham, England UK in conjunction with the TITANIUM EUROPE 2015 conference and expo where guest speakers Dr Susan Durbin, Associate Professor in Employment Studies and Dr Ana Lopes, Senior Lecture in Human Resource Management from the University of the West of England, UK will present “Designing a Mentoring Scheme for Female Professionals in the Aviation and Aerospace Industry: Research and Reflections.”

The objective of the WiT committee is to contribute to the growth of the overall titanium industry by providing networking opportunities for women, and to take part in programs that advance gender equality in STEM (science, technology, engineering and mathematics) courses for elementary, high school and college women. WiT will look to attract, advance and retain professional women interested in the titanium field. In recent years, Dawne Hickton and other ITA leaders have focused on the need for industry stewardship programs—dedicated efforts to cultivate the next generation of titanium designers, engineers, metallurgists and executives. The ITA’s WiT initiative is part of that overall effort.
Opportunities for Female Students

In her aspiration to join WiT, Both felt she had the skills and experience to “help ensure the success” of the group. She said he was excited to learn about the WiT’s mission to network women within and into the titanium industry while simultaneously promoting the industry as an opportunity for high school and college female students. She’s also a member of the Association of Women in Metals.

“My involvement (in WiT) would be an excellent starting point for me and for Plymouth to become more active in the ITA and its subcommittees. I feel strongly about the value of the ITA and WiT and the supplemental educational, informational, networking and development opportunities they provide for our industry’s current and future professionals.”

Embracing the Mentoring Spirit

Much of the mission for WiT involves mentoring women currently in the titanium field to support their career development plans and leadership skills, as well as encouraging prospective candidates looking to enter the market. Both has volunteered time this summer at Northern Illinois University’s STEM summer camps for kids. Recently Both became involved with The Kishwaukee Education Consortium of Northern Illinois and its Manufacturing Technology Academy, a 2-year high school program designed to prepare students for careers in manufacturing. Both will be speaking to students about her manufacturing career path and will answer questions about the opportunities available to them.

As a member of the WiT executive committee, Both will be working with Michelle M. Pharand, WiT vice chair and the director of sales and business development for Dynamet Inc., a subsidiary of Carpenter Technology Corp., Wyomissing, PA, and Dawne S. Hickton, the vice chair, president and chief executive officer of RTI International Metals Inc., Pittsburgh, who founded the WiT group. Jennifer Simpson serves as the executive director of the International Titanium Association.

Women in Titanium (continued)

Upcoming Women in Titanium (WiT) Meeting information

Monday, May 11th
Meeting and Guest Speaker, Dr. Susan Durbin and Dr. Ana Lopes “Designing a Mentoring Scheme for Female Professionals in the Aviation and Aerospace Industry: Research and Reflections”
Birmingham, United Kingdom

Wednesday, May 13th
Industry Tour RTI International Metals Tamworth plant
Birmingham, England UK

Thursday, August 20th
Fundamentals of Titanium & Evening Networking Reception

Friday, August 21st
Meeting & Guest Speaker, Ms. Stacie Greenfield Stone, Goldman Titanium, “Review of Scrap Titanium Recycling Process” with plant tour of Goldman Titanium, Inc. scrap facility
Buffalo, New York USA

Wednesday, October 7th
Meeting with Guest Speaker and Networking Reception
Orlando, Florida USA

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Novel Welding, Joining Techniques Focus on Machining and Additive Manufacturing

Novel technologies will be featured during the Welding and Allied Technologies session at TITANIUM EUROPE 2015, held the 11th – 13th May at the Hilton Birmingham Metropole Hotel National Exhibition Centre in the UK. Ian D. Harris, Ph.D., technology leader, arc welding, for Edison Welding Institute (EWI), Columbus, OH, is moderator for the session.

Harris’ colleague, Matt Short, EWI ultrasonics technology leader, will discuss the EWI ultrasonic-assisted machining processes that can be retrofitted into standard machine tools. Short said EWI has developed a system that “sends a longitudinal wave through the tool, generating an intense oscillating motion at the material interface. Research conducted on titanium and many other materials and processes have shown significant improvements in tool life, feed rates, surface finish, and quality.”

EWI’s Acoustech Machining

Known as “Acoustech” Machining,” Short said the technology “dramatically improves metalworking capabilities by bringing ultrasonic performance to new and existing manufacturing equipment,” which is designed to fit existing metalworking equipment and tooling. Designed especially for hard-to-machine metals, like titanium, Acoustech, developed in recent years by EWI, is a patented system that provides acoustical vibrations to conventional cutting tools, bringing the many benefits of ultrasonic technology to today’s plant floor. Benefits of the system include accelerated production rates and extended tool life, according to Short. He said manufacturers can increase output and profits “without purchasing new machining centers, because this patented Acoustech tool holder was specifically engineered to work with standard equipment installed throughout the manufacturing industry.”

By applying high-power ultrasonic vibrations to traditional machining processes (drilling, turning, milling), Acoustech can enhance the performance of conventional machining equipment and boost the speed and accuracy of machining operations. Short explained that Acoustech utilizes high-power ultrasound within conventional tool holders, which produce longitudinal vibrations along the tool’s axis of rotation at 20-kHz, but very small displacements such as 10μm. This motion produces a friction reduction effect, thereby reducing cutting forces due to the oscillating motion of the tool tip.

“Achieving high-power ultrasonics with conventional metalworking equipment and tools gives manufacturers a significant competitive advantage,” Short said. “The key benefit of ultrasounds is the reduction in cutting force, which ensures many advantages. Tool life is improved due to a reduction in cutting temperatures. Coolants may be reduced, sometimes eliminated. Dimensional stability is improved due to reduced tool deflection.”

Benefits from the Acoustech system include lower operating forces, increased feed rates, improved chip extraction and reduced burr formation and improved surface finish of machined components. EWI describes Acoustech as a “green” technology that does not involve slurry abrasives or coolants.

‘Friction and Forge’

Bertrand Flipo, senior project leader for The Welding Institute (TWI), Cambridge, UK, will provide an update on his group’s “Friction and Forge Processes,” which covers recent developments and economical assessments in the joining of titanium alloys using linear friction welding (LFW). Flipo said the production of near-net shape aerospace components represents the focus for this technology. LFW is an automated, self-regulating, self-cleaning and highly repeatable friction welding process, which delivers fast cycle times (under five minutes), according to Flipo. It preserves the forged microstructure of aerospace parts and can be post-weld heat treated and makes use of common stock plates for producing a range of parts.

Flipo explained that many tight-tolerance aerospace components typically are machined from solid blocks of titanium alloys, which results in relatively poor buy-to-fly ratios. He said the use of near-net shape parts produced by LFW can significantly reduce production costs for a wide range of aerospace components.

He said the buildup of near-net shape parts by LFW also provides the opportunity for selection of appropriate dissimilar alloys in different parts of the structure. This approach allows the production of tailored components,
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resulting in both functional and economic benefits. Examples range from simple LFW fabrications, to more complex components produced by sequential LFW of multiple parts. According to TWI information posted online, the LFW process is finding increasing use as a manufacturing technology for the production of titanium alloy Ti-6Al-4V aerospace components. Computational models give an insight into the process; however, there is limited experimental data that can be used for either modeling inputs or validation. To address this problem, a design of experiments recently was used to investigate the influence of the LFW process inputs on various outputs for experimental Ti-6Al-4V welds. The finite element analysis software “Deform” was also used in conjunction with the experimental findings to investigate the heating of the work pieces.

Key findings showed that the average interface force and coefficient of friction during each phase of the process were insensitive to the rubbing velocity; and the interface of the work pieces reached a temperature of approximately 1000 C during the friction phase. TWI said this work has enabled a greater insight into the underlying process physics and will aid future modeling investigations.

**West County Welding Supplies & M. Braun Alliance**

West Country Welding Supplies Ltd., located in Bristol, UK, a major provider of industrial welding equipment, recently unveiled its new off-the-shelf welding chamber, developed through a partnership with M. Braun Inertgas-Systeme GmbH, Garching, Germany, which is designed for the titanium and specialty metals. Market applications include aerospace, semiconductor, medical, scientific and nuclear industries, all of which have a demand for high-quality welded components. The company said increasing industrial standards have forced these industries to look again at their welding techniques and processes “in order to achieve the perfect titanium weld.”

According to Kyle Loomes, West Country’s 10/10 German-engineered, stainless steel welding chamber delivers titanium welds need to be carried out with minimal oxygen in the weld area. The welding workstations have an ergonomic design that provides “operator comfort while being fully equipped with a shaded sliding eye shield and internal lighting to a fast flow gas purge system and an insulated torch feedthrough.”

M. Braun asserts itself as a world leader in “glove box” welding technology, providing turnkey solutions for all inert gas welding applications, according to West Country, which offers full customer support, from installation and commissioning of the chamber through to complete operator training.

**Development efforts at EWI**

EWI’s Ian Harris will describe other welding and joining additive manufacturing projects currently under development at his group—projects that are in the process of being transitioned into full commercial manufacturing systems. He said EWI is performing directed energy deposition (DED) additive manufacturing with laser, arc, and ultrasonic energy sources.

The thrust and focus for these development efforts, according to Harris, is to significantly increase additive manufacturing deposition rates (up to 40 pounds per hour), in order to produce high-value, complex parts—such as pumps and valves—from titanium alloys and nickel-based superalloys. Part size would fit into a 4 by 4 foot production cell. The cell employs a six-axis robot and gas tungsten arc welding (also known as tungsten inert gas welding, or TIG) with preheated wire. Harris pointed out that is less expensive and more readily available in the supply chain compared with powder metal.

“We’re addressing market needs (for new generations of additive manufacturing),” Harris said. “We look to identify technologies that seem promising, but need additional commercial development work.” He also noted an inherent advantage of additive manufacturing is the reduction of scrap rates, compared with traditional machining, which would result in a potential 50-percent per-part cost reduction, reducing the buy-to-fly ratio. Describing his upcoming presentation, Harris said “the ubiquitous use of robotic arc welding, with added CAD-to-part capability, can become a significant additive manufacturing resource for the supply chain in aerospace, oil and gas, and other markets. EWI is developing the software linkage for true CAD-to-part additive manufacturing using six-axis robotics, as well as the bead size/spacing to achieve both the desired microstructure and properties, and the build strategy/path.”

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the ASTM F42 committee on additive manufacturing technologies (formed in 2009) on the development of standards for DED using arc, laser, and electron beam processes for free-form fabrication of parts larger than can be built in a laser powder-bed fusion (PBF) system. DED processes are not limited in part-size capability compared to PBF processes. They can also build parts much faster at deposition rates of 1 to 40 pounds per hour, depending on material and process selection, and can be developed to meet the required microstructure and properties, Harris said.

Markets targeted by EWI for this high deposition rate for additive manufacturing would be aerospace and oil and gas, according to Harris. The goal is to create “a suite of processes” that can deliver computer-aided design (CAD) to part capability on a commercial scale. EWI is reviewing potential business opportunities for large-part additive manufacturing on a market by market basis. The effort would involve EWI working with various partners and integrators to build such a manufacturing capability, which could involve an integrated, multi-station production system for downstream heat treating, annealing and part finishing. “We’re already thinking beyond a base-line system,” Harris indicated. For example, one program, now in the pilot stage of development, is producing a 3-foot long, curved fin-like aerospace structure.

Another example of EWI’s additive manufacturing capability is the Laser Powder Bed Fusion process. According to information posted on the company’s website (http://ewi.org/technologies/additive-manufacturing) EWI uses a EOS GmbH Electro Optical System (EOS) M280 Direct Metal Laser Sintering (DMLS™) platform with a 400W laser. EWI is a materials development partner with EOS North America with the technical ability to support the development of custom process parameter sets for existing or new alloys via the EOS M280.

EOS GmbH (Electro Optical Systems), Munich, Germany, is involved in commercial utilization of laser technology generating 3-D or additive manufacturing components, layer by layer directly from CAD data.

Additive Manufacturing Consortium

EWI stated they are focused on “developing and maturing metal additive manufacturing processes to produce functional components, not prototypes.” In 2010, EWI established the Additive Manufacturing Consortium (AMC) in 2010 with a mission of advancing the manufacturing readiness of this emerging technology.

The AMC, directed by Shawn Kelly, Ph.D., a senior engineer at EWI, is a national group of industry, government, academic and non-profit research organizations with the mission of accelerating and advancing the manufacturing readiness of metal additive manufacturing technology.

An article written by Dr. Kelly for the June 2014 edition of Welding & Gas Today Online, said that, from an industrial perspective, 3D printing/additive manufacturing is being explored in a number of different industrial segments, most notably aerospace and medical. “The aerospace community, which encounters high value materials, requires components in lower volumes and can benefit significantly from the lifetime energy savings enabled from the lightweight designs, has been a leader thus far. The medical industry is also an early adopter of the technology for the above reasons, and the ability to customize the part for patient-specific needs makes it appealing.” Kelly pointed out that, according to a May 2013 study by the McKinsey Global Institute, it’s estimated the total future market potential for additive manufacturing could reach “an impact of up to $550 billion per year by 2025.” For more information on the AMC, contact the Kelly by phone (1-614-688-5145) or e-mail (skelly@ewi.org).
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ACCURACY. KNOWLEDGE. AVAILABILITY.
Life-cycle costing has long been put forth as a favorable metric to demonstrate titanium’s “good value” as a material of choice in a host of industrial applications. However, despite the math and logic that supports the use of titanium compared with competing materials, industry executives privately admit that this argument, despite its merits, falls short. In some cases, titanium is passed over due to short-term budget constraints for so-called “less-expensive” metals. It’s fair to say titanium’s durability and affordability as a long-term investment for infrastructure or industrial projects simply doesn’t convince everyone.

Barry Benator is looking to address that entrenched mindset and will provide titanium executives and sales representatives the tools they need to make a more convincing case to win business. Benator, the founder and president of Benetech Inc., Roswell, GA, a leadership and management consulting and training firm serving clients throughout the United States and internationally, produces an online seminar on life-cycle costing for the energy industry, and now looks to impart that knowledge to the titanium sector.

ITA has organized a ½ day session at the upcoming TITANIUM USA 2015 conference and exhibition to be held this October 4th – 7th in Orlando, Florida USA. Barry wants to give the titanium industry the “ammunition” it needs to prove to potential customers how and why titanium can be a more affordable investment over the long term, even if there is an initial, higher “up-front” price tag compared with other metals.

Simply put, Benator defines life-cycle costing as a calculation to determine the long-term payback for an investment, taking into account the savings and cost over the entire life of a product or system. “The basic idea is: do I spend a bit more now to get a better system for the long haul,” Benator explained. “Customers are always concerned about their return on investment. A lot of this is intuitive, but some people have to understand it and ‘see’ it before they truly believe it. I try to put together the rationale behind the numbers.”

Businesses and governments make important decisions based on financial benefits (and risks) to their organizations. For industrial projects like desalination installations, heat exchangers, and chemical or food processing, factors such as annual maintenance costs, reliability, production speeds and long-term performance come into play. And of course, material costs are factored into the front end of the equation. Benator said his one-day course can provide ITA members with practical tools to help explain and prove the financial benefits of titanium, especially when the application calls for corrosion resistance and high strength. The course will focus on sound financial comparisons of the strength, durability and other benefits of titanium.

As spelled out in the course description prepared by Benator, the economic analysis method known as life cycle costing (LCC) calculates the total cost incurred with the ownership, lease or rental of a facility or equipment over its lifetime. There are several different methods of LCC analysis that the professional can use to make a purchase decision. Although leasing and rental are also options, it is assumed that the organization will use a financial advisor to evaluate ownership, leasing, and rental options.

He said first it’s necessary to understand the concept of “time value of money.” In analyzing any cost, investment, or stream of cash flows, it’s extremely important to recognize that money, much like any commodity, has a time value. As an illustration, he said to consider the option of receiving a $100 bill now or $100 bill one year from now. Most people would rather have the $100 bill now because they can invest it and earn a return on their investment.

For example, $100 invested now at a 10-percent interest rate will earn $10 in one year. The investor will have a total of $110 at the end of one year. Compounded annually, the investor will have $121 at the end of two years. Even with zero inflation, money in the future is worth less than the same amount of money now. Again, this is because money can be invested now to earn a return on the investment for the investor.

Similarly, he said cash in the future can be “discounted” to the present through the use of discount formulas and tables that are the inverse of the familiar compound interest formulas and tables. This can determine the present value of a future amount of money.

Benator’s upcoming session in Orlando will provide the essential definitions of net-present value (NPV), internal rate of
return (IRR) and savings-to-investment ratio (SIR) and how to calculate these values in order to illuminate the financial benefits of titanium compared to other metals. He will demonstrate how to use LCC spreadsheets to quickly and accurately determine NPV, IRR and SIR.

Over the years Benator’s financial expertise and cost-calculating systems have been devoted to the energy business—a knowledge base that he now hopes to redeploy to the titanium industry. And while he’s not a metallurgist, industrial designer or manufacturing engineer, he did spend more than 20 years in the Navy, including four years of active duty as a naval lieutenant on a nuclear submarine. During that period, when he was studying submarine design and capabilities, he came to understand that Russian-made titanium subs were lighter, faster and more agile and durable than U.S.-built steel vessels.

The Life Cycle Costing course developed by Barry Benator has been approved by the Washington D.C. based American Institute of Architects Continuing Education Systems Registered Provider program for continuing education credits. The Association of Energy Engineers, headquartered in Atlanta, is an approved training provider of the program.

Benator has more than 30 years of consulting and training experience for corporate and governmental clients and has taught energy engineering and LCC skills to more than 5,000 energy engineers, facility managers and utility personnel. He received an M.B.A. in finance from Loyola College and M.S. and bachelor degrees in electrical engineering from Georgia Tech. He is a Myers-Briggs Type Indicator® Master Practitioner, a certified Situational Leadership® Program trainer, and a Professional Engineer/Certified Energy Manager.
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Chris Olin is the head of the specialty materials & aerospace-related research team. Each quarter, we offer a free update report on the visible trends in key markets (like titanium and nickel-based alloys) for any company/person that completes our quarter survey(s). We also host a series of webcasts to highlight the interesting themes and potential topics.

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Kevin Kreitman, EFO Consultant
Phone: +1-530-921-1711
kkkreitman@gmail.com

Chief Kreitman has 36 years’ experience in the fire service beginning his career as a firefighter in Albany, OR. He was Fire Chief with the City of Albany from 1999 until accepting the Fire Chief’s job with the City of Redding, CA in Sept. 2008. Kreitman developed significant experience during his time in Albany dealing with the numerous metal industries handling materials that presented unique fire hazards. Based on those hazards, Kreitman wrote a paper on the proper handling of titanium and zirconium metal fires.

He’s a member of National Fire Protection Association (NFPA) Combustible Metals committee and has been active in the standard process with emphasis on the development of the Fire Prevention, Fire Protection and Emergency Response Chapters. He has written articles on dust & combustible metal hazards and conducted presentations at national conferences; he has assisted NFPA and the National Institutes for Occupational Safety and Health on investigations and publications dealing with combustible metal hazards, and was an author of the Combustible Metals chapter in NFPA’s recent 9th Edition of the Fire & Life Safety Inspection Manual.

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METALINX MATERIAL MANAGEMENT, INC. PROUDLY ANNOUNCES
THE OPENING OF A METALINX DEMONSTRATION CENTER

Opening in May of 2015 located near DFW Airport at 1620 N. I-35 E, Suite 311 in Carrollton, Texas. Demonstrations of patented MetaLinx technology will be conducted for titanium industry visitors to reveal the most proficient and cost effective material management system available that assures transparency, accountability and control of recyclable materials.

MetaLinx systems are custom designed for each facility and may incorporate a wide array of on-site processing and monitoring equipment/software options and choices of operating service by MetaLinx technicians or MetaLinx trained facility personnel.

Demonstrations may be scheduled by contacting Dr. Bert Erdel at cell phone (908) 229-0823, email berte@metalinx.com or David H. Jones at cell phone (310) 595-4130, e-mail davidj@metalinx.com.

SOLAR ATMOSPHERES VACUUM HEAT TREATS TI MANIFOLD FOR ORION SPACECRAFT

HERMITAGE, PA.   
JANUARY 06, 2015 –

On Friday, December 5, 2014, NASA’s new spacecraft Orion launched successfully from Cape Canaveral and completed its first test flight. One of the tricky parts of launching humans into space is deciding what to do if something goes wrong while riding on top of a controlled explosion for nine minutes. New to all future “human present” rockets will be the Launch Abort System (LAS). This critical part of the safety system was vacuum heat treated by Solar Atmospheres of Western PA. The large manifold housing made from 6Al 4V titanium is designed to rapidly propel astronauts away from the main rocket in case of a catastrophic explosion or any other unexpected event. Once fired, the LAS will accelerate the astronauts away from the main rocket at forces up to 10 to 15 g’s.

Michael Johnson, Sales Manager stated “The welded component needed to be homogenously treated to insure peak performance in the event the LAS would be needed. Precise temperature monitoring of the part and uniformity of the furnace was the easy part, while minimizing distortion, and avoiding eutectic’s with the fixturing materials used, were ultimately the real challenge. At the end of the day, both Solar and its customer had a process that proved to be successful on the prototype and the three additional manifolds that followed.”

Solar Atmospheres of Western PA is very proud knowing that they contributed to the success of the Orion Mission.

For more information about Solar Atmospheres of Western PA, please contact Mike Johnson at (866) 982-0660 ext. 2223, or mike@solaratm.com, and visit us at www.solaratm.com.
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SUCCESSFUL CLOSING OF JOINT VENTURE: THYSSENKRUPP UHDE CHLORINE ENGINEERS STARTS BUSINESS OPERATIONS

The joint venture between plant engineering and construction specialist ThyssenKrupp Industrial Solutions and electrochemical technologies supplier De Nora was concluded successfully on April 1st, 2015. It will trade under the name ThyssenKrupp Uhde Chlorine Engineers and is operational with immediate effect. The new company combines the electrolysis business of the two companies under the managerial control of ThyssenKrupp Industrial Solutions, the majority shareholder. The shareholder board consists of seven members, three of which are from De Nora. The plan to create a joint venture had been announced on November 2013 but was subject to approval by the supervisory bodies and the relevant antitrust authorities.

An increased global presence will be achieved by combining and harmonizing the worldwide capabilities for engineering, procurement and construction of electrolysis plants as well as technical support and sales. The new global setup will be rolled out during the next months. The company is headquartered in Dortmund and its main entities are based in Okayama, Tokyo, Shanghai, Milan and Houston.

Dr. Sami Pelkonen, CEO of ThyssenKrupp Uhde Chlorine Engineers: “We are fully committed to innovation. Customer needs and local trends of the global market will drive the further development of our technologies and services.” It is intended to achieve annual sales in the mid three-digit million euro range.

Paolo Dellachà, CEO of De Nora: “This new joint venture will take the already proven cooperation between our two companies to a new level. We will be able to respond better and faster to our customers regardless of the technology they employ and the country where the support is required.”

ThyssenKrupp Uhde Chlorine Engineers will continue all existing electrolysis processes of the two companies, including, for example, the filter press-based BiTAC® process from Chlorine Engineers, all generations of single-element technology developed by UHDENORA/Uhde and the HCl ODC and NaCl ODC technologies. Another key area of the activities will be the development of water electrolysis for hydrogen production for the efficient intermediate storage of renewable energy.
A leader in Metallurgy

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ITA ANNOUNCES CALL FOR PAPERS FOR TITANIUM USA 2015

International Titanium Association (ITA), Denver, CO, has issued a "Call for Papers" to be presented at the TITANIUM 2015 Conference, which will be held October 4-7, 2015 at the Rosen Shingle Creek Resort, located at 9939 Universal Boulevard in Orlando, Florida USA. TITANIUM 2015 is the International Titanium Association’s 31st annual conference.

Interested presenters (ITA members and non-members alike) may submit abstracts by e-mail to ita@titanium.org for consideration by the conference organizing committee. Instructions for proper submissions are located in the Industry Events section of the ITA website at www.titanium.org.

Sufficient detail for fair evaluation of the proposed paper and presentation should be included along with an indication which of the following session(s) the presenter would prefer to participate in: Raw Materials; Alternative Energy; Commercial Aerospace; Military/Defense; Automotive; Medical; Industrial Markets; Economy/Finance; Additive Manufacturing; Manufacturing Technology; New Materials; Consumer Markets; Architectural; Welding & Joining; Medical Applications; or Other. Only abstracts written in English will be considered.

The Call for Papers Deadline is June 30, 2015.

Questions may be directed to ITA headquarters at 1-303-404-2221 or by email at ita@titanium.org.

Jennifer Simpson, executive director of the ITA, also announced “early bird” registration is now available for the event in Orlando now through April 15th. ITA staff members are available to answer any questions regarding registration and housing or simply visit www.titanium.org for more details.

TITANIUM USA 2015 is designed to suit the needs of titanium industry professionals, suppliers, customers and stakeholders. The gathering offers a full spectrum of information on the latest business, technology and market trends and developments in the global titanium industry. It provides an excellent forum for expert discussions, continuing education, networking opportunities and more.

Conference attendees typically hold executive positions in areas such as management, sales and marketing, product development, procurement, engineering and design, purchasing and quality control. Last year TITANIUM 2014, held in Chicago, drew an attendance of 950 guests from 25 countries. For more information contact the International Titanium Association at +1-303-404-2221 or email ita@titanium.org.
Titanium and Combustible Metal Safety

Metals in a combustible form including titanium, can present fire and explosion hazards. Improper handling of these materials in fire incidents, place personnel and responders at great risk, these risks however can be minimized through proper pre-planning, engineering, housekeeping, and training.

Preventive actions are important to minimizing potential fire and explosion hazards. Knowledge of the risks associated with the metal and the form it is in along with proper housekeeping will greatly reduce risks and likelihood of an incident.

Should an incident occur however, how the incident is handled is critical to a safe outcome. The proper handling of fires involving titanium and metals in a combustible form does not occur by happenstance. One of the most important items is to ensure that pre-planning with emergency responders on the risks and hazards associated with titanium and other metals in a combustible form has taken place prior to the incident, to ensure proper actions are taken in the handling of the emergency which is critical to a safe outcome.

Developing a close working relationship with the facility and working closely with facility personnel is a must to minimize risks for the facility and emergency responders. Incidents involving a fire at a titanium or other facility involving metals in combustible form may very well present additional risks based on the form of the material involved, such as powders, dusts, molten metal, as well as the potential involvement of chemicals that may be associated with the processing of the metal.

It is essential that facility personnel and emergency responders develop a close working relationship and policies and procedures to ensure the safe handling of incident should they occur. This presentation will provide a general overview of NFPA's Combustible Metal Standard, the importance of housekeeping, and the proper handling of fires involving titanium and metals combustible form.

In this 1 hour video, Kevin Kreitman, Redding California Fire Department Chief provides an overview of Titanium and Combustible Metal Safety.

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- Titanium
- Titanium Alloys

- Stable base for other coatings & adhesive bonding; appearance; color coding
- Prevents fretting & galling
- Natural, reproducible colors

Ion Vapor Deposition of Aluminum

- Aluminum
- Steel
- Alloys
- Titanium

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- No hydrogen embrittlement
- High operating temperature (1100°F)

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- Aluminum
- Aluminum Alloys

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- Allows aluminum application where wear, corrosion or other factors would otherwise exclude its use

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- Automatic & manual application; TFC processes comply with a variety of mil specs; combines with other coatings
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The following chart provides a quick overview of the features and advantages of TFC’s coating processes:
Career Announcements

Promotions

John Barnes
Vice President
of Advanced Manufacturing and Strategy at RTI International Metals, Inc.

Adrian Chaffins
Vice President Operations at AL Solutions

Dave Chapman
Business Development Manager at Code A Weld

Andy Green
Management Analyst at Defense Logistics Agency

Enrico Rossi
Sales Manager at Tubiflex SpA

AXEL WenZEL
Director Sales Oil & Gas Special Applications, Kind & Co.

Work Anniversaries

Serena Bao
Sales Celebrating 5 years at Xi’an Jiate Titanium Industry Co., Ltd!

Viatcheslav Brecht
Director Celebrating 9 years at HVM Metalls AG

Dave Ochar
Director of Sales, North America - West Celebrating 14 years at Bodycote

Mike Poorman
Owner Celebrating 8 years at ReMelt Scientific, Inc.

Celia Qi
Senior Buy & Import &Export Specialist Celebrating 2 years at Nissens

Hans-Henk Wolters
CEO Celebrating 12 years at ECM Technologies

Retiring

Jeff White,
TICO Titanium

Jeffrey A. White, also known as Jeff, served as President of TICO Titanium, Inc. from 2007 to January, 2015. Jeff led the company’s Oak Ridge North (Houston) facility and fabricated products group.

In Memoriam

Joel P. Moskowitz
(May 17, 1939 - March 15, 2015)

Joel Moskowitz of Corona Del Mar, CA, died March 15, due to complications from non-Hodgkins lymphoma. Joel spent his career as the CEO and guiding force of Ceradyne, Inc., which he founded in 1967. Joel was an active member in a broad range of charitable organizations and a Board member of his alma mater Alfred University. Born in Brooklyn, NY and raised in Troy, NY Moskowitz graduated from Alfred University (Alfred, New York). After serving as a First Lieutenant in the US Army from 1961-1963, he moved to California where he met his wife Ann who he married and in 1964. He co-founded Ceradyne in 1967 which he ran until 3M acquired it in 2012. Under his leadership, the company grew from 5 employees to over 2,900 in divisions situated in five states as well as China, Germany and Canada. Ceradyne developed technical ceramics, most notably armored inserts used in the protective vests worn by military personnel in Afghanistan and Iraq. These products are credited with saving at least 10,000 lives by protecting soldiers and marines from shots that knocked them down but did not take their lives. While primarily known as a defense company, Ceradyne manufactured products ranging from translucent orthodontic braces, to neutron absorbing materials for storing and transporting nuclear power and waste, and crucibles tailored for uses as diverse as the manufacture of silicon solar cells and aluminum production. Throughout his career, Moskowitz was recognized for his leadership: Ernst and Young named him 1997 “Entrepreneur of the Year” for Orange County manufacturing, and the Orange County Register named him named Orange County’s CEO of the year in 2004 after being named to their top 10 list the two prior years. Among his other honors, Moskowitz received Albert Einstein Technology Award from the Israeli government in 2004 and an honorary Doctor of Science degree from Alfred University in 2005. He and his wife Ann were active members of Temple Bat Yahm in Newport Beach where he served as a President of the congregation. Following his retirement from Ceradyne, Moskowitz continued his philanthropic work with the Jewish Federation and Temple Bat Yahm. He was founding chair of the the American Ceramic Society’s, non-profit Ceramic and Glass Industry Foundation, an organization dedicated to promoting education and careers in ceramic and glass sciences.
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- International trade and pricing summary
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- Strategic issues and outlook
- Appendix 1 - Titanium metal industry
- Appendix 2 - Emerging technologies
- Appendix 2 - Profiles of major industry participants
- Appendix 3 - Glossary and definitions

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Butech Bliss is a designer and manufacturer of capital equipment, repair components and engineering and field services for metals producers and processors that roll, forge, melt, flatten, stretch, shear and extrude metals of all types. Butech Bliss is located in Salem, Ohio and is home to one of the largest manufacturing facilities in the industry. With over 50 engineers on staff, 400,000 sq. feet, 100+ machining centers, full fabrication and assembly departments, 200 ton crane capacity and a dedicated rail siding, Butech Bliss is equipped to handle any project. Butech Bliss product offerings include copper crucibles, liners, molds, hearths, etc. for VAR, ESR, PAM and EBM Re-melting equipment as well as Rolling Mills, Forging and Extrusion Press upgrades and Coil, Plate and Sheet processing equipment for all metals. Butech Bliss is comprised of Butech Inc., E.W. Bliss (Bliss-Salem), Loewy Machinery and Lombard Industries.

Caledonian Alloys
Phone: +1-252-975-3101
www.pccforgedproducts.com/brands/caledonian_alloys/

Caledonian Alloys is the world leader in the management of nickel and cobalt base superalloy and titanium alloy recycling for the aerospace, land-based turbine, and chemical industries. The company transforms revert, through rigorous process, into material which can be re-melted, to produce new nickel, cobalt, or titanium alloys. Revert consists of excess alloy material which can arise from high performance component manufacturing, from decommissioned parts, and from the melting process. Caledonian Alloys provides customers with a range of tailored revert management services designed to enable them to optimize the use and value of their own revert material. Accredited with all major vacuum and high temperature melters worldwide, Caledonian Alloys supplies fully processed nickel and titanium revert material to the melting industry. We also purchase revert material from a wide range of industrial customers throughout the world.

CEFIVAL
Phone: +33 1 39 37 12 27
www.cefival.fr

Manufacturing of hot extruded special sections, tubes and rings for aircraft engines in any kind of steels, nickel alloys and titanium alloys.
Main application fields: aeronautics (for aircraft engines and structural parts), energy (nuclear and conventional applications) and medical.

Chaoyang Jinda Titanium Co., Ltd.
Phone: +86 421 2976177
www.jinda.cc

Chaoyang Jinda Titanium Co., Ltd., A subsidiary of Chaoyang Jinda Group, specialize in manufacturing high purity titanium sponge in lower content of oxygen (0.04%), lower carbon (0.005%) and lower nitrogen(0.004%). Production is 10000 MT per year.

Chesapeake Industrial Cleaning Products, Inc.
Phone: +1-410-340-9052
www.chesapeakeindustrial.com

Chesapeake Industrial formulates and supplies manufacturing chemicals and degreasers to titanium recyclers and processors.
Cleaners for removing oil from turnings, dirt and oil from scrap, cutting fluids from formed products and other typical operations are our expertise. Chesapeake provides a wide range of formulated products from general cleaners to high spec materials made at facilities in several US locations. Products specifically designed for individual operations can be formulated for costs often lower than ‘off-the-shelf’ materials. Chesapeake has served customers in the titanium industry for over 10 years. Drums, Totes and Bulk deliveries of materials are all available.

China Huaxia Special Metal Limited
Phone: +86-21-58770128
www.nonferrous-metal.com

China Huaxia Special Metal Limited is the professional manufacturer of titanium products, with a complete production line and high technology team. The quality can be guaranteed. Huaxia is working hard to be the best manufacturer of special metal products including titanium sheet, tube/pipe, bar, wire, stainless steel tube/pipe, duplex & super duplex tube/pipe, nickel & nickel alloy, flange, forging, fitting and valve. Huaxia products provide good quality, good price and good service.

China Steel Corporation
Phone: +886-7-802-1111
www.csc.com.tw

China Steel Corporation (CSC), located in Kaohsiung, Taiwan, was founded in December 1971. with annual production (in terms of crude steel)around 10 million tones, CSC produces a range of products that includes plates, bars, wire rod, hot and cold rolled coils, electrogalvanized coils, electrical steel coils, hot-dip galvanized coils, and Ti/Ni- base alloys. The domestic markets takes roughly 65% of CSC’s production and the exports take the remaining 35%. CSC is the largest steel company in Taiwan, enjoying more than 50% of the domestic market. Major export destinations are Mainland China, Japan, and Southeast Asia.

Titanium Buyers Guide (continued)
Titanium & Titanium Alloys
Bar, sheet, plate, tube and pipe

Titanium Grade 1, 2, 3, 4, 7, 9 / 6AL4V / 6AL4V ELI / 6AL7Nb
Management Systems according to ISO 9001, EN ISO 13485 &
EN 9120/AS 9120A

Stockholder with offices & service centres in:
Switzerland, Poland, Hungary, Romania, Bulgaria,
Czech Republic, Ukraine, Russia, China and the UK
Cleveland Research Company
Phone: +1-216-649-7212
www.cleveland-research.com
colin@cleveland-research.com

Cleveland Research Company is an independent equity research firm headquartered in Cleveland, Ohio. We pride ourselves on a disciplined research process that has us regularly engaged with the companies we cover. We are focused mainly on uncovering inflection points via rigorous digging in the channel. We limit the distribution of our proprietary research and findings to 125 of the largest institutional investors in the US, a discipline which allows us to provide a high level of service to our partners. Our firm is comprised of intellectually curious, highly motivated individuals who are all striving to build the best equity research firm in the business.

Chris Olin is the head of the specialty materials & aerospace-related research team. Each quarter, we offer a free update report on the visible trends in key markets (like titanium and nickel-based alloys) for any company/person that completes our quarter survey(s). We also host a series of webcasts to highlight the interesting themes and potential topics.

Consarc Corporation
Phone: +1-609-267-8000
www.consarc.com

Consarc Corporation, an Inductotherm Group Company, is a manufacturer of vacuum furnaces for the titanium forging and casting industry. Consarc custom designs and manufactures Reactive Vacuum Arc Remelting (RVAR) furnaces for primary electrode melts of compacted sponge titanium and titanium alloys, and secondary melt furnaces for remelting fully dense electrodes. Consarc also designs and manufactures fully customized Induction Skull Melting (ISM) systems for melting titanium in a refractory-free environment for casting or ingot withdrawal. Consarc is ISO 9001-2008 certified, and with operations on 5 continents, is well equipped to tackle fully customized furnace projects globally.

Continental Steel and Tube Company
Phone: +1-954-332-2290
www.continentalsteel.com/Titanium/default.asp

Continental Steel and Tube Company is one of the world’s leading value added volume suppliers of quality metals. With an outstanding global reputation, our team of expert sales associates can source a comprehensive inventory of metals to meet any application requirements.

Continental Steel supplies a wide range of metals including, titanium, stainless steel, nickel, steel, aluminum, hot/cold rolled, galvanized, and stainless and electrical steel in carbon and alloy grades. Our long list of Titanium Grades includes Ti 6Al-4V ELI. Our materials are available in coils, sheets, strips, plates, angels, bars, rounds squares, hexagons, and other custom shapes. Continental also offers tubing or pipes in welded, DOM and seamless.

Cristal Metals Inc.
Phone: +1-815-834-2112
www.cristalmetals.com

Cristal Metals was formed in 1997 as International Titanium Powder (ITP) to develop and commercialize Armstrong Process® patented and proprietary technology for high purity metal and alloy powders with specific emphasis on titanium. Armstrong Process® technology is intended to lower the production cost of powders suitable for direct consolidation, to lower the manufacturing costs of titanium products through powder metallurgy processing, and to reduce the environmental impact of titanium production.

CSIRO High Performance Metal Industries
Phone: +61 3 9545 8644
www.csiro.au/TitaniumTechnologies

The High Performance Metal Industries Program, is engaged in applied R&D across the metal value chain, specialising in novel metal production techniques, interfaces/corrosion, metal forming, and additive manufacturing / 3D printing, particularly for Titanium and its alloys. HPMI partners with commercial industry in applied research or to develop new technologies as well as provides consulting services use of specialized facilities, and aims to be a global leader in the knowledge and application of fundamental metals technologies. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is Australia’s primary national research body, with over 5,000 researchers active over a wide range of fundamental and applied research challenges.

Cyril Bath Company
Phone: +1-704-289-8531
www.cyrilbath.com

Cyril Bath produces titanium air frame components by Hot Stretch Forming HSF® titanium profiles in lengths up to 30 feet long. Most of these air frame components are provided as machined and finished, ready for airplane assembly installation. We purchase titanium in extrusion or rolled product forms.

Danielli Corporation
Phone: +1-724-778-5400
www.danielli.com

Danielli Centro Maskin combines Swedish, North American and Italian technology together with know-how gained through our experience of 55 years of activity in the field of Surface Conditioning, NDT Inspection and Finishing Lines for the titanium industry. Danielli Centro Maskin surface conditioning, drawing, straightening, peeling, centerless grinding, cutting, and tube finishing lines, incorporate the most modern engineering and design technologies. Danielli Wean United is recognized worldwide as a leader in the field of engineering and manufacturing of complete hot and cold mill complexes for ferrous and non-ferrous metals."

DGA
Phone: +33 1 4619 8074
www.defense.gouv.fr/dga

DHL Drawback Services
Phone: +1-585-328-7130
www.dhldrawback.com

DHL Drawback Services is a licensed Customhouse broker specializing in duty drawback matters. With offices in Houston, Texas and Rochester, New York, we have over 20 years experience
THE CRUCIBLE AND MOLD EXPERTS

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- EB & PLASMA MOLDS AND PULLERS
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- REPAIR & REFURBISHMENT

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obtaining the maximum in allowable duty drawback refunds and excise tax credits for our clients in a compliant, timely, thorough, and professional manner that imposes the least amount of administrative burden on our client’s time and resources.

DKSH Switzerland Ltd.
Phone: +41 44 386 72 72
www.dksh.com
ti@dksh.com

Pioneers in sourcing of Titanium bars and plates from Japan and China: DKSH Advanced Metals is part of a Swiss group with 140 years of experience in bridging Asia and the West. For the last 30 years, we have been instrumental in introducing high quality titanium and titanium alloys from top quality Japanese and Chinese producers to European, US and South East Asian customers. We serve stockists as well as end users in the Medical, Aerospace, Automotive, Chemical, Oil & Gas and other high tech industries. Our wide range of services includes access to a comprehensive stock of Ti semi finished products, advanced supply chain management as vendor managed inventory and subcontracting for machining and forging, tailor made financing solutions and metallurgical expertise. Our deeply rooted knowledge of sourcing and subcontracting markets coupled with our Swiss sense for premium quality ensures that we remain at the forefront of innovation when it comes to serving your needs.

Dufierco SA
Phone: +41 91 822 56 00
www.dufierco.com

Dufierco Group is the ultimate shareholder of Vanchem Vanadium Products (Pty) Ltd. (“Vanchem”). Vanchem is one of the world’s top five vanadium producers and its assets comprise mining activities and various vanadium oxide, ferro-vanadium, and vanadium chemical production facilities. Visit our websites at www.vanchenvanadiumproducts.com and www.dufierco.com

Dynamet Incorporated
Phone: +1-800-237-9655
www.carterch.com/dynamet

Dynamet Incorporated was founded in 1967 to produce titanium wire and bar for the aircraft fastener industry. Purchased by Carpenter Technology Corporation in 1987, Dynamet has become a leader in the development of high performance titanium long products for the aerospace, medical, motorsports, recreation and consumer industries. As a supplier of fastener wire, bar, precision shapes, fine wire and weld wire, Dynamet offers unmatched flexibility in manufacturing custom sizes, chemistries and quantities to meet demanding customer specifications and production needs.

EFC Systems, Inc.
Phone: +410-939-7155
www.efcusa.com

EFC - Electrostatic Finishing Components and Systems, Inc., an American engineering and manufacturing firm serving both the domestic and international markets, is a complete systems supplier for advanced spraying technologies. We design, fabricate, and repair electrostatic finishing components - turbine and spray gun systems - at our headquarters in Havre de Grace, Maryland.

ELG Utica Alloys, Inc.
Phone: +1-315-574-1680
www.elgunticaalloys.com

EUA is one of the world’s largest Titanium, Nickel and Cobalt alloy recycling companies. We operate under the tightest quality standards, utilize the latest equipment, offer unparalleled service, are fed by over 40 sister yards worldwide and have the financial backing of ELG Haniel GmbH.

Evraz Stratcor, Inc.
Phone: +1-312-533-3650
www.evrazstratcor.com

EVRAZ Stratcor offers titanium producers one-stop shopping for all their master-alloy requirements. Using a state-of-the-art, ISO approved production facility that is focused on meeting the ever-increasing quality needs of the aerospace industry, we can provide a full range of vanadium and other master alloys, including innovative and customized specialty alloys that are marketed and managed by EVRAZ Stratcor, Inc. based in Chicago, Illinois.

EWI
Phone: +1-614-688-5000
www.ewi.org
info@ewi.org

EWI is the leading engineering and technology organization in North America dedicated to developing, testing, and implementing advanced manufacturing technologies for industry. Since 1984, EWI has offered applied research, manufacturing support, and strategic services to leaders in the aerospace, automotive, consumer electronic, medical, energy, government and defense, and heavy manufacturing sectors. By matching our expertise to the needs of forward-thinking manufacturers, our technology team serves as a valuable extension of our clients’ innovation and R&D teams to provide premium, game-changing solutions that deliver a competitive advantage in the global marketplace. To learn more, visit www.ewi.org, email info@ewi.org, or call 614.688.5000.

FAE S.A.
Phone: +54-11-6326-1493/94/95
www.fae.com.ar

FAE is an Argentinean company that is proud to announce that had been qualified by Airbus for supplying hydraulic titanium Ti-3Al-2.5 tubing for Family 320. Also it is the first Latin-American company in getting a tier one contract with EADS group. One of its main activities, apart from aerospace, is the manufacturing of seamless commercial pure titanium and titanium alloy tubes for heat exchangers which are up to 20 meters (65 ft) long. It also produces ingots and bars in titanium alloys and bright annealed finish seamless instrumentation titanium tubes (0.075” up to 5/8”). FAE is certified according UNE EN 9100: 2009, ISO 9001: 2008, ISO 14001: 2004, OHSAS 18001: 2007, PED 97/23/EC & CSA N285.0 standards. Its products are exported to countries all over the world and they are used in aerospace and corrosion resistant applications.
Super ferritic stainless steel tube (UNS S44660/S44735)
Super duplex stainless steel tube
Heat exchanger tube (U-tubes, straight lengths)
Large diameter stainless steel pipe (specialising in thin wall thickness and hollow bars)
Bright annealed ultra purity stainless steel tubing (for semi-conductor or high pure gas transportation service)
Nickel alloy seamless tube (UNS N08800, N08810, N08825, N04400, N10276, N06600, N06625, etc)
LSI Specialises in providing superior quality products and efficient Solutions for its clients.
FRIEDRICH KOCKS GmbH & Co KG / KOCKS PITTSBURGH COMPANY
Phone: +49-2103-7900
Phone: +49-412-367-4174
www.kocks.de
marketing@kocks.de

FRIEDRICH KOCKS GmbH & Co KG was founded in 1946 by Dr.-Ing. Friedrich Kocks. We have been successfully operating worldwide in the field of rolling mills for tube, wire rod and bar as independent, medium sized family owned company.

By a consistent and future-oriented development of our products, our technology has acquired a leading position on a global scale. KOCKS rolling mills are the benchmark for creative application oriented solutions as well as first class competence in engineering and manufacturing. Following its policy, KOCKS will pursue these constant innovations so that KOCKS will provide tomorrow’s technologies today.

Fluor Corporation
Phone: +1-864-281-8385
www.fluor.com

Fluor Corporation (NYSE: FLR) is a global engineering and construction firm that designs and builds some of the world’s most complex projects. The company creates and delivers innovative solutions for its clients in engineering, procurement, fabrication, construction, maintenance, and project management on a global basis. For more than a century, Fluor has served clients in the energy, chemicals, government, industrial, infrastructure, mining and power market sectors. Headquartered in Irving, Texas, Fluor ranks 109 on the FORTUNE 500 list. With more than 40,000 employees worldwide, the company’s revenue for 2013 was $27.4 billion. Visit Fluor at www.fluor.com and follow on Twitter @FluorCorp.

G&S Titanium, Inc.
Phone: +1-330-263-0564
www.gs-titanium.com

G&S Titanium manufactures many grades of titanium in the form of round and hex bars, fastener wire, spring wire, weld wire, precision ground medical bars, and fine wire. This includes the standard grades such as CP Gr. 1-2-3-4, 6AL-4V, 6AL-4V-ELI, as well as hard to find alloys such as 3-8-6-4-4, 13-11-3, 6-2-4-2, 8-1-1, Gr. 7, Gr. 9, Gr. 12, 21S, 230, 679, 685, etc.

Gautier Steel Ltd.
Phone: +1-814-691-6050
www.gautiersteel.com

Gautier Steel Ltd. has the capabilities to turn your ideas into reality. Our 3 rolling mills allow us to provide a broad range of shapes and sizes, whether you desire a non-standard section or a special length. We satisfy the most demanding customer specifications.

From the engineers in our on-site Roll Shop to the highly skilled craftsmen who operate our mills, Gautier is experienced, knowledgeable and versatile. We begin with a flow sheet.
Titanium is demanding. To succeed, you need everything Makino titanium ADVANTiGE brings to your shop floor. From higher metal-removal rates to extended tool life, ADVANTiGE technology delivers on-time performance, builds your reputation and secures your company’s future.

Build your business cutting the materials that matter most.

makino.com/ADVANTiGE

WHEN YOU MAKE WHAT MATTERS
determining the number of passes it will take on the mill to roll your shape. Our advanced wire EDM machine, templates are cut with exacting tolerances – down to less than .001”. These templates are used for operation of tracer lathes and as inspection fixtures. This same system produces programs for turning rolls on our CNC lathe. When it comes to quality at Gautier Steel, you are in control.

GeoCorp, Inc.
Phone: +1-419-433-1101
www.geocorpinc.com
Manufacturer of thermocouples and thermocouple wire with an ISO 17025 accredited temperature calibration lab. All of our products meet the requirements of AMS 2750 Rev. E & BAC 5621K. Custom built thermocouples ship in days-not weeks. We offer material with a maximum temperature tolerance not to exceed +/- 2°F or .2% whichever is greater. This tighter tolerance allows for easier furnace testing during surveys and/or system accuracy tests. GeoCorp has a tenured staff that attends annual Nadcap meetings. We also attend the AMEC (committee that writes AMS 2750 Rev. E) meetings to work on updating specifications and addressing any customer issues with AMS 2750 Rev. E or Nadcap. Call today if you have any questions about thermocouples or wire as they pertain to Nadcap.

GfE Metalle und Materialien GmbH
Phone: +49 911 9315 299
www.gfe.com
alloys@gfe.com
GfE, founded in 1911, is a leading manufacturer and global supplier of high performance metals and materials. During the last 40 years GfE has gained valuable expertise in the production of master alloys. As part of the AMG Advanced Metallurgical Group N.V., GfE offers a wide range of high quality products that meet the highest technical requirements for the aerospace industry. GfE’s master alloys are used in titanium and nickel based super alloys, to produce special parts for aircraft engines, land based turbines, off-shore drilling applications, and exterior shields. Furthermore titanium as high-purity HDH powder is produced by GfE for thermal spray coatings. Its specific characteristics offer an advantageous material for porous layers on medical implants.
GfE is certificated in accordance to ISO 9001, EN 9100, ISO 14001 as well as BS OHSAS 18001 and operates an accredited laboratory according to DIN EN ISO/IEC 17025.

GIE Media Inc. - Industrial Division
Phone: +1-216-393-0264
www.OnlineTES.com
eonic@gie.net
The Industrial Division of GIE Media publishes four manufacturing and design B2B magazines: Aerospace Manufacturing and Design, Today’s Medical Developments, Today’s Energy Solutions, and Today’s Motor Vehicles. All four publications are manufacturing and design oriented and provide insight into the latest developments in material selection, production processes, equipment, tooling/

Global Titanium Inc.
Phone: +1-313-366-5300
www.globaltitanium.com
Global Titanium is a leading producer of ferrotitanium, titanium scrap products, and titanium HDH powder. Located in Detroit, Michigan, Global Titanium serves the steel, stainless steel, aluminum, and titanium industries. Global Titanium is an ISO 9001:2008 registered company with a strong commitment to safety, quality, and customer service.

GNB Corporation
Phone: +1-916-395-3003
www.gnvalves.com
GNB has a proven track record of manufacturing high quality, reliable vacuum products since 1968 and is known as America’s leading manufacturer of large vacuum valves. In addition, GNB offers a diverse range of vacuum products and services, including: inline chambers, silt valves, gate valves, pendulum valves, angle valves, vacuum chambers, liquid nitrogen traps, custom flanges and fittings, viewports, bellows, multi-coolant baffles, throttle plates, and much more. With our expert group of engineers, GNB can efficiently customize our clients’ products. Extensive experience combined with an outstanding reputation for high quality products and customer service, GNB is the valued resource for your next vacuum system.

Goldman Titanium, Inc.
Phone: +1-716-823-9900
www.goldmanti.com
info@goldmanti.com
Goldman Titanium, Inc. purchases and processes scrap titanium in order to supply the highest quality finished product to our customers. As a pioneer in the titanium industry, our company was first established in 1955, and we have continuously expanded our business over the years. Titanium is the only metal we handle, making us experts in our field.
Goldman Titanium is certified to ISO 9001: 2008 and AS9100:2009, Rev. C, complying with the rigorous requirements of the aerospace and defense industries. Our company’s products have been approved by major U.S., European, and Asian melters, as well as by master alloy producers, steel and stainless steel producers, and ferro titanium producers.

Grandis Titanium
Phone: +1-949-459-2621
www.grandis.com
titanium@grandis.com
GRANDIS TITANUM is a major worldwide supplier of titanium products like Titanium Bars, Sheets, Plates and Wire for Industrial and Chemical applications. Company maintains warehouses in Los Angeles and Rotterdam, and sales offices in USA: California, Ohio and Oregon, also in South Korea, China, Russia, Belgium and Italy.
Butech Bliss delivering excellence in melting equipment repairs

That's why when it comes to the design and manufacture or the repair and reconditioning of crucibles, molds, and hearths for your ESR, VAR, EBM, or PAM installations, we draw on our more than 125 years of design, engineering and manufacturing excellence to ensure that your copper-based melting equipment is operating at peak efficiency.

A reputation for quality work and on-time delivery.

Our staff of expert millwrights, welders and machinists can tear down, assess, repair and test your valuable melting equipment. Additionally, our manufacturing capabilities are fully supported by our staff of over 40 engineers.

Our services include:
- Machining, welding, straightening, and sizing of stainless steel, copper, nickel, aluminum bronze, and carbon steel
- Preventative maintenance, including cleaning, re-sizing, straightening and seal replacement
- Crucible diameter and size modifications
- New crucibles, molds, base assemblies, water jackets, etc.

To learn more about our manufacturing services, call +1 (330) 337-0000, visit www.ButechBliss.com or email cu@butech.com.
Producers, Distributors, Fabricators, OEM’s, & Vendors to the Industry

Haynes International Inc.
Phone: +1-765-456-6000
www.haynesintl.com

Haynes International, Inc., headquartered in Kokomo, Indiana, USA, is a leading developer, manufacturer and marketer of high-performance nickel- and cobalt-based alloys used in corrosion and high-temperature applications. Our highly-trained staff and technicians provide superior customer service, worldwide technical support and one-on-one consultation in selecting the proper alloy for the application. In addition to stocking our standard product forms, our global service centers offer value-added services to shorten your cycle time, reduce material waste and increase your operation’s efficiency. Haynes International is a partner in your entire material management system and provides value far beyond the alloys themselves.

Hempel Special Metals GmbH
Phone: +49 208 6204 0
www.hempel-metals.com

Hempel Special Metals in Germany is one of the largest stockists for Titanium, Nickel Alloy and Zirconium in Europe with companies in England, Poland, Switzerland, Italy and various sales representatives. Our main businesses are chemical process industry, flue gas desulfurization, oil & gas, medical and watch industry. Beside all standard titanium grades we stock special grades (Grade 4, 5, 5-ELI, 7, 9) in bars, sheet/plates and tubes. Our services include individual stocking, cutting, sawing, plasma, laser- and water jet cutting, individual bar marking and turning. We supply material tailor made and in packages for special projects.

Hi Tech Alloys, Inc.
Phone: +1-925-937-3836
sales@hitech-alloys.com

Hi Tech Alloys, Inc. has a GFM Model 412 radial forge for producing bar. The GFM uses 4 dies to produce more force to the center of the bar than rolling or drawing methods. Our GFM produces 120 tons of force per die, 900 times per minute. Rolling mills have difficulty with some of the more difficult (Beta) alloys at lower processing temperatures. Our process produces a more refined grain structure due to the 360 degree directed force and the high forging forces.

H.P.A. is a secondary producer of the high performance alloys. We process small to medium lots of materials; excellent for prototype research, and providing low volume or specific alloys (normally requiring a mill quantity). Short production lead times are achievable because we start with existing (available) stock and produce the diameter you require. Call us when your job requires a shorter lead time.

HORIE Corporation
Phone: +81-256-66-2237
www.horie.co.jp
a-tanabe@horie.co.jp

Horie Corporation is the world leader at surface engineering of Titanium such as precision coloring, etching, grain controlling and the solution provider to complex titanium fabrications. Horie has developed its original titanium technology using Horie’s electro-chemical technology and surface treatment technology. Our titanium knowledge provides our customers with unequaled solutions in titanium. Horie will continue to develop many new products and search the unlimited possibilities and beauty of titanium.

Independent Forgings & Alloys Ltd
Phone: +44-114-234-3000
www.independentforgings.com
sales@independentforgings.com

Independent Forgings & Alloys Ltd is an open die forge with expertise in titanium, nickel and steel alloys. Processing ingots to billets, rolled/ hammer forged rings and flat bars through our onsite capabilities which include a 1600 tonne open die press, 2 x ring rollers, 3 forging hammers, NADCAP approved heat treatment and machining facility.

Inductotherm Corp. - Long Products Division
Phone: +609-267-9000
www.inductotherm.com
sales@inductotherm.com

President: Bernard Raffner
General Manager: Bert Armstrong
Director – Sales: Andrew Procopio

PRODUCTS and SERVICES - Inductotherm manufactures a complete line of induction heating and boosting systems for titanium slabs, billets, blooms, bars and rods prior to rolling. Other products include vacuum induction melting, holding, pouring, heating and coating equipment for thermal applications in air or controlled atmospheres for the metals industry. Coreless and channel furnaces with capabilities up to 500 tons; power supplies up to 42,000 kW; automatic pouring systems with vision control; computer controls and charge handling systems.

Industrial Metals International Ltd.
Phone: +1-631-981-2300
www.industrialmetals.com

IML is a supplier of bar, sheet, tube, wire, rings and forgings in aluminum, titanium, nickel stainless steel, alloy and bronze products. In business for over 40 years, IML is approved by companies such as Rolls Royce, Boeing, Airbus, and Pratt and Whitney. Located near JFK Airport in NY, IML is able to offer same day shipping to countries worldwide with no minimum order charge for stock items.
One of the largest producers of titanium and titanium alloys in Europe

**CUTTING SERVICES**

Zirom S.A. can provide titanium cutting services using our Blade Cutting Machine in special titanium processing conditions. Considering the special properties of titanium, we use an emulsion jet to obtain perfect and defects free surface.

**MACHINING SERVICES**

Zirom S.A. can offer products with a precision tolerance, knowing that the specific size is a critical requirement in the titanium world. To meet our customer demands, we can machine the products surface using our performant equipment (shot blasting machine, mobile grinder, turning machine).

**US+EDDY TESTING**

The advantage of this inspection system is the great flexibility in terms of control tasks in combination with a high resolution control. We can check bars between 1 and 4 m lengths and diameters/side between 100 and 350 mm. The support transducers contain both ultrasonic transducers and eddy transducers that can highlighting the surface defects or in near insides.

**SCRAP MELTING**

ZIROM SA has developed the technology for recycling of titanium material (ends of bars, billets, turning briquettes, rods, wires in different shapes and sizes) by EB melting. Our company offers specialized services like melting the secondary materials - scrap.

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Km 4 Sloboziu Road, 080331 Giurgiu, Romania  
Phone: +40 (0)246 216666; +40 (0)346 566906  
E-mail: zirom@zirom.ro, Web site: http://www.zirom.ro
Kevin Kreitman, EFO  
Email: kkkreitman@gmail.com

Chief Kreitman has 36 years’ experience in the fire service beginning his career as a firefighter in Albany, OR. He was Fire Chief with the City of Albany from 1999 until accepting the Fire Chief’s job with the City of Redding, CA in Sept. 2008. Kreitman developed significant experience during his time in Albany dealing with the numerous metal industries handling materials that presented unique fire hazards. Based on those hazards, Kreitman wrote a paper on the proper handling of titanium and zirconium metal fires.

He’s a member of National Fire Protection Association (NFPA) Combustible Metals committee and has been active in the standard process with emphasis on the development of the Fire Prevention, Fire Protection and Emergency Response Chapters. He has written articles on dust & combustible metal hazards and conducted presentations at national conferences; he has assisted NFPA and the National Institutes for Occupational Safety and Health on investigations and publications dealing with combustible metal hazards, and was an author of the Combustible Metals chapter in NFPA’s recent 9th Edition of the Fire & Life Safety Inspection Manual.

Keywell Metals, LLC  
Email: peterd@invera.com

Invera is the leading supplier of ERP software for the metal distribution industry. Our STRATIX software provides advanced functions for sales, inventory control, production, shipping and outside processing of specialty metals.

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Keywell Metals, LLC is the industry leader in specialty steel recycling and a worldwide purchaser, processor and seller of titanium scrap metal for ingot formulation, alloy additions and ferro-titanium production. In addition to the complete range of processing capabilities, Keywell Metals, LLC operates the largest and most modern fully equipped on site analytical laboratory in the scrap metal industry. Every product shipped from Keywell Metals, LLC is fully certified and guaranteed to meet Customer Specification.

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Jiangsu Hongbao Group Co., Ltd.

Phone: +86-512-58715276

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Hongbao is an ISO, PED, Lloyd’s, DNV and NORSOK approved manufacturer in China. We melt titanium sponge and produce titanium ingot, bar, plate and tube. We are exporting to USA, U.K., Germany, France, Sweden and Korea etc. and the total quantity is more than 800 tons per year. E-Mail: export@hongbao.com

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www.lordsteel.com

Lord Steel Industry Company Limited (LSI) is a global leading solution provider and manufacturer in Tube & Pipe of Stainless Steel, Nickel Alloy, Copper Alloy and Titanium since 1990. LSI has a registered office in Hongkong as the Financial Center, another office located in Suzhou Industry Park (Lord Steel International Co., Ltd. - Sales & Marketing Center), hold two green and nice factories located in Taiyuan LSI WTNM, and in Nanjing (LSI WORD partial shareholder).

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Mega Metals Inc., is a globally recognized high quality processor of Titanium Turnings and Solids. We are certified by major mills and casting houses for prepared aerospace grade material. Our philosophy is to unite the highest quality in customer service with the highest quality of our materials, in order to serve the expanding international demands of the metals recycling industry.

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www.MetaLinx.com

MetaLinx Material Management, Inc. announces the opening of a MetaLinx® Technology Demonstration Site situated near DFW Airport in Carrollton, Texas. The MetaLinx® System, an internationally patented and proven technology, assures complete transparency and accountability of recyclable materials. By this unique means, a high degree of material management and control is achieved from scrap creation through material sale when full containers are released by the system. MetaLinx® identifies system containers and tare weight; continuously monitors content weight and records all variance; automatically transmits action alerts by e-mail, fax, text and voice messaging; issues transaction reports/invoices computed by index-based price formula; and produces real time and stored inventory data and reports accessible via the MetaLinx® Web Portal. To arrange a demonstration at your earliest convenience; please contact Dr. Bert Erdel at berte@metalinkx.com or David H. Jones at davidj@metalinkx.com

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Phone: +33680562848
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METALVALUE provides strategic consulting services and invests into selected industrial companies.

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Metalwerks PMD, Inc. produces a wide variety of specialty metals, superalloys and developmental alloys in iron, Nickel and Cobalt based alloys. We melt current and developmental titanium alloys in ingot form from 400 grams to VAR ingots weighing up to 5000 pounds. We also convert these ingots into mill products for use by our customers.

Metalysis Ltd.
Phone: +44 (0) 1709 872 111
www.metalysis.com
kartik.rao@metalysis.com

Metalysis is a UK-based technology company, which has developed a proprietary process to produce metal powders at low cost using electrolysis. It is currently focused on the production of tantalum and titanium alloy powders for use in conventional and additive manufacturing, with a variety of applications in industries including aerospace, electronics, bio-medical, petro-chemical and automotive.

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www.metalconditioning.com

MetCon provides conditioning and finishing services for both intermediate and finished products, including bloom, billet, bar, plate, sheet, and machined or fabricated components employing a patented “Green” electrochemical technology. Product yields and costs are dramatically improved when compared to conventional processing. The technology can also provide alpha case removal, precise gauge removal, and ultra-bright micropolishing. MetCon is based in Monaca, PA, 30 miles northwest of Pittsburgh.

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MetSuisse Distribution AG
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MetSuisse reflects the precision and high quality products the industry requires. Being the first metal distribution company specializing in the medical and watch industry, MetSuisse has been able to specialize in sourcing for these industries. The stringent and
Fully integrated manufacture
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precise requirements found in the medical & watch industry has given us the experience and abilities required to meet the various requests. Next to our experience we are the first metal distribution company specialized in the medical industry, and operate strictly according to ISO 13485 (Medical) and the GDP standards valid for pharmaceuticals (besides ISO 9001). Currently, we are specialized mainly in the metals titanium, zirconium, CoCrMo, medical stainless and tungsten alloys. However, you can contact us with any of your sourcing requests. We work with dedicated partners worldwide.

MetSuisse has a unique grinding facility allowing: precision grinding of titanium foils, sheets and plates, technology applied for the Swiss watch industry, no min. quantities for CP Grade 1, 2, 4 and Ti6Al4V Eli, min. 0.09 +/- 0.015 mm , (= in inch 0.003543307” +/- 0.000590551”)

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www.vulcangroup.com
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Mid-West Machine™ provides metal conditioning equipment and systems for the Steel and Titanium industries. This includes both bonded wheel and coated abrasive belt grinders. We offer Traveling, Stationary, Gantry, Overhead, and Ingot End Grinders as well as material handling equipment for processing slabs, billets and rounds through the grinders.

Monico Alloys
Phone: +1-310-928-0168
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info@monicoalloys.com

Monico Alloys specializes in the processing of titanium scrap in the form of solids and turnings. Monico is a Global Mill processor for Titanium Scrap metal ISO 9001:2008 and approved by every major titanium melter. Monico Alloys prepares bulk-weldable solids, feedstock, cobbles, and turnings to rotor quality specifications. Monico Alloys remains the industry leader by utilizing only the latest scrap processing technology. Monico Alloys offers a wide variety of Titanium Alloy inventory which includes CP, 6-4, 6-2-4-2, 6-6-2, 3-2.5, and others.

Montana Precision Products
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www.seacast.com

SeaCast operates four full service investment casting foundries which cast a wide range of alloys including stainless steel, nickel-based superalloys, titanium and aluminum. Foundries in Marysville, WA, Seattle, WA, East Greenwich, RI and Butte, MT offer extensive in-house support services such as CNC machining, heat treat, NDT and assembly. The company serves a wide variety of industries including aerospace, defense, industrial pumps, industrial gas turbines, medical, transportation and computer hardware.
SeaCast’s manufacturing processes have earned ISO9000, AS9100 and NADCAP certifications. To broaden SeaCast’s wide alloy capabilities, the company has built a new titanium vacuum melting facility, Montana Precision Products.

MoTiV Metals, LLC
Phone: +1-412-200-5832
www.motivmetals.com
MoTiV Metals, LLC is an independent sales and marketing company supplying molybdenum, titanium, vanadium and other products to the global steel, titanium and chemical industries. The company has a vast array of expertise and knowledge in domestic and international sales, logistics and supply chain management.
MoTiV Metals LLC offers Master Alloys to the Titanium industry, through its relationship with BHN Special Materials Ltd, including V-Al, Mo-Al, and other alloys.

Nanjing Plate Titanium Industries
Phone: +86-138-5188-2939
www.plattitainium.com.cn

Plate Titanium Industries (PTI) manufactures welded-pipes and its parts, made of special materials such as Titanium, Nickel and Zirconium. PTI is certified with many national and international standards (such as the ISO9001). PTI is also granted a special permit to manufacture pressurized vessels and pipes by National Quality Inspection Bureau of China. PTI is conveniently located at Lishui District of Nanjing, China, only 10 km to Nanjing Lukou International Airport.

nanoPrecision Products, Inc.
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www.nanoprecision.com

nanoPrecision Products is a designer, developer & manufacturer of precision products with applications in the telecommunication, data communications, consumer electronics, mil/aero and bio &medical device markets. We employ various metals in our products including titanium. The products we are introducing to the market that utilize titanium are anticipated to consume large volume of material.

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NF&M International, Inc., subsidiary of VSMPO-Tirus US, is a producer of premium quality triple melted and standard grade titanium bar and billet products for the aerospace market and manufacturer of small-diameter precision tolerance bar and seamless coil products for aerospace fastener, automotive and medical applications. NF&M also provides a wide range of conversion services, including intermediate grinding and finishing of bar/billet, heat treating, straightening, bar peeling, bar polishing, pickling and inspection. NF&M’s Nadcap approved laboratory performs room temperature tensile, hardness, hydrogen analysis and micro/ macrostructure evaluation.

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**Nu-Tech Precision Metals**

Phone: +1-613-623-6544

www.nutechpm.com

Nu-Tech Precision Metals manufactures by hot extrusion seamless pipe, tube, fittings, bar, rod and shapes for nuclear, aerospace, military, offshore, mining, chemical, sub-sea and corrosive environments. Shapes, especially those for the aerospace industry, fit within a 12” (300 mm) circle size. Our extrusion process creates a near-net shape that reduces material and machining costs overall. Our ability to alpha-beta process results in improved fatigue resistance over beta extrusions…contact us to learn more about how this process will benefit your extrusion requirements. Seamless pipe schedules from 1.5” (40 mm) to 14” (350 mm) plus specialty sizes and wall thickness. Custom extrusions in all grades of Ti Zr Nb Ni Cu Hf Ni, specialty stainless, carbon steels, copper, and high purity aluminum alloys. Bi-metal extrusions such as titanium clad copper, copper clad niobium tubes for RF cavities, nickel clad steel, etc are extruded resulting in a metallurgical bond. Sputtering tubes and backing tubes are our specialty!

**Oak Ridge National Laboratory**

Phone: +1-865-241-8113

www.ornl.gov

ORNL is a multiprogram science and technology laboratory managed for the U.S. Department of Energy by UT-Battelle, LLC. Scientists and engineers at ORNL conduct basic and applied research and development to create scientific knowledge and technological solutions that strengthen the nation’s leadership in key areas of science; increase the availability of clean, abundant energy; restore and protect the environment; and contribute to national security.

**OSAKA Titanium technologies Co., Ltd.**

Phone: +81 3 5776 3103

www.osaka-ti.co.jp

OSAKA Titanium technologies Co., Ltd. manufactures premium quality titanium sponge mainly for aerospace use, high-purity titanium billet and polycrystalline silicon for semiconductor industry, titanium powder for powder metallurgy and additive manufacturing, and other titanium-silicon related products.

**Parker, Messana & Associates, Inc.**

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PMA Engineering brings a broad and extensive depth of engineering and operating experience in titanium to work for you. Our understanding of the critical requirements of the RG/PG world opens the door for us to benefit your organization. Our experience and ability to assist across all facets of an operation, including sponge, sponge processing, scrap and scrap handling, melting, finishing, flattening, and other operations, allows for comprehensive solutions. We can work with you to Optimize Processes and assist with reviews of your operations in regards to RG/PG standards and expectations. We will utilize our experience to upgrade or replace equipment to improve or increase your production capabilities. We can provide Feasibility Studies, FEED Studies, and Detailed Engineering for new process and manufacturing facilities, including the integration of your control and data systems for reporting, chronological documentation and MIS reporting. And, we can audit your processes against industry quality standards and provide paths for continuous quality improvement. We partner to make you better.

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Phone: +1-503-777-3881

www.pccstructural.com

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**Perryman Company**

Phone: +1-724-746-9390

www.perrymanco.com

Perryman Company is a vertically integrated producer of specialty titanium products. From melting, forging, and fabrication to finished product, Perryman’s quality and technical expertise is unmatched. Perryman supplies and services customers in the aerospace, medical, consumer, and recreation markets worldwide. Approvals include ISO9001:2008; AS9100, and NADCAP. Perryman Company is headquartered in Houston, Pennsylvania. Company offices are located in Philadelphia, Warsaw, IN, Los Angeles, London, Zurich, Tokyo, and Xi’an.
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**“Titanium Valley” Special Economic Zone**

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www.tricormetals.com  
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We are a woman-owned, small business with facilities in Wooster, OH, Conroe, TX, Plymouth, MI and Oxnard, CA with over 25 years’ experience in the supply of titanium mill products, titanium forgings and fabrication of ASME Code equipment for the petrochemical, pharmaceutical, mining, aerospace, and bi-medical served markets. We provide quick-ship service center sales and processing of titanium mill products, titanium forgings, design and build fabricated process equipment built with the most advanced corrosion resistant metals, provide reactive metal and high alloy welding repair services, and supply high performance welding wire. We maintain one of the world’s most complete inventories of titanium mill products in ASTM grades for corrosion including sheet, plate, pipe, fittings, bar, billet, wire, tubing, and fasteners. And we maintain staged billets for custom forgings. We offer advanced processing including water jet cutting, saw cutting, and shearing. We provide custom parts manufacturing and just-in-time inventory for ‘blanket’ order processing to meet our customer’s needs. Our fabrication and distribution facilities are in Wooster, Ohio and Conroe, Texas. We also operate sales facilities in Plymouth, MI and Oxnard, CA.

**Tricor Alloys for Aerospace & Medical applications**
Phone: +1-330-264-3299  
www.tricormetals.com  
sales@tricormetals.com

Welding wire and titanium for aerospace - We stock, clean, process, and package UltraGrade™ high performance welding wires for aerospace, power, and turbine engines. We stock AMS-grades of titanium sheet, plate, bar and billet for aerospace and bio-medical served markets.

**Tzimet Titanium & Alloys s.r.l.**
Phone: +39-0302-914401  
www.tzimet.it

Tzimet Titanium & Alloys srl is an Italian private Company specialized in the PROCESSING & PREPARATION of reactive and refractory metal scraps: Titanium and its Alloys, Zirconium, Niobium and Tantalum. These scraps, of different alloys, are dedicated after preparation, to be remelt in vacuum process from our customer: Titanium CP Gr. 1-2-3-4, 6 Al-4 V, 6 Al-4 V eli, Ti Pd (Gr. 7-11-16-17), Ti Gr. 12, IMI 367 (Ti 6 Al 7 Nb), Ti 15-3-3-3, Zirconium, Niobium, Tantalum

Tzimet Titanium & Alloys buy and sell these scraps: Titanium and Titanium Alloys, Zirconium, Niobium, Tantalum. Tzimet Titanium & Alloys has acquired in August 2014 the Certification ISO 9001:2008

Tzimet Titanium & Alloys srl is supplier of scrap for domestic market normally Ti CP and foreign market (USA, Germany, Russia, England), the material supplied is used for production of ingots Ti and its alloys and Fe-Ti for: Petro-chemical application (Ti CP, Ti Gr 12, Grade 7-11-16-17), Surgical application (Ti 6Al 4 V eli, IMI 367), Fe-Ti (steel-factory) oreglia@titanium.tzimet.it

**TZMI, Inc.**
Phone: +1 281 956 2500  
www.tzmi.com  
houston@tzmi.com

TZMI is an independent consulting company that works with a wide range of global clients to provide insight and expert advice on opaque mineral, metal and chemical sectors. Our uniqueness is that TZMI contains technical and operational experience, together with strategic and commercial competency, to provide a full service offering to our clients. As trusted advisors, our reputation is underpinned by having an experienced cross-section of technical specialists around the globe. TZMI partners with clients from the private and public sectors to provide bespoke solutions across markets and strategic services; and also technical and engineering services. Our 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 the consulting activities and ensure up-to-date, high quality and comprehensive data, analysis and information is provided. TZMI annually hosts the largest titanium and zircon industry conference. Email: Houston@tzmi.com
Ulbrich Stainless Steels & Special Metals, Inc.
Phone: +1-203-239-4481
www.ulbrich.com
information@ulbrich.com

Ulbrich Stainless Steels & Special Metals, Inc., is a leading processor of a variety of different alloys including, but not limited to: stainless steels, PH grades, nickel and nickel alloys, cobalt alloys, niobium, zirconium, titanium and titanium alloys. Commercially Pure Titanium: Grade 1, Grade 2, Grade 3, Grade 4, and Titanium Alloys: Grade 9 (Ti 3-2.5), Ti 15.3.3.3 and 21s (Ti Beta21s), as well as the aforementioned metals are available in strip, foil, flat, round and shaped wire. Nitinol, Grade 5 (Ti 6-4) and Ti 6.2.4.2, are available in limited widths at Ulbrich. Please inquire for more detail on all of our product offerings.

United Alloys & Metals, Inc.
Phone: +1-323-235-2156
www.uametals.com

United Alloys & Metals is one of the world's leading processors of all grades and forms of Titanium Scrap for all Titanium applications. Both our Los Angeles and Columbus, OH plants have full processing capabilities and are certified to ISO 9001:2000 standards.

Uniti Titanium
Phone: +1-412-424-0440
www.uniti-titanium.com

Uniti Titanium brings together two major global titanium producers with complimentary manufacturing and technical capabilities, Allegheny Technologies Incorporated (ATI) of the United States, and VSMPO-Avissa (Verkhnyaya Salda Metallurgical Production Association - Berezniki Titanium -Magnesium Works) from Russia, to create a joint venture focused on titanium mill products for industrial and other non-aerospace, non-military and non-medical markets. Uniti Titanium integrates the synergistic use of raw material, melting, hot rolling, finishing, research and technology resources of the two companies.

Universal Technical Resource Services, Inc.
Phone: +1-856-667-6770
www.utrs.com

Engineering services company, primarily focused on delivering services to the US Government. UTRS maintains a research and development facility working with material science projects, specifically with titanium and titanium alloys.

University of Northern Iowa
Phone: +1-319-273-7085
www.mcc.uni.edu

UNI's metal Casting Center, established in 1989, has achieved unique stature as the premiere not-for-profit US research and development facility specializing in manufacturing technologies and materials for the metal casting industry. The MCC testing laboratory and pilot-plant demonstration facility are the most advanced of their kind. The center's primary mission is to assist the foundry industry by developing technical solutions to keep this primary industry competitive in a global economy.

UTC Aerospace Systems
Phone: +1-216-429-4227
www.goodrich.com

Provide, Manufacture and Assemble landing gear for the aerospace industry.

VALLOUREC
Phone: +33-1-49-09-37-98
www.vallourec.com

Vallourec Heat Exchanger Tubes is leader in the manufacturing of titanium and stainless steel welded tubes for heat exchangers serving energy, process and desalination markets. Our products include not only bare, straight tubes but enhanced surface tubes, such as low fin and corrugated tubes as well as u-bent tubes for special applications. The highest level of quality and safety in the market is guaranteed by stringent control procedures and unchallenged technical experience. The best testimony of product quality is the long list of references, worldwide. Our R&D teams develop ambitious innovation and research programs to enhance the performance of the tubes in the toughest environments. We have high manufacturing capacities, with production mills on three continents, Asia, North America and Europe, (namely in China, France, India, South-Korea, the USA) as well as a secured access to superior quality titanium strip.

VDM Metals
Phone: +1 973 437-1513
www.vdm-metals.com

VDM Metals has been developing high-performance materials for particularly demanding applications and processes for decades. Our product portfolio of titanium, nickel, zirconium and special stainless steels is wide and varied – it includes:
- sheet & plate
- strip
- wire
- rods, bars & forgings
- pre-material for seamless & welded pipes and tubes.

We focus on the specific demands of very different industries. Our strength is the development of tailored material concepts. In many key technologies, our materials are an indispensable prerequisite for the industrial-scale implementation and reliable control of important processes: in aerospace, energy and environmental engineering, electrical and electronic engineering, the automotive, chemical and petrochemical industries, offshore and marine engineering, and in industrial furnace construction.

In an ever more complex market with all its different demands and expectations, we have made it our principle to always develop new material solutions together with our customers.

Vericheck Technical Services, Inc.
Phone: +1-412-854-1800
www.verichek.net

Producers, Distributors, Fabricators, OEM’s, & Vendors to the Industry

VSMPO - AVISMA
Phone: +7-34345-55764
www.vsmpo.ru
VSMPO-AVISMA, the world’s largest producer of titanium, holds more than 300 international quality certifications and approvals at major aerospace OEMs and medical device companies. VSMPO-Tirus operations in the US, the UK, Germany and China provide regional sales, distribution and service center processing.

VSMPO - Tirus China Ltd.
Phone: +86 10 8455 4688
VSMPO-Tirus China Ltd. is the Chinese sales and distribution division of VSMPO-AVISMA, the world’s largest producer of titanium, holding more than 300 international quality certifications. VSMPO-Tirus China distributes ingot, slab, sheet, plate, bar and billet to the aerospace, medical, and consumer products industries.

VSMPO - Tirus, US
Phone: +1-720-746-1023
www.vsmpo-tirus.com
VSMPO-Tirus, US is the North American sales and distribution division of VSMPO-AVISMA, the world’s largest producer of titanium, holding more than 300 international quality certifications. VSMPO-Tirus US distributes ingot, forgings, slab, sheet, plate, bar, and billet to the aerospace, medical, and consumer products industries. VSMPO-Tirus US also manufactures small diameter bar and coil for medical and aerospace fastener applications.

VSMPO TiRus GmbH
Phone: +0049 69 905477-25
www.vsmpo.de
VSMPO TiRus GmbH is responsible for the sales and distribution of titanium semi-finished products in Europe (except the UK), Brazil and Israel to the aerospace, medical and automotive industries. The company was established in 1999 in Frankfurt/Main. The German affiliate of the largest vertically integrated international titanium producer VSMPO-AVISMA offers optimum service, including custom-made processing of semi-finished products as well as a comprehensive transport service. We offer cut-to-size material (bars, billets, sheets and plates) to meet our customers’ individual operational needs. TiRus GmbH also distributes electrodes, ingots, rolled rings and different types of forgings.

VSMPO Tirus UK Ltd.
Phone: +(0) 1527 514111
VSMPO Tirus UK Ltd. is the UK’s sales and distribution division of VSMPO-AVISMA, the world’s largest producer of titanium, holding more than 300 international quality certifications. Tirus UK distributes ingot, forgings, sheet, plate, bar, and billet to the aerospace, medical, and consumer products industries.

VSMPO Titan Ukraine Ltd.
Phone: +380 563 313092
www.tw-vsmpoavisma.com
VSMPO Titan Ukraine Ltd. is fabricator of seamless tubular products from titanium and its alloys. It is part of the world’s largest producer of semi-products and finished titanium products - JSC Corporation VSMPO-AVISMA (Russia) which supplies billets and bars to the plant. It is guarantee of quality competitiveness of manufactured production for the customers. Annual production capabilities of the enterprise is 700 tons of cold-finished titanium tubes (diameter 3-134 mm and wall thickness 0,2-9 mm), and in cooperation additionally 200 tons of hot-finished titanium tubes (outside diameter 169-325 mm and wall thickness 7-30 mm).
Engineers and technical specialists are developing new technologies of titanium tubes production and new types of products. For example, octahedral and ribbed tubes, special kind of thin tubes for silphons, technologies of long-length tubes production, etc. VSMPO Titan Ukraine Ltd. has all equipment necessary for different tests and QA inspections. It allows manufacturing not only according to the international and national standards, but meeting any customer’s requirements.

Vulcanium Metals International
Phone: +1-888-326-7556
www.vulcanium.com
titanium@vulcanium.com
Vulcanium Metals International, a leading distributor and processor of titanium and high performance alloys, serves global aerospace, medical device and industrial markets. VMI’s fully operational facilities in the US and UK carry a complete line of inventories in titanium sheet, coil, plate, bar and forged block products of CP, Ti-6AL-4V and Ti-6AL-4V Eli grades as well as CCM and 316L stainless round bar. FIRSTCUT+® services offer a comprehensive suite of first-stage processing including precision shearing and sawing, machining, chamfering and facing, deburring and finishing, leveling, slitting, and laser and water jet cutting. VMI also offers inventory management solutions to save its customers supply chain costs and reduce manufacturing bottle-necks. Vulcanium is a specialty division of United Performance Metals, one of more than a dozen companies comprising O’Neal Industries, Inc. (onealind.com), parent company of the USA’s largest, family-owned group of metal service centers. ISO 13485 & 9001, AS 9100 and LEAN Quality Management.

Webco Industries
Phone: +1-918-245-2211
www.webcotube.com
heat_exchanger@webcotube.com
Webco delivers North America’s widest range of tubular products, rapidly fulfilling urgent orders and helping customers avoid costly unscheduled shutdowns and production delays. Customers in the aerospace, automotive, chemical processing, industrial, oil & gas, power generation and other industries, rely on Webco’s strength, agility, and innovation to deliver solutions for their most challenging requirements. In fact, Webco manufactures and distributes millions of feet quality tubing made to meet today’s most demanding specifications.
Our welded and seamless titanium tube products are available in variety of grades and sizes, standard/off-the-shelf or tailored to meet customers’ unique requirements.

Webco maintains a culture for relentlessly pursuing process and product excellence, enabling ever-improving productivity/product quality. For a current list of our ISO, TS, PED, and other certifications as well as ASME, ASTM, and other specifications offered, visit webcotube.com.

**Webco Metals, Inc.**
Phone: +1-562-602-0260  
www.webermetas.com

Webco Metals, Inc. specializes in Aluminum and Titanium open and closed die forgings for the Commercial and Military Airframe, Air and Land Turbine, Nuclear and Semiconductor industries. Our press sizes range in size from 1200 to 33,000 tons. We have capabilities to perform heat treatment, non-destructive and destructive testing in house. Our forgings range in size from 1 pound to 11,000 pounds. Our aluminum stress relieved forgings are some of the most stable products in the industry for machining.

**Welded Pipe Industries s.r.l.**
Phone: +39 049 8844878  
www.wpisrl.com

WPI - Welded Pipe Industries is the leading NORSOK M-650, DNV and RINA approved manufacturer of welded pipes, spools and pressure vessels in Titanium, Duplex, Superduplex, 254-SMO and Nickel Alloys. The production range of welded pipes covers diameters from 6” up to 82” with maximum wall thickness of 60 mm. Spools and pressure vessels are fabricated in accordance with customer’s drawings up to a maximum diameter of 5 meters.

**Wellmet International Inc**
Phone: +1-909- 594-9639  
www.wellmetusa.com

We supply and distribute Titanium Sponge and Titanium Powder. We represent the largest Titanium sponge and powder producers in China. We can also supply other non-ferrous metals which are of Chinese origin with approved quality. The Titanium Sponge producer is ISO9001:2008 certified and sponge quality is approved by world main consumers.

**West Penn Testing Group**
Phone: +1-724-334-1900  
www.westpenntesting.com

West Penn Testing Group is a full-service, independent testing laboratory with diverse inspection and testing capabilities since 1952. They provide an extensive array of non-destructive, chemical, metallographic, failure analysis and mechanical evaluation services, serving customers in these industries: aerospace, medical, power generation, commercial, military, raw materials, refractories, oil and gas, and the automotive industry. They have three locations in New Kensington, Pennsylvania and Richburg, South Carolina and perform testing nationally and internationally. Their 79,000 sq. ft. facilities accommodate parts up to 20,000 lbs. www.westpenntesting.com

**Western Smelting & Metals, Inc.**
Phone: +1-503-623-8341  
www.westernsmelting.com

Western Smelting & Metals Inc in Dallas, OR is a third generation metal recycling business with almost 60 years of experience in the industry. We are the most preferred locally owned metal recycling service provider with 30 year of experience in titanium processing. Our experts provide valuable information to the clients to help them make a right decision about the formulation of materials. Whether it is blending, sizing or sorting of metals, our experts ensure that we deliver fast and exceed our clients’ expectations. Depending upon the clients’ needs, we also provide aluminum, cobalt and nickel alloys.

**Western Superconducting Technologies Co. Ltd.**
Phone: +86-29-8651-4505  
www.c-wst.com  
than@c-wst.com

Western Superconducting Technologies Co., Ltd. (WST), located in Xi’an, the capital city of Shaanxi Province, China, is a leading corporation for the production, R&D, and marketing of titanium ingot, billet, bar, wire, slab, plate, etc. Especially from the ingot to bar and wire, WST has the most advanced and integrated production line and quality assurance system in the world. The production capacity for bars is 4000 tons per year, and 6000 tons for ingots. WST is an ISO 9001:2008, AS 9100C and Nadcap approved company and the products are widely used in the aerospace, medical, offshore, sporting, car and petroleum chemical market.

**Westmoreland Mechanical Testing & Research Inc.**
Phone: +1-724-537-3131  
www.wmtr.com  
us.sales@wmtr.com

Westmoreland Mechanical Testing & Research is a world leader in materials testing. Founded in 1967, WMT&R serves a broad range of industries including aerospace, automotive, medical, and nuclear. We support our customers with our highly-skilled staff and advanced facilities. Our turnaround time is unrivaled, and with over 150,000 square feet of accredited production and testing space, we have the capacity and equipment to handle any materials testing project. WMT&R is organized into the following specialized testing groups: Mechanical, Composites, Fatigue, Stress Rupture and Creep, Fracture Mechanics, Metallography, Chemical/Analytical Laboratory, and Mechanical Engineering. For more information, please visit www.wmtr.com or email admin@wmtr.com.
Xi’an Metals & Minerals Import & Export Co., Ltd.
Phone: +0086-29-88210716
www.tiwmo.com

As a leading manufacturer and distributor of Titanium, Molybdenum and Tungsten products in China, Xi’an Metals and Minerals Import & Export Co. Ltd., has joined into manufacturing, researching and competing in titanium industry. We supply Titanium and its alloys in various forms as per ASTM, AMS and other main internationally recognized specifications. Our advantage is the most competitive prices as well as guaranteed high quality! Our products are exported worldwide, and gained high reputation because of their excellent performance.

Yunnan Titanium Industry Co., Ltd.
Phone: +86 13888217035
www.ytico.com.cn

Yunnan Titanium Industry Co., Ltd (Yunti) is specialized in the production and processing of titanium strip and coil and dedicated to technology research of titanium industry in China, which has manufactured ability from titanium slab to cold rolled titanium strip and coil with minimum thickness of 0.5 mm, Yunti has rich technical resources and innovation ability, Yunti has established the standard quality management system, Occupational Health and Safety & Environment management and systems based upon international standards. Yunti has a production capacity of 5,000 tons titanium coils per year.

Its products range from 800 ~ 1400 mm in width, 0.5 ~ 10 mm in thickness, 2000kg - 8000kg in weight, the quality and performance of titanium strip is stable. The surface is of good consistency, and mainly used for the manufacturing of titanium welded pipe, anodizing plate, plate heat exchanger etc.

Zak, Incorporated
Phone: +1-518-273-3912
www.zakinc.com

Zak Incorporated is a fully integrated design, fabrication, machine, and test facility. We engineer, manufacture, and refurbish crucibles, liners, molds, and accessories for the remelting and production of specialty metals. Our manufacturing and consulting experience has contributed significantly to the VAR, ESR, Plasma, EB, C.C., and EB-PVD processing industries. This experience, along with our precision CNC machining capabilities, will extend your product life cycles and improve the reliability of your process. Our ISO 9001-2008 certified services include a full range of dual pallet, multi-axis CNC machining centers with live tooling; MIG, TIG, and stick welding of copper and other dissimilar metals; hydro, helium, X-ray and other available NDT services. For more information about Zak Incorporated, please visit us at www.zakinc.com

ZIROM S.A.
+40 246 216666
www.zirom.ro
zirom@zirom.ro

Zirom SA came into prominence, over the last decades, as one of the largest producers of titanium and titanium alloys in Europe. Ever since the foundation, a permanent emphasis has been laid on its development, through technological optimization and through development of the technology for melting titanium and zirconium recycle material, by combining EB and VAR technologies, and further, the development of free forging process.

The products manufactured, ingots and forged products, are intended both for cutting edge fields (aviation and nuclear areas) and various fields (metallurgy, chemical industry, medical technique and devices).

Our company is certified according to international standards: AS 9100 / EN 9100, ISO 9001, ISO 14001.

Zirom SA can also provide a series of services like melting the secondary recycle materials, machining/grinding the surface of products, full chemical analyses, LP, US+ Eddy testing.

ZTMC Zaporozhye Titanium & Magnesium Combine
Phone: + 38 067 466 5791
www.ztmc.zp.ua

Zaporozhye Titanium-Magnesium Combine (ZTMC) located in Zaporozhye city industrial zone, Ukraine, is one of the first in the world and unique in Europe titanium sponge manufacturer. It works since 1956. During this period production facilities were modernized and rebuilt more than once, which allowed to modernize technological processes and to increase titanium sponge production volume. ZTMC as a reknowned sponge manufacturer has been investing in the new technologies to increase both its capacity and allow us to supply high quality sponge to various customers around the globe. The wide range of ZTMC products are represented by titanium sponge, titanium ingots, titanium casting, refined titanium tetrachloride, ferrotitanium, titanium slag, casting. The quality of ZTMC products is guaranteed by a certified quality management system in accordance with the requirements of the International Standard ISO 9001:2008. Currently works underway to create and implement the requirements of the management system for Aviation standard EN 9100.
SERVICES:

3-ROLL TECHNOLOGY FOR TITANIUM WIRE ROD AND BAR PRODUCTION
The first 3-roll block for non-ferrous wire rod rolling was built by KOCKS in 1964, meanwhile this manufacturing process has become a well proven production method even for Titanium wire rod and bar. Due to their deformation characteristics 3-roll blocks are ideally suited to roll wire rod and bar of non-ferrous materials and also a majority of their respective alloys such as tungsten, molybdenum, titanium, aluminium and copper as well as hafnium and zirconium. Call us under +1-412-367-4174.

SC ZIROM produces a diverse range of titanium and titanium alloys, including ingots, and from this year, free forging products. The Company practices a modern production technology (VAR and EB) according to different quality international standards. Technical and qualitative parameters of products meet the most stringent quality requirements and can be used in different applications.

SUPPLY OF PEELING AND OTHER COLD FINISHING EQUIPMENT FOR TITANIUM PROCESSING.
Danieli Centro Maskin, the cold finishing division of the multinational DANIELI group, design and manufacture a wide range of equipment that cover the processes of peeling, drawing, cut to length, straightening, chamfering, packaging and all associated equipment. Enquiries for individual machines and/ or complete cold finishing plants are welcome. For USA enquiries contact Danieli Corporation USA (Bob Smith Tel: (724) 778 5448; r.smith@danielicorp.com). For all other enquiries contact Danieli headquarters in Italy (Kristiaan van Teutem, Tel: +39 04321957295; k.vanteutem@danieli.it)

PRODUCTS FOR SALE:

CICP MC 4127 - CHESAPEAKE INDUSTRIAL
CICP MC 4127, an effective cleaner/degreaser for turnings and scrap titanium, has now been approved for use at several facilities and is available on a pay-as-you-use basis. MC 4127 is available in totes or in bulk and continues to gain market share. Contact us at 1-410-340-9052 or email sales@chesapeakeindustrial.com to learn more.

MATERIAL FOR SALE:

ADVANCED METALS FOR ADVANCED APPLICATIONS
Metals for the medical and watch industries - MetSuisse
Ti6Al4V, Ti6Al4V Eli, CP grade 1, 2 and 4 low and highC CoCrMo, medical steel, tantalum and zirconium: bars, wire, plate, sheet, high precision foils ISO 9001 and ISO 13485 certified company just first class sources: www.metsuisse.com

BAOJI TITANIUM INDUSTRY CO., LTD., (BAOTI) is the largest titanium manufacturer and supplier in China, also the only titanium supplier in China that have obtained complete quality & process qualification by NORSOK, including plates, bars, pipes and castings of titanium. As one of the world leading professional titanium alloy producers, Baoti own a complete titanium industry chain, the products have been used in application such as chemical processing, oil and gas, power generation, metallurgy, marine engineering, geothermal engineering, refrigeration engineering and automotive industries. Contact us for your needs.

NORTH AMERICAN ALLOYS is supplying new and used titanium mill products such as sheet, plate, bar, billet, shapes and tubing from our Kennewick, WA warehouse. Please see our website at www.northamericanalloys.com for a complete and current list of all our inventory. Contact Steve Meredith at 1-800-890-2250 x 2 or e-mail at steve@northamericanalloys.com

TMS TITANIUM – Grade 5 Round Bars
• 6AL-4V Grade 5 titanium round bar, commonly used for clutch stands
• Large quantity 2” diameter racer Ti discounted for quick sale
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Request a quote today! Give us a call at 1-888-748-8510 or email info@tmstitanium.com

MATERIALS WANTED:

NORTH AMERICAN ALLOYS is looking to buy titanium scrap and new and surplus titanium mill products such as sheet, plate, bar and tubing. Please contact Steve Meredith at 1-800-890-2250 x 2 or e-mail at steve@northamericanalloys.com

MATERIALS WANTED:
Act Now for Pre-Registration Rates!

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- Aerospace

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Locate titanium metal producers, users, raw materials suppliers, original equipment manufacturers, consultants, from across the globe.

www.titanium.org

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ADMINISTRATIVE MANAGER
Plymouth Engineered Shapes
Hopkinsville, Kentucky USA

Hopkinsville began operating in 1980 & produces near net shapes by extrusion in titanium, stainless, carbon and alloy steels in a 130,000 square foot plant. Responsibilities include: Plans, directs and controls the administration groups of the organization. This position oversees such functions as Accounting, Information Systems, Purchasing, and Shipping activities of the company. The objective of this role is to manage the administrative functions as they support the operational units within the company and satisfy the external requirements related to the Legal and Governmental mandates. For detailed information visit: http://www.plymouth.com/employment/

ADVANCED/ADDITIVE MANUFACTURING ENGINEER
RTI Niles Plant
Niles, Ohio USA

The primary function of the Advanced/ Additive Manufacturing Engineer is to lead development and continuous improvement activities within our 3D printing and Advanced Powered Metals groups. The position will work to partner with customers to provide cost effective solutions on their next generation platforms. Responsible for optimization of Additive Manufacturing processes focused on Advanced Powder Technology and 3D printing, delivering cost reductions & design improvements. Establish collaboration with universities, consortia, and government to drive RTI priorities and leverage R&D investment. Develop and maintain a database for mechanical properties and capabilities delivered via additive processes. Implement and support company wide value added initiatives and programs. Provide insight in the improvement of the complete value stream associated with the development and production of our products. Drive improved product quality by identifying manufacturing issues, developing advanced manufacturing cost-effective solutions, and overseeing successful implementation of Additive Manufacturing into production. Supports the creation of new business opportunities through developing advancements in additive manufacturing and building relationships with clients in the industry. For detailed information visit: www.rtintl.com

AEROSPACE ENGINEER HIGH TEMPERATURE ALLOY SPECIALIST
Research & Development / Technology Business Unit Group, Alcoa Technical Center, PA USA

The position is responsible for participating in, defining and executing alloy and process development projects targeted for high-performance high temperature alloys and to create growth opportunities for Alcoa through the introduction of new products. The individual will be an on-site technical leader for high temperature alloys and will interface with plant engineers, application engineers, technology managers and commercial managers across Alcoa, including Alcoa Technical Center, Alcoa Power & Propulsion, Alcoa Forgings and Extrusions, Alcoa Fastening Systems, and other businesses within Alcoa’s EPS Business group. This position requires a fundamental understanding of Ti, Ni, Co or Mo alloys, including fundamental and applied metallurgical knowledge, experience in alloy design, knowledge of structure-processing-property relationships in high temperature alloys, thermal process development, working knowledge of various manufacturing technologies for cast and wrought products, and experience in material selection for new product design. For detailed information visit: www.alcoa.com

ASSOCIATE TECHNICAL SALES REP - BAHCO® BAND SAW SPECIALIST
Snap-on Industrial
Los Angeles, California USA

This outside sales position will assist in working with industrial distributors, manufacturing reps and agencies and/or direct sales to identify and evaluate production end users and stimulate additional product demand with current accounts and develop new customer accounts. This position will create band saw performance tests at customer sites, record and document and assist the lead sales person in presentations to customers. Working with company support to help “close the sale”, and grow the territory are key objectives. The assigned territory will cover the California, Arizona and Nevada saw industry markets with an emphasis on the greater Los Angeles area. Overnight travel of about 50% required. As the band saw industry changes, the territory assigned may be modified to meet growing demand. Must be mechanically inclined and capable of operating and adjusting machines. For detailed information visit: https://ch.tbe.taleo.net/CH01/ats/careers/requisition.jsp?org=SNAPON&cws=1&rid=3483

ENVIRONMENTAL ENGINEER - WATER SYSTEMS - (PCC-US 178526)
TIMET, Titanium Metals Corporation
Henderson, Nevada USA

TIMET offers a full range of titanium products, including ingot and slab, forging billet and mill forms. TIMET is vertically integrated, capable of making its own titanium sponge. Provide leadership and technical support to address water systems throughout the facility including: Water Conservation Facility, storm water, sanitary sewer, groundwater, potable and non-potable water and evaporation ponds. Assist with the development and corporate-wide...
integration of sustainability initiatives related to water and the environment. Manage and coordinate sustainability efforts to reduce TIMET’s environmental impacts. Establish, maintain and report progress on sustainability metrics. Drive improvements within the company and communicate efforts and results to stakeholders. For detailed information visit: www.timet.com

INTERNATIONAL CUSTOMER SERVICE ASSOCIATES

**Ft. Wayne Metals**

We are looking for an International Customer Service Representative to assist our customers. Must be fluent in Mandarin, as well as English. Main Responsibility: Perform sales and customer service functions for new and existing accounts for assigned international geographic zones. For detailed information visit: http://www.fwmetals.com/people/join-our-team/

MAINTENANCE PLANNER

**ATI Flat Rolled Products (ALC)**

**Brackenridge, Pennsylvania USA**

ATI Flat Rolled Products produces and markets a wide range of specialty metals, including stainless steel, nickel alloys, and titanium to end use markets such as aerospace, power generation, automotive, and housing. We deliver exceptional products and services to customers around the world. We are currently seeking a Maintenance Planner for the Hot Rolling Processing Facility in Brackenridge, PA. Responsibilities include: Plan, organize and schedule all necessary resources required to accomplish maintenance activities. Prepare and issue the maintenance activity work schedule. Prepare and coordinate contractor activities and work schedule. Prepare detailed critical path plans including equipment and materials for major jobs such as planned shutdowns. Ensure that equipment and material are available when required. Assist storeroom in parts procurement, repair and identification. Issue and follow up on preventative/predictive maintenance inspections and procedures. Ensure that necessary work history and documentation are organized and inputted. Attend daily meetings with operations and maintenance representatives. Prepare summary and exception reports. Prepare long-term plans and schedules for review and approval by management. For detailed information visit: www.atimetals.com

MECHANICAL ENGINEER

**ATI**

**Latrobe, Pennsylvania USA**

ATI Flat Rolled Products, an operating company of Allegheny Technologies (NYSE: ATI), manufactures and markets a wide range of flat rolled specialty metals, including stainless steel, nickel alloys, titanium and electrical steels to global end use markets such as aerospace, power generation, automotive and housing. Our goal is to safely deliver exceptional value to our customers, suppliers, employees and shareholders. We are seeking a Mechanical Engineer for melt shop in Latrobe, PA. For detailed information visit: www.atimetals.com

OPERATIONS PLANNING ANALYST

**Dynamet, a subsidiary of Carpenter Technology Corporation**

**Washington, Pennsylvania USA**

Responsible for application of material. Also interface between Sales, PA Manufacturing, Technical and Development, Quality and Raw Material Purchasing and has a detailed understanding of customer’s requirements and specifications. Responsible for application of material. Also interface between Sales, PA Manufacturing, Technical and Development, Quality and Raw Material Purchasing and has a detailed understanding of customer’s requirements and specifications. Track raw material at the various stages of the process. Work with the various manufacturing groups to understand breakdowns, personnel issues, constraints or other issues that can impact throughput and delivery. Adjust scheduling plan and/or provide visibility to upper management when these events can affect customer deliveries. Quote deliveries for products based upon available production capacities and inventory with the goal of on time delivery to customer. Research, facilitate discussions, recommend and respond to questions from customers (via Sales) regarding capacity and delivery. Lead weekly production meeting. Review load and schedules looking for conflicts or abnormalities and providing possible solutions when necessary. Create material work orders and planning intermediate material for supply. Participate in various MRP focus/improvement projects. Review and disposition fallout and slow moving inventory. Hot Roll Planning for intermediate material requirements. Work with Technical Development, Manufacturing and Sales team members on developmental process improvements, new product development and capacity increases. Part number, router and work order creation and maintenance. Perform all other duties and special projects as assigned. For detailed information visit: www.cartech.com/dynamet

TECHNICAL SALES REPRESENTATIVE - BAHCO® BAND SAW SPECIALIST

**Snap-on Industrial**

**Los Angeles, California USA**

This outside sales position will work with industrial distributors, manufacturing reps and agencies and/or direct sales to identify and evaluate production end users and stimulate additional product demand with current accounts and develop new customer accounts. Working with company support to help “close the sale”, and grow the territory are key objectives. The assigned territory will cover the California saw industry markets with an emphasis
TITANIUM RESEARCH ENGINEER
ATI Powder Metals
Pittsburgh, Pennsylvania USA

ATI Powder Metals, an Allegheny Technologies Company, is a recognized world leader in the production of specialty alloys including titanium, nickel and specialty steel for the aerospace, biomedical, oil & gas, chemical processing and nuclear industries. This position is responsible for providing technical assistance to the operation and maintenance of the 100 pound titanium gas atomizer(s) as well as the one pound research atomizer for the production of titanium based gas atomized powders and experimental alloys. Plan and conduct assigned programs and propose new research programs involving titanium, titanium powder and other materials/processes as required. Provide technical assistance to the operating and production personnel of standard one pound and 100 pound titanium gas atomization units in an efficient and accurate manner by: Addressing known safety issues with technicians and operators to safely and efficiently produce titanium powder. Maintaining material inventory and requisitioning raw materials as needed. Determining melt consumables and maintenance items. Tracking and reporting shipping information. Anticipating potential production delays and potential equipment breakdowns to specify needed maintenance and minimize equipment downtime. View the complete description at www.atimetals.com.

MATERIALS CATEGORY MANAGER
Zimmer
Warsaw, Indiana USA

Implements global sourcing strategies and initiatives for non-metal category OR metal category as assigned. Non-metal categories includes ceramic, poly and packaging. Metals category includes titanium, cobalt chrome and stainless steel wrought bar, cobalt chrome ingot, forgings, castings and sheet. Ensures that the global strategies are executed at all sites. Accountable for developing, negotiating and implementing cost reductions. Develop and manage a business continuity plan that identifies, quantifies and reduces risk. Active and early involvement in new product development. Manage all key supplier relationships. Reports to Direct Material Category Sourcing Director. For complete description visit: www.zimmer.com/careers.htm

POINT OPERATOR
Alcoa
City of Industry, California USA

A global leader in lightweight metals technology, engineering and manufacturing, Alcoa innovates multi-material solutions that advance our world. Our technologies enhance transportation, from automotive and commercial transport to air and space travel, and improve industrial and consumer electronics products. We enable smart buildings, sustainable food and beverage packaging, high-performance defense vehicles across air, land and sea, deeper oil and gas drilling and more efficient power generation. We pioneered the aluminum industry over 125 years ago, and today, our approximately 59,000 people in 30 countries deliver value-add products made of titanium, nickel and aluminum, and produce best-in-class bauxite, alumina and primary aluminum products. Position will set up and run Economy 3300 pointer, Ability to read blueprint and use measuring instruments, have experience working with steel and titanium, tool preparation and usage of surface grinder is required and shop knowledge must read precision instruments and shop prints. View the complete description at www.alcoa.com

on the greater Los Angeles area. As the band saw industry changes, the territory assigned may be modified to meet growing demand. BA Degree in business, marketing or equivalent sales experience required as well as prior technical training in metals, metallurgy, cutting tools. Must have a minimum of 3-5 years outside sales experience in an Industrial environment and with distributors and/or agency reps. For detailed information visit: https://ch.tbe.taleo.net/CH01/ats/careers/requisition.jsp?org=SNAPON&cws=1&rid=3484

Looking for Titanium?
TITANIUM Resource Center
www.titanium.org
CNC APPRENTICE
Rolls-Royce
Prince George, Virginia USA

Innovation is in our DNA at Rolls-Royce. We create integrated power solutions that continually break new ground across multiple markets. Our civil aerospace business powers over 30 types of commercial aircraft. We have an outstanding reputation in all sectors of the market – widebody, narrowbody and corporate and regional aircraft – and we support customers in nearly every country across the globe.

From helicopters and general aviation aircraft, to business jets and the world’s largest airliners, we offer the industry’s broadest range of engines. In fact, over 30,000 Rolls-Royce engines are currently in service with 650 airlines, freight operators and lessors, and 4,000 corporate operators.

The Rotatives Supply Chain unit manufactures high precision titanium and nickel alloy gas turbine engine components at the new Rolls-Royce Crosspointe facility. The Crosspointe facility, located in Prince George County, VA, is the first Rolls-Royce manufacturing site built from the ground up. Combining related instruction with on-the-job training, our Apprenticeship Program provides a genuine alternative to a traditional college experience, providing the foundation for a career in CNC Machining. It offers the training, guidance, and support you need to develop valuable skills, earn sought-after qualifications and establish yourself in your chosen career. For complete description visit: http://www.rolls-royce.com/

MANAGER SALES SUPPORT
ThermoFisher Scientific
Pittsburgh, PA and Houston, TX USA

Requisition ID: 20653BR - The primary duty of this position is to execute on the mission of the Sales Support Team (SST) and directly manage the Sales Support Representative (SSR) team that is co-located in Pittsburgh, PA and Houston, TX. The mission of the SST is to increase sales effectiveness and improve the customer experience by providing the sales team with Customer issue resolution support, Internal process support, Standard reporting support. In performing the primary duties, the Sales Support Manager exercises discretion and independent judgment with respect to activity based problem resolutions in the company’s pursuit of business growth and directly managing all aspects of the Sales Support Team.

A majority of the time, this role will be making decisions around prioritizing issue resolution tasks and working with the various functional areas and customers to resolve issues. Additionally, the Sales Support Manager will analyze team activity data and drive root cause analysis of repeating issues and work with Sales Operations Director and the functional areas to identify projects to improve processes and find permanent solutions to these issues. This role will perform work that requires knowledge of the Healthcare Market Division’s data management system, sales processes and other internal processes involving Customer Service, Finance, Pricing and other areas. Additionally, the role requires knowledge of and experience with PPI Business System processes and tools or similar continuous improvement processes. For detailed information visit: http://jobs.thermofisher.com/us/united-states/sales/jobid7395827-manager-sales-support?apstr=%26codes%3DIndeed

Welding Titanium DVD
Available
Price: $19.99 + shipping

In this Welding Titanium dvd, the techniques demonstrated are being routinely used by fabricators in the shop and in the field to construct pressure vessels and heat exchangers, to build chemical and food processing equipment. Without the welders and welding engineers desire to take on new challenges and test the boundaries within science, the development of new materials for industry would dwindle and the growth of industry itself would stagnate. The International Titanium Association and EWI have made a commitment to industrial growth and development and to providing you with the knowledge and training you need to be a part of the future. To order your copy the ITA online store at visit www.titanium.org.
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<td>L.C.M.A.</td>
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L.C.M.A. S.A. is a leading European manufacturer, processor and distributor of a wide range of C.P titanium and titanium alloy semi-finished products and present on the market for 20 years.

Bars, ingots, blocks, tubes, sheets/plates and wire belong to the product portfolio of L.C.M.A. S.A.

We deliver in the aerospace, medical and petrochemical industries.

L.C.M.A. S.A. is part of a vertically integrated structure which produces, melts, forges and rolls its products only in Europe, according to international quality standards ISO 9001:2008 and EN9100:2009/AS9100:2009!

Website : www.lcma.lu
Titanium Fabrication Corporation (TiFab) is the world’s largest fabricator of reactive metals including titanium, zirconium and high nickel alloys fabrication. With three facilities in North America, Titanium Fabrication serves a broad range of industries including: Chemical/Petrochemical, Oil & Gas, Pulp & Paper, Mining, and the Military. Primary materials of construction are titanium and zirconium, but we also fabricate with high nickel alloys including Hastelloy®, Inconel®, Monel® and more.

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