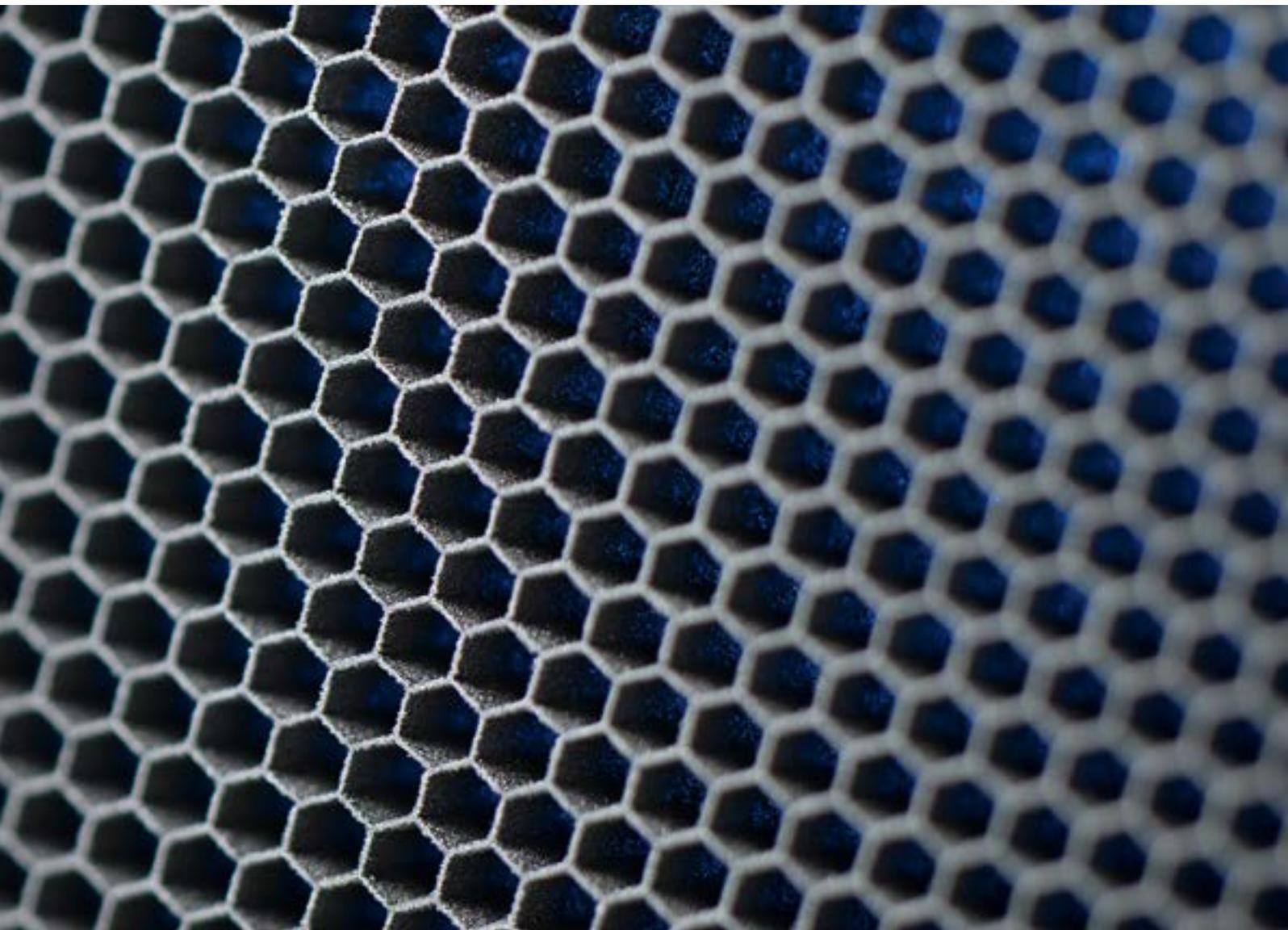
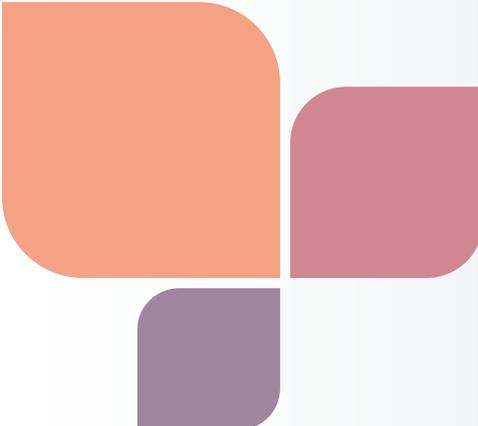


Complex components: following the **example of nature**

- Saving fuel with coatings
- Dream job in Shanghai





Our
responsibility
towards people,
society and
the environment

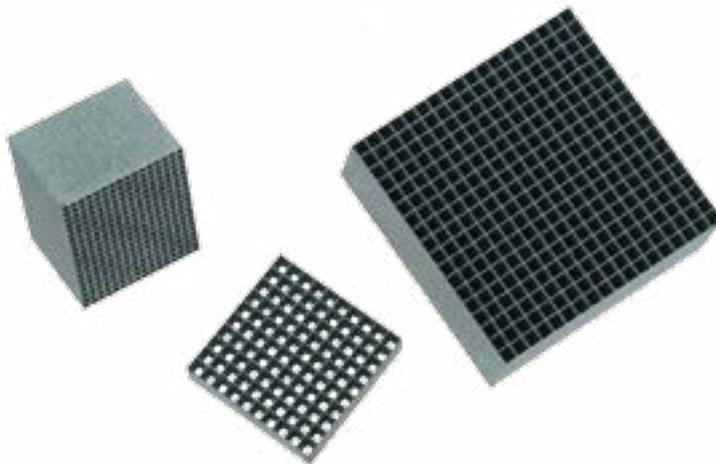
The sustainability magazine

For the past three years, the Plansee Group has published a separate Corporate Responsibility Report, most recently covering the four major production locations in Mamer, Reutte, Towanda and Xiamen. This year, we have integrated the reports on compliance and the responsibility of the Plansee Group towards people, society and the environment in this issue of livingmetals.

The figures in this publication are consolidated Plansee Group figures or average values for all production plants with more than 100 employees. You will find detailed information on the key figures published by the Plansee Group at www.responsibility.plansee-group.com. There, you will find figures and detailed information on: raw materials, financial data, research and development, human resources, sales and marketing, investment, process improvements, the environment and safety at work.

A word on the title

Plansee High Performance Materials has developed a new production process for manufacturing complex components. Laser melting involves melting refractory metal powder precisely where it is needed for the structure of the component.



Stories, not figures

» Firmly rooted in our world of strong metals, we want to continue to be a reliable supplier and an employer of choice going forward.

Dear readers,

Our strong metals tungsten and molybdenum are vital for our high-tech world, both now and in the future. Our materials make our technological world simpler, safer and more worthwhile, whether it be in the field of medical engineering, consumer electronics or mechanical engineering.

But it is not just what we do; how we do it is also becoming increasingly important for our customers and our staff. Successful and ethical, permanently innovative and always with a sense of responsibility. This image of who we are is both a promise and an obligation and has for decades made the Plansee Group what it is: a reliable supplier and an employer of choice.

And we would like to use this issue of livingmetals to show you how we live up to this promise to our customers and our staff. We shall not just be quoting facts and figures, but will make it all come to life with plenty of pictures from stories small and large.

Dénes Széchényi
Head of Group Communications





Efficiency in motion

The higher the combustion temperature of the kerosene, the more efficiently the engine of a modern passenger aircraft will work, delivering higher performance. The designers use alloys that are resistant to high temperatures for the turbine blades, and reliable tools are needed to process these difficult materials. Ceratizit has developed high-performance carbide grades and milling cutters for the aerospace industry.



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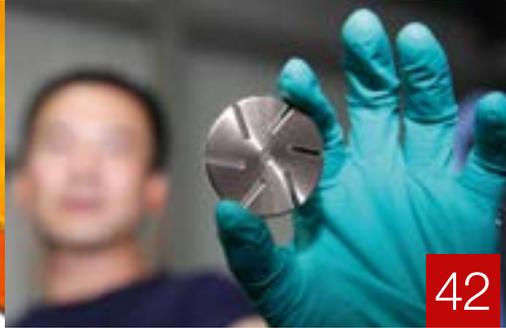
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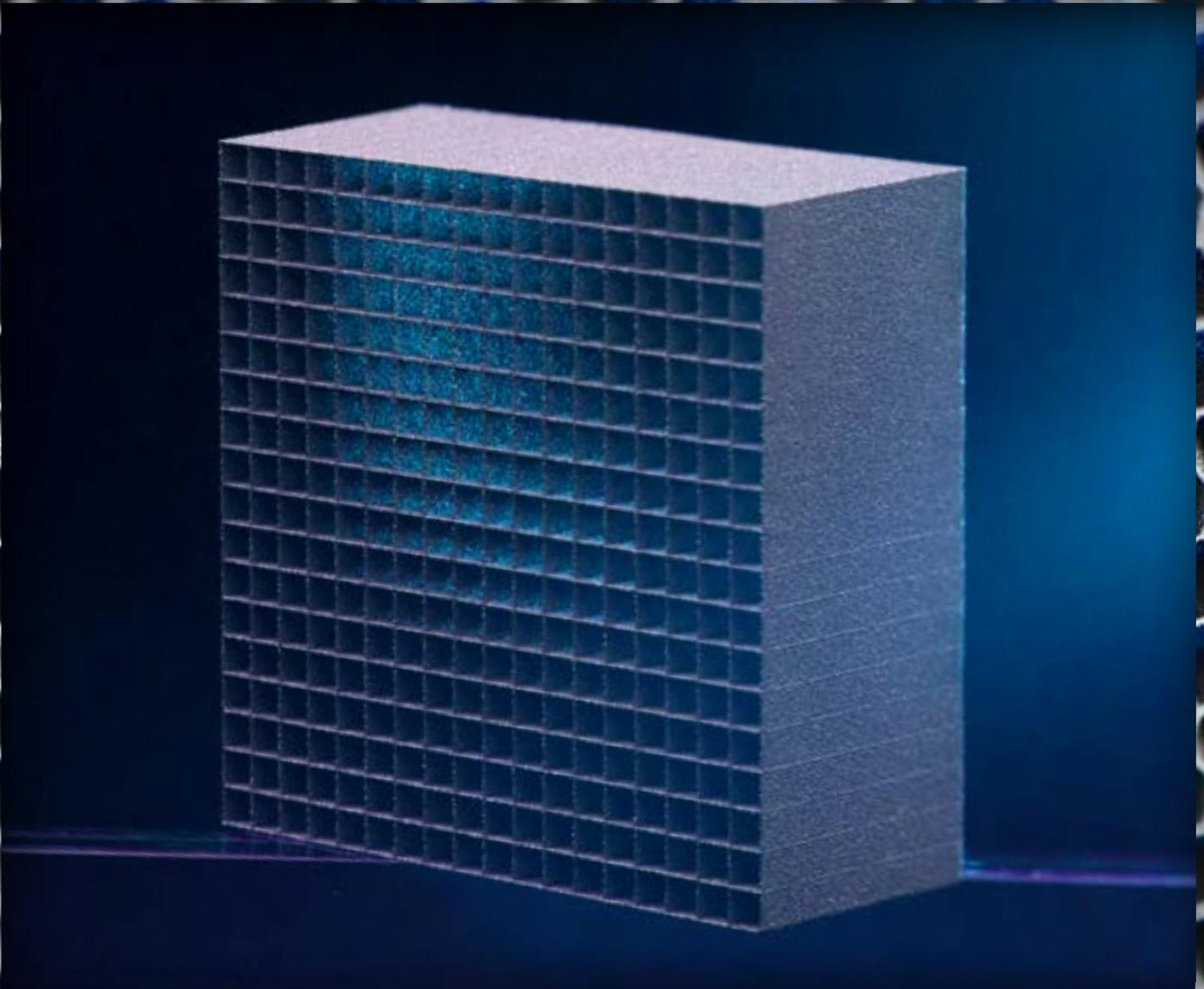
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World of Plansee Group



A marvel in two colors: The new silver-niobium coin. In Austria, it is both legal tender and a sought-after collectors' item. And it shimmers in green and blue. To bring this two-colored marvel into being, Plansee developed a new manufacturing process. The pre-embossed niobium core is first stained in the basic green color by means of anodic oxidation. The raised surfaces created by the pre-embossing process are then carefully prepared for the second coloring stage.



Plansee follows the example of nature when manufacturing complex components. When bees build a honeycomb, they deposit the wax exactly where it is needed. Laser melting works on the same principle: Thin layers of hard or refractory metal powder are gradually built up. Step by step, the laser melts the powder at precisely the point where the component is created. The result is three-dimensional components with complex geometries for the medical engineering, aerospace and mechanical engineering industries.



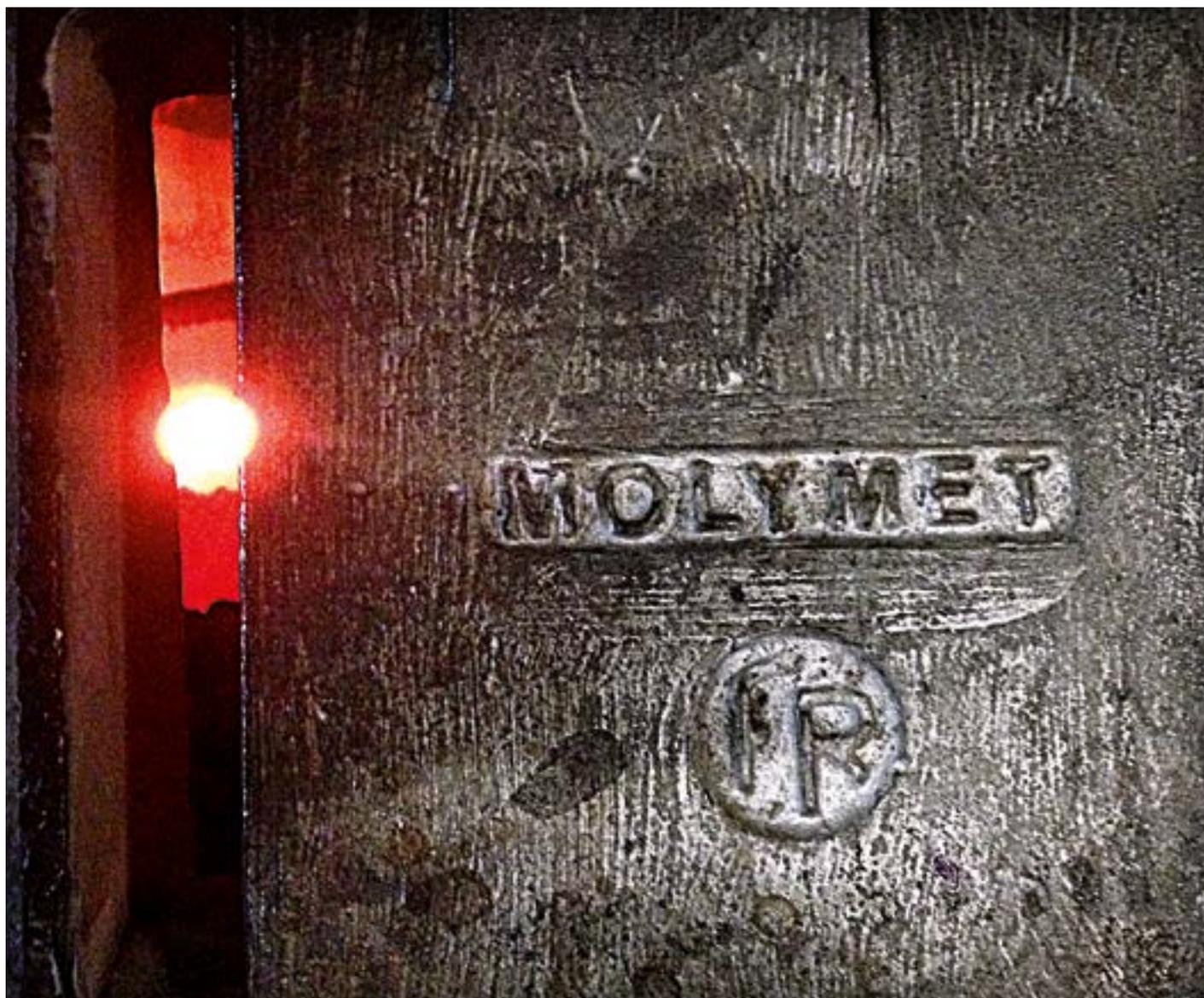
From small beginnings: For just over a year, seven young trees have been growing in the Uluberia Industrial Growth Centre in the Kolkata region. They were planted to celebrate the opening of Ceratizit's new, greatly expanded production plant in India. And it is from here that Ceratizit wants to significantly boost its presence in the Asian machine tools market over the coming years.



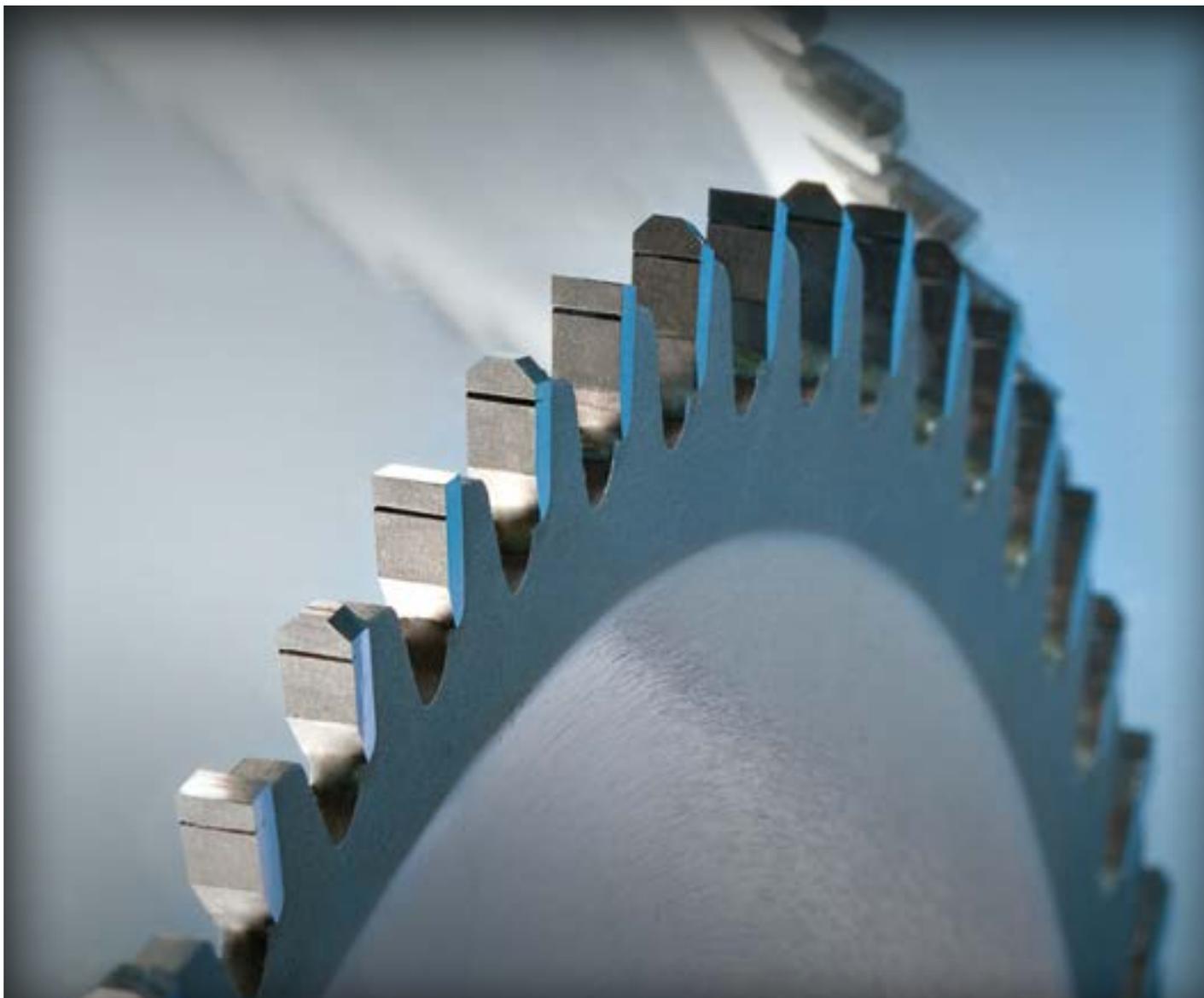
For a good cause: The dragon boat team from the Plansee site in Lechbruck, Germany, pulls together. The team takes on teams from other companies on the Heiterwanger See in the Tyrolean mountains. The prize: An unparalleled team experience, a lot of fun and a well-filled charity fund for social projects in the region.



Everything is ready: This will soon be the site of a drilling rig designed to take cylindrical rock samples several meters in length from the ore mine in the northwest of Canada. If the samples glisten blue under UV light, this is an important indication that the rock contains tungsten. It can then be converted to ore concentrate and gradually processed to produce pure tungsten powder at Global Tungsten & Powders. Yet another component in the complex constellation that will keep our high-tech world supplied with tungsten in the future.



Round the clock, huge rakes in Molymet's roasting kilns ensure that molybdenum disulfide oxidizes to form molybdenum trioxide in the presence of large quantities of oxygen. The maximum temperature in the roasting kilns is 650 °C. The Plansee Group increased its holding in the Chilean company Molymet from 14 to 20 percent last year.



Up to 250 kilometers: This is the distance that a new marathon saw tooth from Ceratizit can cut without needing to be sharpened. Conventional saw teeth made from carbide last around seven kilometers. The new saw tooth is made up of a number of different layers, which wear at different rates and protect each other. This ensures a constant cutting edge radius and a sharp cutting edge throughout the whole marathon sawing.



Concentrated expertise: From tool blank to custom-built and coated round tool – this is how the Ceratizit Group positions itself following the successful integration of the two solid carbide manufacturers Günther Wirth in Germany and Promax Tools in California.

New cold rolling mill

Perfectly flat

Plansee's new cold-rolling mill represents a technological milestone in the cold forming of molybdenum sheet.

The first impressions alone are jawdropping: Visitors enter a clearly laid out and thoroughly clean production hall in the Plansee production plant in Reutte, Austria. To the west, 15-meter glass walls offer a panoramic view of the mountains, with several Alpine peaks. And the technology in the hall is the finest around. Without a sound, a robot takes a molybdenum sheet from the transport container. The sheet is weighted and positioned "in flight" before being laid down gently onto the roller table. Now two clamps approach from the front and back to firmly clamp the sheet. Once it has been clamped, the real work starts: An x-ray machine moves over the sheet,

measuring its thickness and profile. The control system calculates the optimum rolling program in an instant. The rolls of the mill start to turn. The sheet is rolled backwards and forwards, and the final thickness is reached after just a few passes. A laser monitors the speed and controls the rolling process. And all is done with the utmost care; after all, the material should not degrade during the process. The finished material has been rolled to an impressive size of up to eleven meters by 950 millimeters at a thickness of up to 0.15 millimeters. "And we can work at a tolerance of less than 3 micrometers," says process engineer Dr. Andreas Hoffmann proudly. It is the impressive combination of width, thickness and tolerance which means that Plansee High Performance Materials' new cold rolling mill represents a technological milestone in the cold forming of molybdenum sheet. Once it has been rolled, the strip is wound onto reels or cut to single sheets.

With its new cold rolling plant, Plansee has laid the foundations for end-to-end industrial manufacture of flat products. Hoffmann: "We are supporting our customers from a huge range of industries with rapid throughput times, high capacity and completely dependable quality."

Wide formats

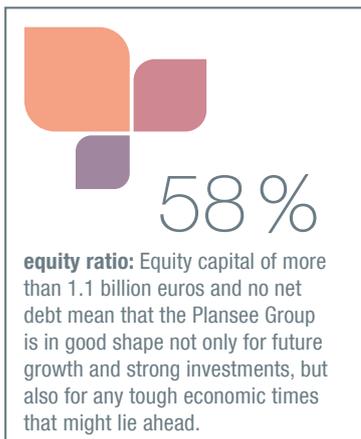
The molybdenum sheets are subsequently processed to make shield packs for high-temperature furnaces. They are shaped to form tubes before being riveted and then joined to other tubes. Wider sheets mean that it is possible to save several rows of rivets. When punching, wider sheet formats offer more flexibility to allow optimal use of the material.

Thin and completely flat

The electronics industry requires extremely thin material with an outstanding surface quality and thickness tolerance for heat spreaders and semiconductor base plates. What is more, the precise adjustment of the rollers means that the rolled sheets are exceptionally flat. This makes it possible to avoid expensive follow-up operations and therefore to achieve both material and cost savings.

Reliable material properties

Creep resistance plays a crucial role in high-temperature applications such as annealing boats and sintering boats. This property can be influenced beneficially and, most importantly, in a reproducible way through the use of defined, high, adjustable levels of deformation. ■





*Impressive dimensions:
The new plant rolls
sheets to a size of up to
eleven meters by 950
millimeters at a thickness
of up to 0.15 millimeters.*



conflict-free!

Ensuring raw material

Supply over the long term

Over the past six years, the Plansee Group has invested heavily in ensuring supplies of tungsten and molybdenum raw materials.



Following an audit conducted in December 2013, the audit committee of the Electronic Industry Citizenship Coalition (EICC) and the Global e-Sustainability Initiative (GeSI) has confirmed that Global Tungsten & Powders (GTP), a division of the Plansee Group does, not process any tungsten sourced from regions of conflict. GTP is the world's first tungsten producer to receive this certification. GTP employs a wide range of measures to ensure that they do not use any raw materials from socially, ethically or ecologically questionable sources.



Plansee Group chairman Dr. Michael Schwarzkopf referred to the acquisition of a 20 percent share in the Chilean company Molibdenos y Metales (Molymet) as the biggest single investment in the company's history. Molymet has for many years been a key supplier to the Plansee Group. Dr. Michael Schwarzkopf: "By gradually increasing our share in Molymet since 2011, we are pursuing a strategy that firmly focuses on the two high-tech materials molybdenum and tungsten, ensures our supplies of raw materials in the long term and covers all processing steps, from the ore right through to custom-built components." Molymet was founded in 1975 and,

with a market share of 35 percent, is the world's largest processor of molybdenum ore concentrate. Molymet has been listed on the Santiago de Chile stock exchange, in the country's capital, since 1983. Alongside the Plansee Group, Molymet's key stockholders consist of four South American families. There are relatively few other stockholders. The most recent figures show that Molymet realized annual sales of 890 million US dollars and now employs 1535 staff. Much of the molybdenum that is produced by Molymet is used as an alloy additive in the steel industry. The chemicals industry needs molybdenum for catalytic converters. Within the Plansee Group, high-purity ►





Raw materials procurement

*Always on the road:
Karin Laursen tracking
down promising tungsten
deposits.*

Five years until the first powder is produced

Ensuring sufficient quantities of raw materials at the right time and from unimpeachable sources: Karin Laursen plans well into the future to ensure that GTP will always be able to procure raw materials. A qualified geologist, she is responsible for procuring tungsten ore in the Plansee Group.

***livingmetals:* You are constantly searching for new sources of raw materials. How do you go about it?**

Karin Laursen: We take initial samples and test them to see whether they meet our requirements. Not all ores yield the quantity and quality that we need for our tungsten powder. Mined ore contains between 0.2 and one percent tungsten.

***livingmetals:* And where does the tungsten ore come from?**

Karin Laursen: We have long-term contracts with mines in North and South America, Europe and Australia. GTP also purchases from smaller mines when the need arises. But our supplier policy means that we do not source materials from conflict zones such as Central Africa. This has been confirmed by an audit conducted at the end of 2013 by the independent auditors EICC and GeSi. We are extremely proud to be the first tungsten processor to have been awarded this certificate.

***livingmetals:* How will GTP be able to guarantee a constant supply of ore going forward?**

Karin Laursen: I am constantly looking for new sources of tungsten. Our tungsten requirements, together with the expected life of the existing mines and their output, allow us to estimate future needs very accurately and embark on new mine projects.

***livingmetals:* What are the most important criteria when choosing a mine?**

Karin Laursen: There are a lot of questions to be answered: Where is the mine located? How long will it take before the mine is able to produce ore concentrate? How long will the mine be productive before the ore is exhausted? How much tungsten does the ore contain? How good is the infrastructure of the mine in terms of logistics, in other words, does it have roads, water and electricity? Is there an adequate workforce available in the

vicinity? And, of course, we have a good look at the experience the mine operator has in mining and processing ore. Finally, the project also needs to be financially viable.

***livingmetals:* How long does it take before the mine begins to yield ore concentrate?**

Karin Laursen: Several years. The Hemerdon Mine in England is a good example: Exploratory drilling to assess the potential of the mine was completed in the spring of 2011. When I arrived there in summer, I saw an old mine surrounded by green fields and a few houses. Some two years later we were able to sign the contract laying down the start of delivery and output volume with the mine operator. And now, the necessary infrastructure has been put in place to allow the mine to start operation. Over the coming months, a plant will be installed to gradually separate out the tungsten ore from the rest of the ore using a number of mechanical and chemical processes. We expect Hemerdon to start producing ore concentrate with a tungsten content of around 65 percent by the end of 2015. So it can take up to five years from the start date before the mine begins to deliver the goods.

***livingmetals:* This is a long time and requires a significant financial commitment on the part of the operator.**

Karin Laursen: Which is where we come in. We do not own the mine, but we work very closely with the operator and offer financial support. These things, combined with our commitment to take delivery of the ore concentrate, helps the operators to secure the necessary finance from banks and investors. In many cases, tungsten would simply not have been mined if it had not been for our support. ■

After the drilling, the drill samples are analyzed. Rock that contains tungsten (scheelite) shines blue under a UV light.



- molybdenum is used to manufacture semifinished products and components for a wide range of high-tech industries.

High-tech metal

Global molybdenum deposits are estimated at approximately 19 million tons. Molybdenum is contained in various minerals, but only molybdenite (MoS₂) is suitable for the industrial production of marketable molybdenum products. Molybdenite can occur as the sole mineralization in an ore body, but is often associated with the sulphide minerals of other metals, notably copper. The molybdenum content of viable ore

bodies ranges between 0.01 and 0.25 percent. Molybmet has entered into medium-term and long-term supply contracts with mines in order to ensure the supply of molybdenum across the globe.

Molybdenum ore is often produced as a byproduct from large copper mines. One byproduct of processing molybdenum ore is the extremely rare and valuable metal rhenium. Some of the uses of alloys containing rhenium include turbine vanes for aircraft engines, catalyzers for the production of lead-free gasoline and thermometry at extreme high temperatures. ►



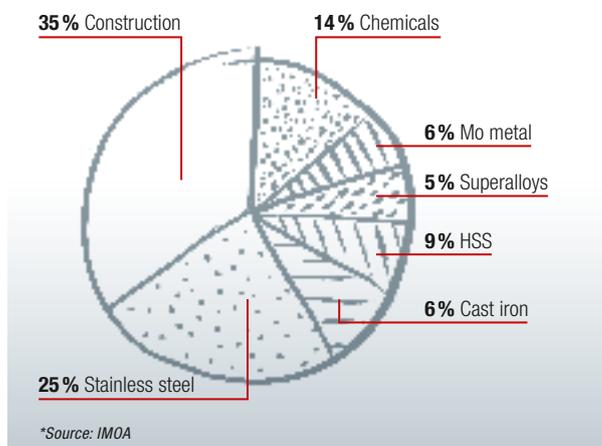
50%

of the tungsten processed in the Plansee Group has been recovered from old drills and cutting tools and swarf. The aim is to further increase the proportion of recycled tungsten used in production. In order to achieve this, the Plansee Group last year set up additional recycling capacity in the United States, Europe and Asia.

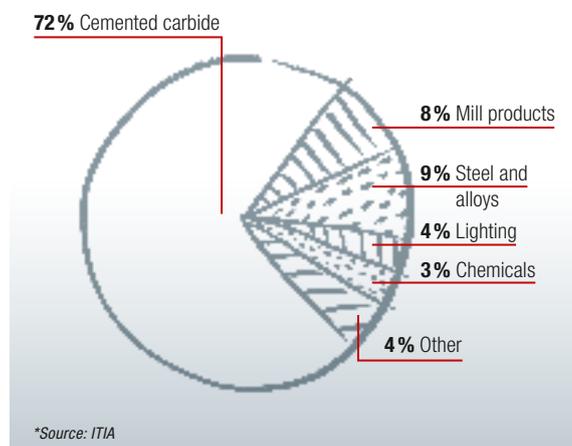
Molybdenum and tungsten are vital for many high-tech industries. The Plansee Group, through its investments in Molymet and GTP, helps to secure the global supply of the raw materials molybdenum and tungsten.



Markets that use molybdenum*



Markets that use tungsten*



► Global tungsten producer

The second biggest investment made by the Plansee Group was the acquisition of Global Tungsten & Powders with the goal of ensuring supplies of tungsten in the West. GTP's production is intended to meet not only the internal needs of the Plansee Group; its customers include many other companies that manufacture tools from this extremely tough, long-lasting hard metal. But the US tungsten powder producer is not just concerned with ensuring a reliable supply of the valuable and scarce resource. Along with the resources tin, gold and tantalum, tungsten is classed as a conflict mineral. These are minerals whose sources include conflict zones such as the Congo region. Tungsten is needed

in many high-tech industries such as the automotive industry, consumer electronics and the construction industry. In order to be able to assure manufacturers of cars or electronic equipment that no raw materials from conflict zones enter their supply chains, Global Tungsten & Powders gained certification as a conflict-free smelter in December 2013, becoming the first tungsten processor in the world to do so.

Increased recycling activities

The Electronic Industry Citizenship Coalition (EICC) and the Global e-Sustainability Initiative (GeSI) confirmed that GTP does not process any tungsten from conflict zones. There are three ways in which GTP ensures

that this is so: 1. GTP is involved in developing and financing new mine projects in safe regions such as England, Canada and Australia. 2. GTP develops methods that allow commercial exploitation of ore deposits that were previously deemed unviable. 3. Since the 1960s, the company has been working on recycling techniques that not only protect valuable resources, but also ensure commercially viable extraction of tungsten. This involves collecting used hard metal tools and other tungsten containing scrap from around the globe. The recycling techniques also guarantee that the recovered tungsten has the same chemical properties as "virgin" tungsten, in other words that it is equal to the original raw material in every respect. ■



180 plants

Each year, Plansee India celebrates World Environment Day. This year, under the motto “Raise Your Voice Not The Sea Level”, the company raised its employees’ awareness of environmentally conscious behavior and gave away a total of 180 foliage plants. They also ran a competition for the employees to create a relevant slogan in which 250 employees took part.

Efficient and environmentally friendly

GTP has managed to make the manufacture of ammonium paratungstate (APT) significantly more efficient and environmentally friendly. This was done by introducing a new process for performing the liquid-liquid extraction separation that makes use of gravity. The new process requires far less energy and production space. Emissions of volatile organic compounds are reduced by 30 percent.

The goal: World champions in the energy stakes

In fall 2012, Austria committed itself to improving energy efficiency across the nation by 20 percent by 2020. All companies must provide evidence that they have played their part. The Reutte plant in Austria has set itself the target of having the most energy-efficient processes worldwide for the production of refractory and hard metals. In order to document its efforts to improve energy efficiency, Reutte has introduced an energy management system per ISO 50001 and was certified in summer 2013.

To realize the objectives, staff received training in three aspects: How do I change my behavior and use energy responsibly; how can I introduce ideas to save energy in processes and in the area of plant engineering; how can I actively support energy-saving projects and measures that have already been defined in a large number

of production lines? The progress can be seen in the form of an energy certificate that is published every month on announcement boards in each production department.

When less is more

A great deal of energy is needed to process the raw materials molybdenum and tungsten. The Plansee Group is constantly working to reduce energy consumption in every processing step.

CO₂-Emissions

Saving fuel with coatings

Friction in vehicles can be reduced by intelligently coating components.

Reducing CO₂ emissions is a key issue in the automotive industry. By 2015, new vehicles in the European Union will only be permitted to emit a maximum of 130 grams of CO₂ per kilometer. By 2020, fleet average emissions are to drop to 95 grams per kilometer.

There are four major forces that have a significant impact on fuel consumption in cars: Three of these are inertial forces (reduce the weight of the vehicle!), rolling resistance forces (improve tire compounds!) and internal friction forces. While the influence of these forces drops as a percentage of total forces as speed increases, that of aerodynamic forces increases (improve designs!).

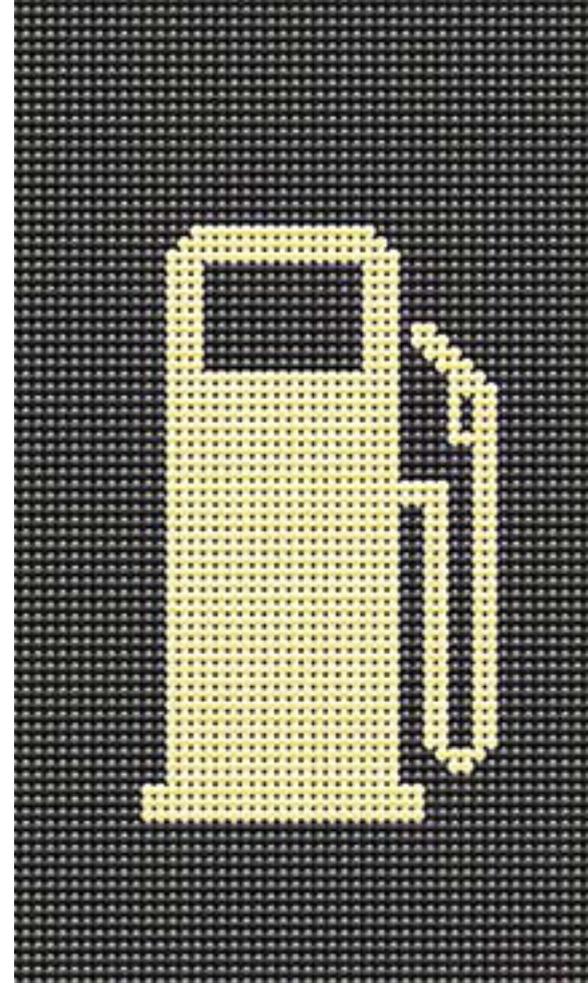
Focus on friction

Up to 20 percent of the power available is lost to friction in the power train. In other words, one fifth of a driver's fuel bill goes on unnecessary heat loss. And to combat this, the automotive industry is working feverishly to develop low-friction, or even friction-free power

trains. One important instrument is to reduce power loss between moving parts with coatings and improved coating materials.

Take a diesel injection system

The greater the precision with which this works, the more complete combustion of the fuel/air mixture will be. In order to reduce the coefficient of friction of the injection needle, it is first coated with chromium nitride, to which a further coating of DLC (diamond-like carbon) is applied. The current state of the art is to use targets (coating materials) made from tungsten carbide to produce this layer. It is intended to achieve further fuel savings by increasing the combustion temperature by up to 150 °C, thus optimizing combustion. This has consequences for the coating in that it has to be more heat-resistant. Plansee is currently working together with major customers to develop coatings made of molybdenum nitride and molybdenum-copper for this application.



Reducing friction still further.

And it is not only the injection system where the automotive industry is looking for ways to reduce friction. Many other moving parts in the engine and gearbox are coming under close scrutiny. And the industry is following a two-pronged strategy. On the one hand, they are looking to further develop and improve existing coatings, and, on the other, they are aiming to develop coatings for moving parts that have never been coated before. And this can have interesting side-effects: It is not rare that the intelligent combination of a (less expensive) substrate material with an optimized coating results in the overall cost of the component being reduced.

Partnering the automotive industry

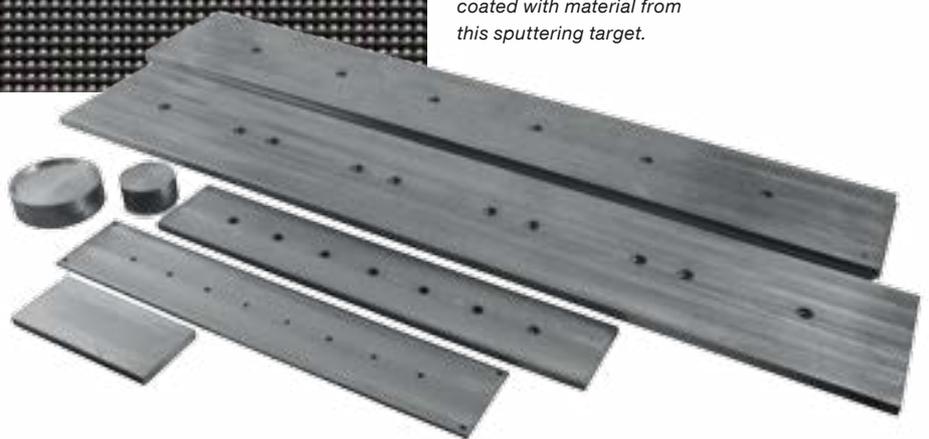
Acting as a development partner, Plansee is collaborating with automotive suppliers to develop new, improved coatings. Plansee provides prototypes that are thoroughly tested in the customers' coating plants. Experience with coated

CONVENTIONAL COMPONENTS + COATING

= LESS FRICTION

= FEWER CO₂ EMISSIONS

*Assisting combustion:
Injection needles are thinly
coated with material from
this sputtering target.*



prototypes on the test rigs makes it possible to further develop the targets to deliver exactly what is needed. At the same time, Plansee is developing and adapting manufacturing procedures that will guarantee the quantities and quality needed for series production. Not just for injection systems, but also for many other moving parts in vehicles. ■



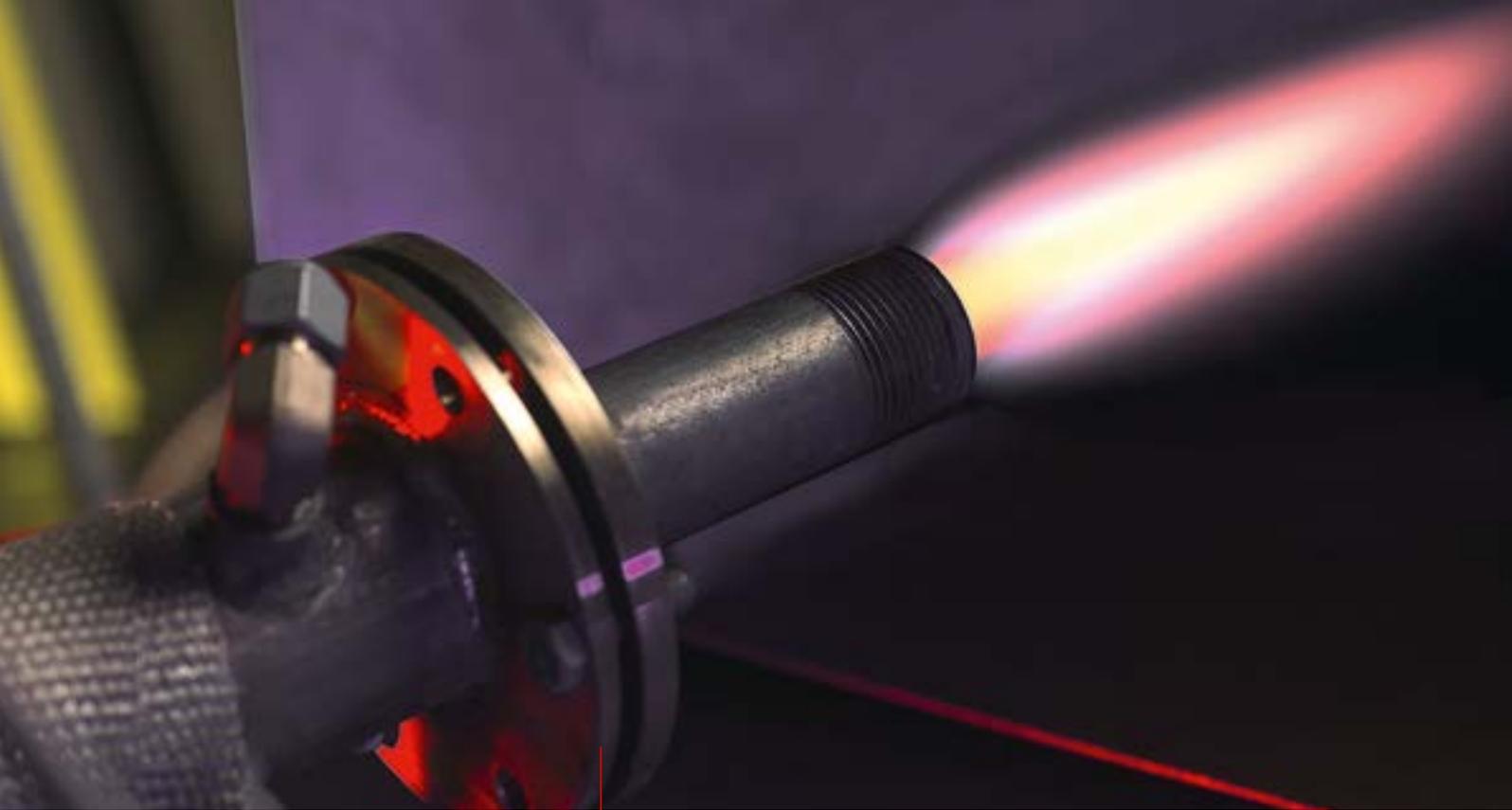
32%

of sales revenues in the Plansee Group were achieved with new products over the past fiscal year. A product is regarded as being new if it is less than five years old, is a significant development of an existing product, or opens up a new application.

Boosting research in Austria

To increase productivity and develop new products for new fields of application: This is the challenge that the hard metal tool developers at Ceratizit have taken on. And they are being supported by the Austrian Research Promotion Agency (FFG). Ceratizit is investigating how new coatings can significantly improve the performance of cutting tools.

Another thrust of Ceratizit's research program is the further development of solid hard metal tools for materials that are difficult to machine. These include materials such as graphite, fiber-reinforced polymers (CFRP, GFRP) and superalloys. These materials are increasingly being used for the lightweight construction of airplanes and in wind turbines, gas turbines or electric vehicles. In both projects, Ceratizit is working closely with universities.



Extraordinarily resilient

Very small quantities of titanium and zirconium improve the strength and performance of molybdenum. The nozzle used for manufacturing high-quality plastic is under permanent stress: The hot plastic with many abrasive and corrosive additives is forced through the nozzle at high pressure. The nozzle is manufactured from titanium-zirconium-molybdenum (TZM). TZM withstands high mechanical loads at temperatures of up to 1400 °C. The material has a higher recrystallization temperature and greater creep resistance than pure molybdenum. All this means that TZM is not only in demand in the plastics industry. It is also needed for manufacturing components for high-temperature furnaces, x-ray machines and shaping tools, hot pressing tools and die casting tools.

Tough materials

Spray powder coating makes cast iron or steel components far more resilient and increases their service life. Depending on the application and the process used, GTP mixes tungsten or molybdenum with cobalt, nickel or chromium to form ready-to-use spray powders. Applications are many and varied: The petrochemicals industry coats the inside of metal pipes to protect against corrosion. In the automotive

industry, spray powders reduce friction in the drive train. In the aerospace industry, the aim is to reduce weight: Lightweight materials are finished with wear-resistant coatings. And the nozzles and electrodes used in the spraying process also come from Plansee. Nowadays, these are thorium-free and environmentally friendly, being made of tungsten-copper.

Environmentally friendly chrome trims

Chrome trims are an indispensable part of modern car design. But although they may be nice to look at, up to now they have been bad for the environment. This is because the galvanic process used to coat the metal or plastic trim is a health hazard and a danger to the environment.

Physical vapor deposition (PVD) allows plastic parts to be coated in a way that does not endanger the environment. Plansee develops the chromium targets needed for this environmentally friendly approach to coating.

Faster with overlenght

To allow engine oil to flow through crankshafts, they are bored out. This drilling operation requires a huge amount of time, in particular with large crankshafts for trucks and ships. The deeper you drill, the harder it is to maintain a constant drilling quality. And so, Günther Wirth manufactures deep-hole drills whose length can be up to 50 times their diameter. In real terms, this means that drill bits with a diameter of eight millimeters can

be up to 425 millimeters in length. This length means that the drill bits need internal coolant holes. This gives the cutting edge a long service life and results in high quality in the workpiece. Modern drill geometries deliver process reliability even during such deep drilling and the chips can be removed quickly without the usual stock removal cycle. This significantly reduces processing time.

Celebrating all things new

No matter whether they come in the form of tools, consumables or replacement parts, the innovative molybdenum and tungsten products from the Plansee Group are vital for our high-tech world, both now and in the future.

Roller coaster in a rod

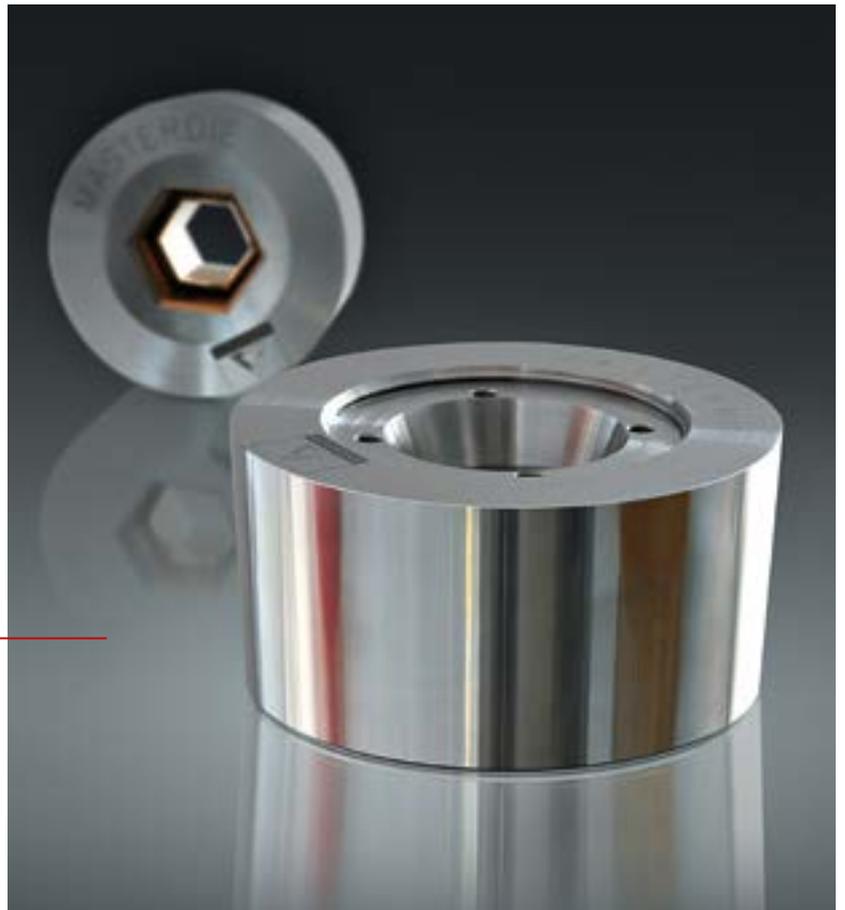
Ceratizit is using a new manufacturing technique to make carbide rods with cooling ducts with a 50-degree spiral. The trend for aircraft manufacturers to use composite materials such as CFRP

or combinations of CFRP, titanium and aluminum has brought with it the need for higher performance drilling tools with integrated coolant delivery. These tools have a large shoulder to

allow the hole and the countersink to be machined in a single operation. To make sure that the cooling ducts reach right to the tip of the drill, the blank rods must have a spiral of more than 50 degrees.

Replaceable and unique!

With MasterDie, Ceratizit has brought an entirely new drawing die onto the market. When the tool is worn, users now only need to replace the drawing die, rather than the entire tool. The steel mounting and the threaded ring can be reused. The carbide insert is also CVD-coated. This doubles the service life and permits higher drawing speeds. Although steel tends to “stick” during drawing, the coating mitigates this effect and reduces friction.

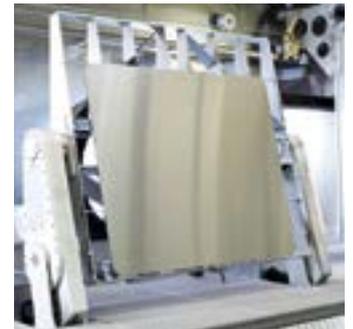




Global production network

Purity and service are what count

The higher the resolution of the display, the greater the demands on the purity of the coating materials.



Maximum purity: The molybdenum sheet is thoroughly cleaned several times during the manufacturing process.

It's a scenario that really shouldn't happen during display production: The production line has come to a standstill because a sputtering target is contaminated or is not available. Contamination with foreign bodies can cause individual pixels in the display to fail. Or it can lead to a touchscreen not responding at a particular point. The risk rises with the resolution of the display.

In use for months

And if this were to happen, there is only one thing that counts: Getting hold of a replacement as soon as possible. A great number of displays for smartphones,

tablets or TVs can be coated using a single sputtering target. Depending on the workload and the process used, the sputtering target remains in use in the coating machine for between one and six months.

Fast-moving industry

Several different coatings must be applied for a display to work. These include ultra-thin films of tungsten or molybdenum. This is done in large coating systems operated by the display manufacturers in Asia. The coating materials that are needed are supplied by material manufacturers such as Plansee in the shape of sputtering targets. ▶

*Production network
for sputtering targets
– from powder to the
bonded product.*

*High surface quality: Quality
assurance in production.*



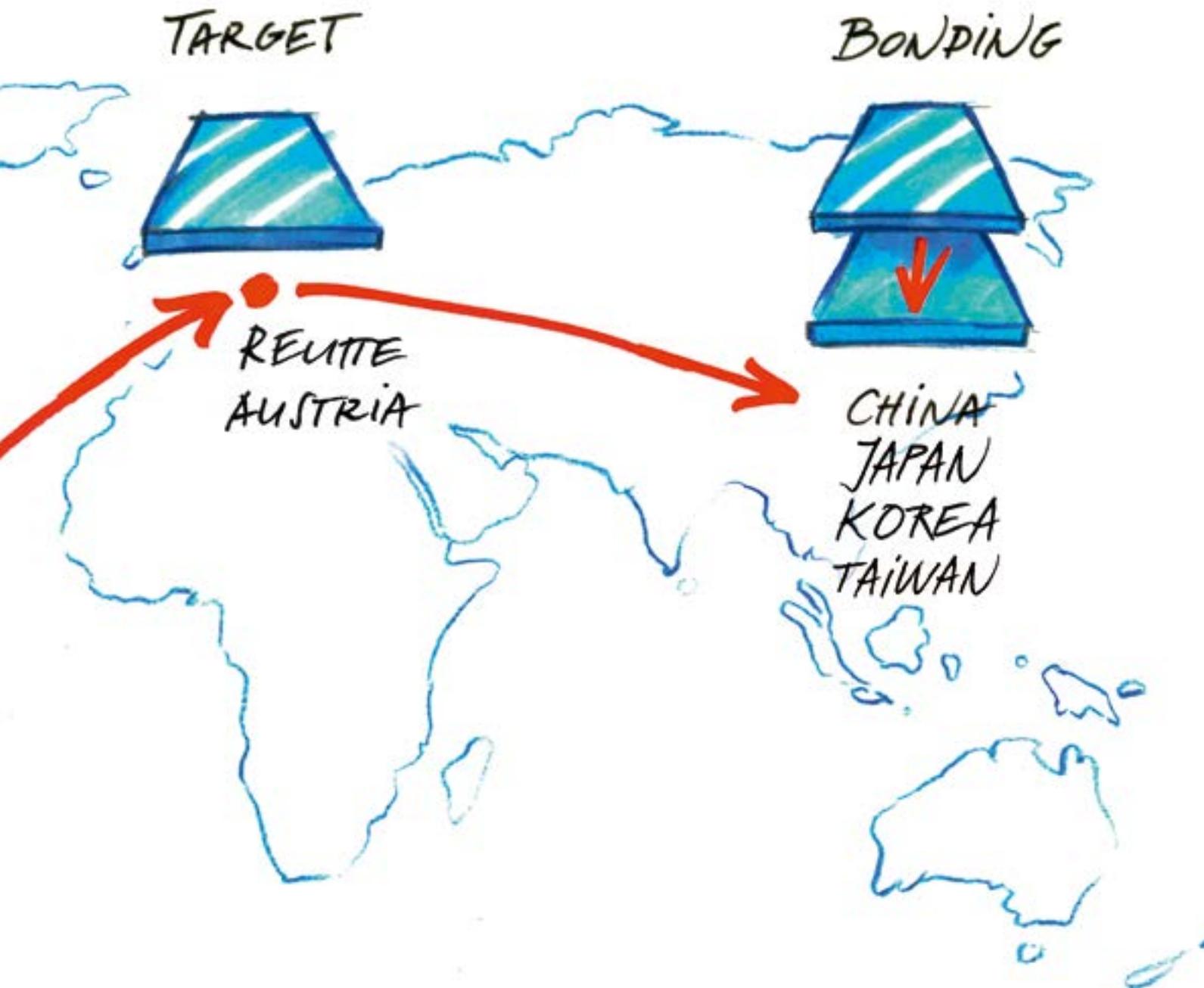
The display industry is fast-moving as never before. Every month, new, more powerful devices are launched: Laptops, tablets, smartphones, TVs. Many of these feature touchscreens. And all of them have increasingly high resolutions. The retail industry plans at short notice. And the customer wants the best model at the lowest price.

Control of the production chain

A quick reaction to market demands is the order of the day. And this encompasses the entire production chain. It is not so long ago that Plansee was able to take three months to deliver a

sputtering target. Nowadays, they need to manage it in six weeks at the outside. And if the customer's production line is at a standstill, something needs to be done quickly. "In this event, we are usually able to deliver a sputtering target at even shorter notice," explains Harald Selb, Head of Market Unit Display & Solar. But speed is far from everything. More than ever, the most important thing is quality. For years now, Plansee has been guaranteeing a material purity of 99.97 percent in a molybdenum sputtering target weighing in at up to 500 kilograms. This can only be done by someone who has complete mastery of every step in the

process. And this is the case at Plansee. Harald Selb: "From the ore concentrate to delivery of the ready-to-fit, bonded sputtering target, we are in control of every last detail." And if problems arise, we get to the bottom of them. Right down to the tiniest structures in the material. But to prevent impurities from entering the material in the first place, every effort is made to ensure maximum purity at



every stage in the production process. The molybdenum ore is processed to form molybdenum trioxide which is in turn reduced to yield pure molybdenum powder in the downstream processing stage. This powder is then pressed into thick blocks, sintered at high temperatures and formed into sheets in several passes. Between the various steps, the material is constantly reheated and thoroughly cleaned in chemical baths. The final shape of the sputtering target is then machined from the molybdenum sheets. Much the same applies when manufacturing rotary sputtering targets, which are becoming increasingly popular.

Closed loop

Right on the doorstep of its customers in Asia, Plansee prepares the sputtering targets to be used for weeks or months in the coating machine. The sputtering target is bonded to a copper backplate using indium. Plansee now operates four bonding shops in China, Japan, Korea and Taiwan to handle this final process step. And that's not all: As soon as the sputtering target has come to the end of its service life, the customer replaces it in the transport container. Plansee then takes on the job of picking it up, conditioning it and recovering the materials. Harald Selb: "The indium

is removed and reused, the copper backplate is prepared to be used again and the remaining coating material is also used." And so the cycle starts again from the beginning. In the meantime, the next sputtering target has long been delivered – for even more sophisticated displays such as curved screens or semitransparent indicator panels. ■



*Milled and polished:
The molybdenum
sputtering target before
being transported to
Asia.*

Supply Chain Management

Fine art

The Plansee HPM Group improves its customer service with shorter, guaranteed delivery times.

With thousands of products for hundreds of applications in dozens of different industries, supply chain management is more than a fine art. And complexity is just one aspect of the Plansee Group's manufacturing operations in short and long runs, whether it be small components weighing just a few grams or sheets weighing dozens of kilos. And all this with materials that demand complex multi-phase processing. To do

this, the company makes use of a global production network of highly specialized manufacturing plants. The other aspect relates to the growing volatility in the market. Customers plan their production at increasingly short notice and are demanding delivery times that are sometimes far below the company's internal production times.

Complete transparency

“All the plants are integrated in a common SAP system,” explains Harro Borowski. He is responsible for logistics and supply chain management within Plansee. Integration in the SAP network is an indispensable IT measure “which turns each of our production plants into a



*The final step:
The sputtering target is
bonded to a backplate.*

fulfillment center.” No matter whether it is Reutte in Austria, Franklin in the USA or Shanghai in China, each plant and shipping site takes over responsibility for the entire logistics operation, even down to handling import when necessary. And the result of comprehensive networking is complete transparency. This is because it is not only the production plants that are integrated in the SAP system, but also the sales offices. If an employee at the Chinese subsidiary wants to know where an open production order is at the moment, all they need to do is have a quick look in the system. This is a key element in being able to provide customers with reliable information on the status of their orders. But another important breakthrough was also achieved, namely a reduction in delivery times. It was sometimes the case that a week elapsed by the time a local customer order had been ordered and planned in the supplying production plant responsible for delivery. Now,

Plansee is able to confirm orders in its global production and delivery network immediately or at the latest within 48 hours, depending on availability.

Understanding the customers

Of course, this impressive achievement did not happen overnight, and not without significant changes. To start with, it was necessary to set up a uniform transfer pricing system across the globe. Borowski: “This speeds up the creation of offers massively and allows us to provide extremely reliable information to the customers. In order to increase our speed and efficiency, we are having a careful look at our forecast, and to do this, we want to have a better understanding of how the production systems of our main customers work.”

Intelligent decoupling

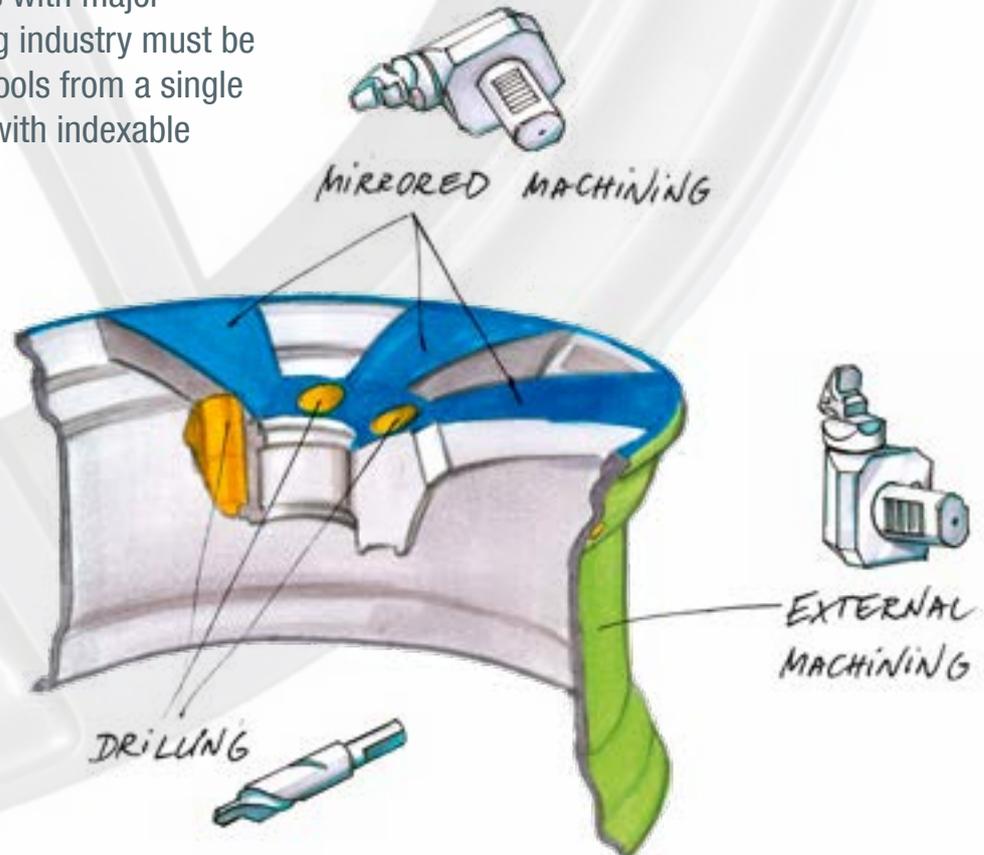
In essence, the aim is to synchronize our own and our customer's supply chain in order to improve service levels and

minimize raw material procurement risks. Borowski offers an example: “The total procurement time for purchasing and transporting molybdenum is several weeks. During manufacturing, the raw material passes through a production process with up to eight production stages. Depending on the planning strategy and the product (from standard articles to customer-specific solutions), this can take up to six months.” When the product reaches the customer, however, it is processed within a few weeks and shipped as modules or finished goods to our customer's customer. “Of course, the increasing market volatility causes problems for our relatively long supply chain. The Plansee supply chain starts just after the mine,” says Borowski. The aim is to use intelligent decoupling points in the value chain. Materials with a high number of uses are managed on a reorder points and safety stock basis to guarantee short-term availability. ■

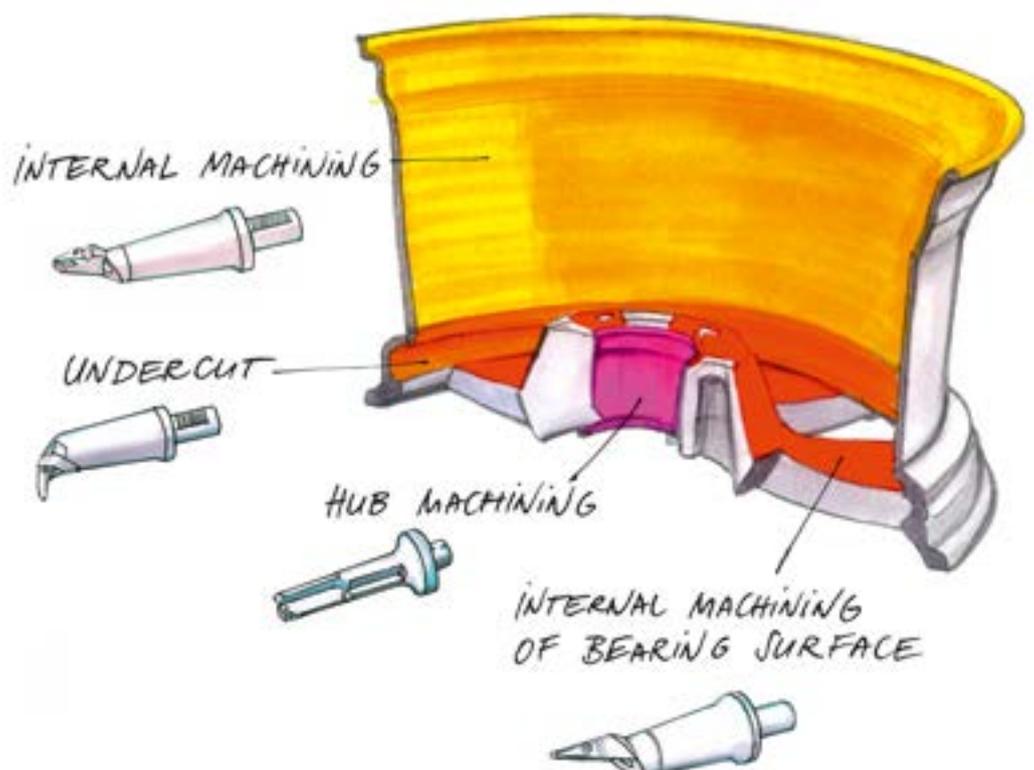
Case study

All the bases covered!

Anyone looking for success with major customers in the machining industry must be able to provide all cutting tools from a single source – hard metal tools with indexable cutting inserts.



An aluminum wheel rim illustrates the complete range from Ceratizit: To start with, the inner and outer profile and the center are machined using indexable cutting insert tools. Solid hard metal drill bits are used to drill the holes for valves and bolts. ■



Seminar series

Milling tungsten carbide

Is it possible to manufacture carbide components for tool, die and moldmaking more cost efficiently? This is a question that the carbide experts at Ceratizit are focused on. And now there is an answer: Yes, based on a reliable milling process!



Product managers from Ceratizit explain to the participants what types of tungsten carbide are best suited for toolmaking.

Up to now, forming tools were mostly manufactured from carbide blocks and preforms by means of die-sinking EDM and grinding. The die-sinking EDM process in particular is a time-consuming and costly operation. But developments in milling technology are beginning to have a noticeable impact. A series of seminars is providing users, designers and engineers with insights into how tungsten carbide can be worked economically and reproducibly using reliable processes to give a specific target surface structure. All this is based on the insights and results of a research project jointly initiated by Ceratizit. The seminars focus on the optimum interaction between innovative milling tools for cutting operations, the latest carbide grades, the right machine and the ideal CAD/CAM system. One thing that the participants particularly appreciate about these seminars is the blend of presentations and live demonstrations, where they can benefit from the application expertise of the speakers. This expertise comes from Ceratizit and also from tool manufacturers, machine tool manufacturers and CAD/

CAM specialists. The aim of this series of seminars is to provide expert support to toolmakers and moldmakers in implementing this new technology in the best way possible and thus allow them to build efficient processes. The seminars primarily address the following questions: How do the new carbide grades feature the corrosion resistance that is so crucial to the tool-making industry while at the same time offering good machinability? How do the new geometries of milling tools help in machining hard metals in such a way that this technology is a genuine alternative to die-sinking EDM? What are the requirements on machines and materials if these milling tools are to be used as effectively as possible? And what are the most promising milling strategies? To date, more than 700 toolmakers, moldmakers and technicians from various universities and institutes have taken part in the seminars in twelve cities in Germany, Austria and Switzerland. Further seminars are planned for Autumn and Spring of 2014/2015. "Milling of tungsten carbide" has been awarded as seminar of the month for June 2014 by a manufacturing journal.

8.2

out of 10 customers' opinions about the Plansee Group's products and services are more than welcome. Compared with last year, Plansee was able to show an improvement in the areas of "Flexibility" and "Openness to customer suggestions". The overall satisfaction rating of 8.2 out of a possible 10 points has risen slightly compared with last year. This result is very pleasing and at the same time encourages us to do more. We want to improve our service by responding to customer inquiries even faster in the future. One in four customers responded to the survey this year. Aspects customers were invited to evaluate after delivery included product quality, service quality, flexibility of the service offering, customer care provided by the sales team, openness to customer requests and willingness to exchange information.

On the right track

Whether it be legislation, the code of conduct or customer specifications, regular training and monitoring within the Plansee Group ensure compliance with regulations and objectives.

Certified skills

Before new staff at the Plansee plant in Shanghai start work on the production line, they take part in an extensive introductory training program. The course covers statutory regulations, safety guidelines within the company and safety measures at the individual workplaces. On completion of each module, the staff take an oral and written examination and a practical examination at the machine. Only when all the tests have been completed successfully do the candidates start their jobs. In this way, Plansee ensures that all the processes are carried out safely and correctly.

A job well done!

In April 2014, the Plansee Electro-Graph plant received recognition for its lean processes. The “Lean Crystal Award for Best Implementation of 5S” was awarded by the US consulting association Employers Group. Developed in Japan, the 5S program is a globally accepted methodology for improving processes and embedding them in the long term.

Automotive quality

Ceratizit Germany has been certified according to the global quality standard for the automotive industry (ISO/TS 16949). Apart from Ceratizit, there is only one other manufacturer of hard metals in the world that can boast this certificate. At its largest production plant in Balz-

heim, Germany, the solid hard metal manufacturer Günther Wirth operates according to the regulations laid down in VDA 6. This was developed for organizations in the automotive supply chain that wish to introduce a holistic quality management system and have it certified.

Single source?

Alongside the primary materials molybdenum and tungsten, the Plansee Group processes a large number of other materials. These are used as alloy additives, for instance, and are vital, despite the small quantities involved. As part of a regular risk assessment, Plansee last year looked at the percentage of sales that depend on raw materials for which there is only one supplier. Other issues that were examined included whether these suppliers provide standard products or special products, how reliable they are and whether it is expedient to develop secondary suppliers for these raw materials.

Employee suggestions improving productivity

Some departments develop a real competitive team spirit to be the ones to submit the most improvement suggestions per employee: Processing times are reduced, transport operations are designed more efficiently, quality is boosted or working conditions are improved. For many locations within the Plansee Group, ideas management is an important tool for achieving the annual productivity targets.

For two years, the target at Reutte (Austria) has been for every employee to submit at least one idea each year. Last year saw a new record of 0.8 ideas per employee. In Alserio (Italy) every seventh employee and at Towanda (USA) every fourth employee submitted an idea. Depending on the location, the companies reward these ideas with bonuses or an additional holiday entitlement.

415 staff

Over the past two years, 415 sales staff and managers from the Plansee Group were asked to complete an online training course about the Code of Conduct, and specifically about fair trade and antitrust legislation. The training course could only be completed successfully if the participants passed a final examination.

Protecting export privileges

A number of countries are subject to export restrictions, embargoes or sanctions affecting specific goods, people and organizations. The challenges facing the Plansee Group in this context are many and varied: It sells its products across the globe. There is an almost infinite range of products, many of which are manufactured to customer drawings. And sales operations are decentralized across many different

units. In this complex scenario, one central department keeps track of the big picture, informs the various specialist departments of the latest legislation and encourages the global sales team to be on their toes with every order and to immediately notify them of any inconsistencies. "No contract is worth risking our export privileges and the reputation of the company for" is the motto of the Plansee Group.

Observing the guiding principles

180 multipliers from the Plansee Group have taken part in internal training courses in the United States, Asia and Europe over the past two years. The aim was to sharpen their awareness of the guiding principles laid down in the Code of Conduct in as practical a manner as possible, without getting bogged down in red tape.

Saving raw materials

In good shape

No manufacturing method uses material as sparingly as direct pressing.



Powder is pressed (left), sintered (center) and coated (right) to produce high-performance hard metal tools.

Plansee recently developed a new technique for pressing switch contacts. The contacts, which are needed for medium-voltage switching chambers, are pressed from copper-chromium powder and then sintered. What is new is that these switch contacts are pressed precisely to their final dimensions despite their complex geometry. Final machining is no longer necessary. The simulation experts at Plansee were kept busy for many months developing the technique. To start with, they had to provide their computers with thousands of individual items of data before they were able to precisely simulate the production workflow. To do this, it was necessary to have a thorough understanding of the pressing operation

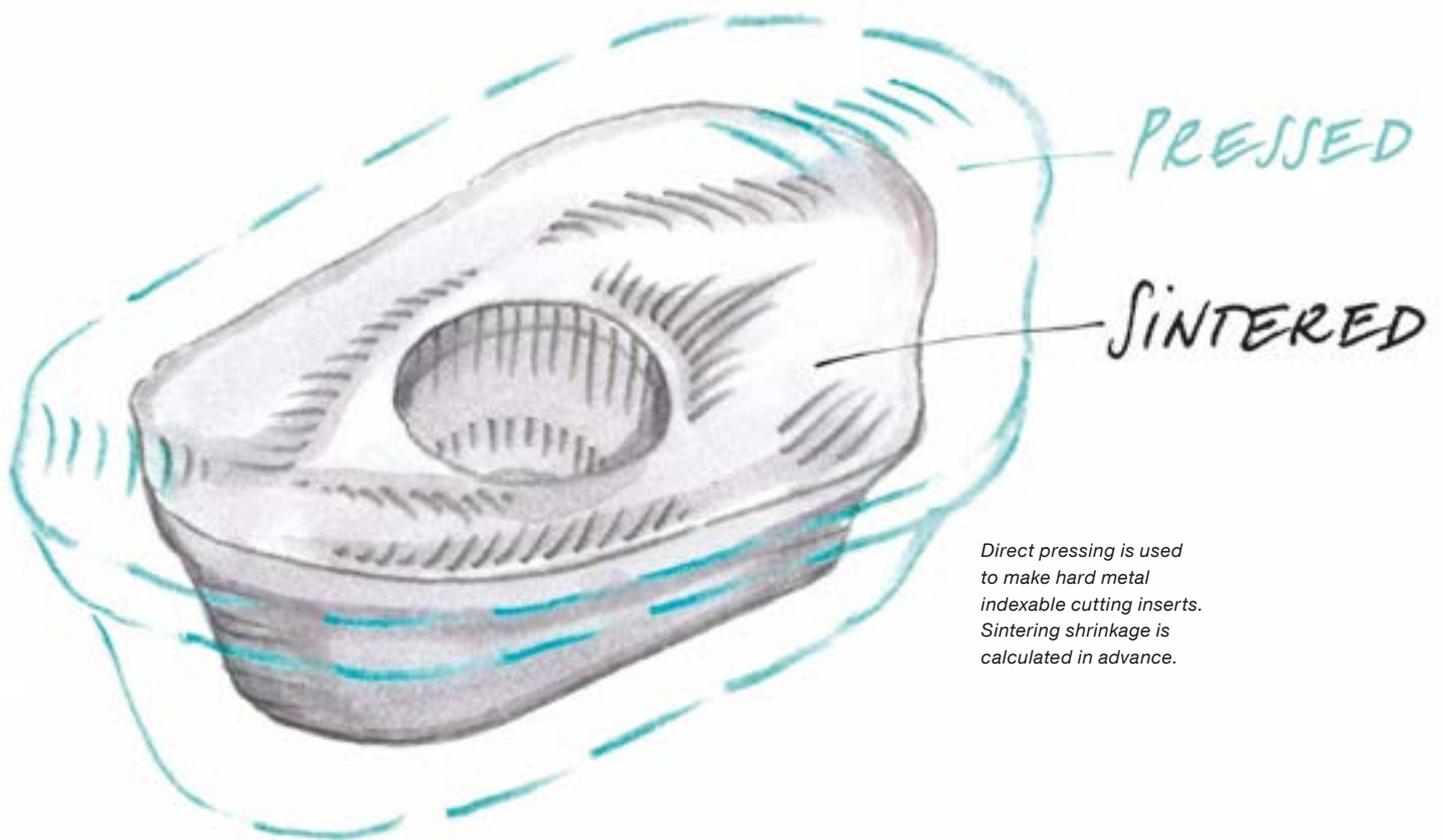
including all the forces involved and investigate the way in which the pressed parts shrink during sintering. The calculations formed the blueprint for the in-house toolmaking shop to build the press tool (see page 40).

Complex series parts

“Direct pressing to the final dimensions makes efficient use of material, is cost effective and suitable for precision mass-produced parts with complex geometries, provided that the parts have a reasonable diameter-to-height ratio, in other words that they are relatively

flat,” says Professor Lorenz Sigl, head of Innovation Services at Plansee. Within the Plansee Group, many other parts are pressed to their final dimensions, not just the copper-chromium switch contacts. These include interconnects for high-temperature fuel cells and inserts for cutting tools, as well as saw teeth, which are brazed onto parting wheels and circular saws.

And for valuable raw materials such as chromium, tungsten or high-alloy steels, direct pressing pays for itself twice over. On the one hand, there is no machining to give the part its final shape, and on the other, only the amount of raw material that is absolutely necessary for the final product is actually used. Sigl: “This means



Direct pressing is used to make hard metal indexable cutting inserts. Sintering shrinkage is calculated in advance.

that we are making a contribution to the responsible use of our resources while at the same time helping our customers to save costs along the entire process chain.”

Retaining pressing force

In the case of the fuel cell, the cost of the interconnect is a crucial aspect. In order to reduce costs, an optimized production process was developed and perfected. “In all pressing operations, the difficulty to be overcome is the friction between the powder and the die, which causes some of the pressing force to be lost. This friction causes the compact density to vary throughout the powder metal component,” explains Sigl. This can have dramatic consequences for the subsequent sintering process. And this is why the focus of development during the interconnect project was on optimizing the pressing operation and the press tools. The cost aspect is even more important if we are talking about

consumables. Hard inserts are a prime example.

“We do everything to maximize the cutting performance while

minimizing the use of hard metals,” says Dr. Uwe Schleinkofer, who is responsible for tool development at Ceratizit.

Simulating sintering shrinkage

Here also, direct pressing is the technology of choice, supported by sophisticated simulation methods for calculating shrinkage during sintering. Tolerances up to 20 micrometers are guaranteed when manufacturing the inserts by direct pressing. Such accuracy can normally only be outperformed by grinding. The advantage: Energy-intensive grinding and cooling processes are no longer needed for a direct pressed insert. Ceratizit is also able to press inserts that are positive on both sides directly. But this cannot be done with conventional press tools. Ceratizit has implemented an innovative technology specially for this purpose. ■

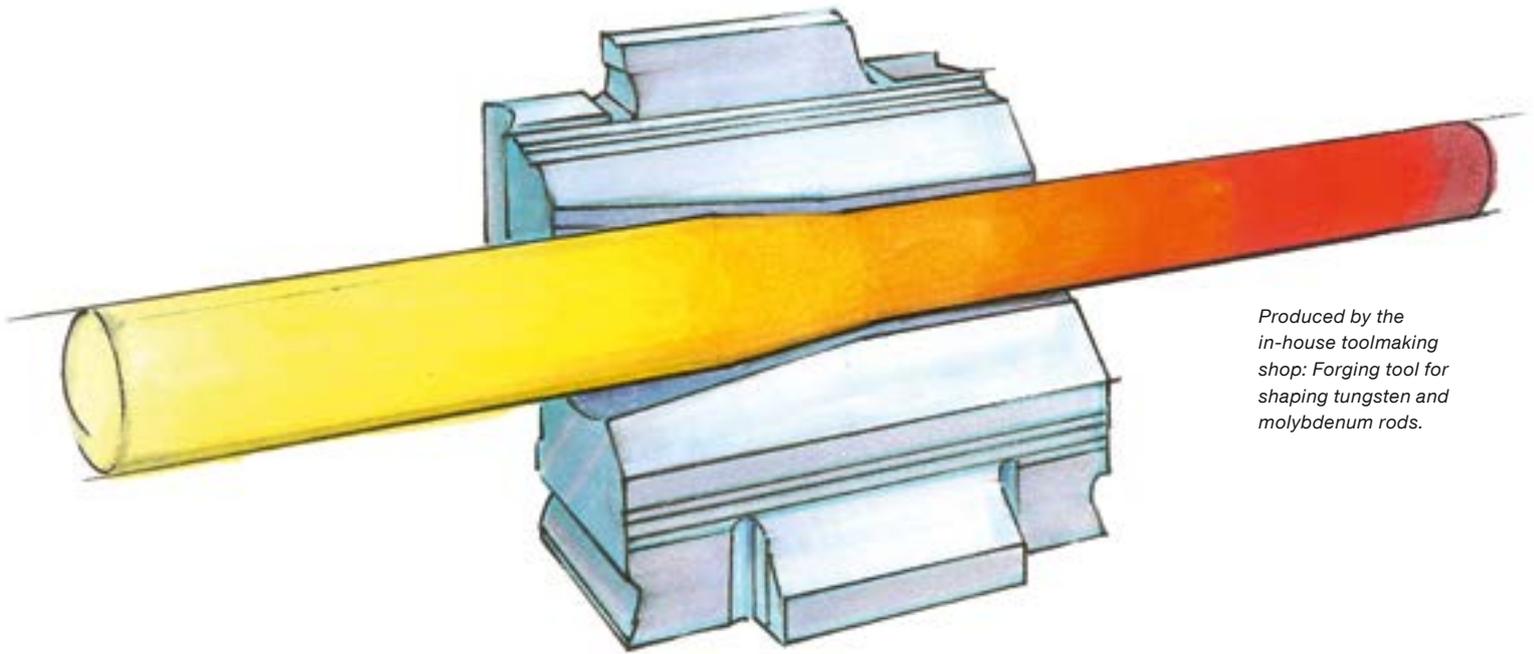
1,9 kilos

of raw materials for each kilo of the product: The aim is to achieve an ongoing reduction of the amount of raw materials used for each kilo of product sold. Processes such as direct pressing will help to realize this. Wherever this process cannot be used, it will be necessary to improve quality across all steps in production, to manufacture as close as possible to the final dimensions and to minimize waste by using the largest possible input formats.

Refractory materials

Tough tools for strong metals

Precise, long-lasting and accurate every time: The Plansee Group needs good tools to manufacture products from strong metals. And these come from the internal toolmaking shop.



Produced by the in-house toolmaking shop: Forging tool for shaping tungsten and molybdenum rods.

With astonishing speed, the filling shoe pushes two handfuls of gray powder into the die. At a force of more than 1000 tonnes and with incredible precision, the ram shapes the powder in the die into an interconnect. Good tools are indispensable for maintaining narrow tolerances over long runs.

Around five interconnects made from chromium-iron powder leave the press every minute. The Plansee Group

currently manufactures interconnects in Austria and the USA. The interconnects are used in high-temperature fuel cells. In the fuel cell, gas and oxygen combine to produce heat and electricity. Several hundred interconnects are fitted in a unit that is capable of generating 100 kilowatts of electricity.

If an optimum reaction between gas and oxygen in the fuel cell is to be achieved, the interconnects must not

differ from each other by more than a few hundredths of a millimeter.

Good tools from real experts

The tools for the powder presses come from the Plansee Group's internal toolmaking shop. The 60-strong workforce designs, manufactures and tests some 200 tools each year. Wherever non-cutting manufacturing operations are in use, and not just for manufacturing interconnects.

The Plansee Group's product range is wide and all these applications place similar demands on the tools: They must be precise, long-lasting and accurate every time, above all when several tool changes are expected during long runs.

From small beginnings

The history of the fuel cell interconnects tells a story: 20 years ago, the toolmaking shop built the powder press tool for manufacturing prototypes. The market for these interconnects grew, and the toolmakers are now confronted with the challenge of building complex press tools, dies and multiple operation tools for manufacturing complex finished products. The focus is on automation. "As soon as the quantities produced begin to grow, it is up to us to develop suitable tools to reduce the amount of manual work involved," explains Helmut Gassler, who has been head of the toolmaking team at the Plansee Group for 22 years.

Tough demands on the tools

It is primarily molybdenum and tungsten that need to be processed. And, like chromium, these are high-tech materials, a group of materials that are extremely difficult to form and machine. Ever since it was founded in 1921, the Plansee Group has had its own toolmaking shop. And it is the most complex tools in particular that they are keen to keep in-house. After all, it is not just a question of ensuring absolute quality; speed and flexibility are also needed when the design is changed, for instance. Gassler sees the main benefit of having an internal toolmaking shop as follows: "We are familiar with the entire process and the application

and are therefore able to tailor tools at any time."

Fitted with a multiple operation tool, the punching machine pushes out bended or deep-drawn molybdenum components at a rate of up to 500 strokes per minute. Gassler: "Although it may sound simple, it is the details that are tricky." In order to avoid downtimes, the toolmaking team is on standby 24/7. Across the globe. And frequently for customers outside the Plansee Group. "It keeps us on our toes, so that we can remain competitive in every respect," smiles Gassler. In the fall of 2013, Plansee opened a brand-new plant in Shanghai. The machines come from Chinese manufacturers. But the tools come from Plansee. Helmut Gassler: "It is only our tried-and-tested tools that allow us to deliver Plansee quality for the local Chinese market, quality that is valued by our customers around the world."

Refractory materials

Heat sinks made from molybdenum and copper do a hard job. They are a relatively recent addition to Plansee's product range and dissipate heat from electronic components, for instance in master stations in mobile communications systems. Heat sinks come in a huge variety

of shapes and sizes. And molybdenum is extremely hard, whereas copper is very soft. This demands a cutting and punching tool that delivers optimum surface quality and produces an extremely small burr height when punching the products to the right shape for the customer's application. Helmut Gassler: "Our materials are needed in high-tech industries such as medical engineering, consumer electronics and lighting." The hardness, density and abrasiveness of the materials make them extremely challenging to process. And this makes it a challenging task to achieve the necessary precision. Helmut Gassler sums up the benefits for the customers: "It is only with our own steel and hard metal tools for cold and hot forming that we can manufacture complex components from tough materials such as tungsten or molybdenum with high precision, without running the risk of the workpieces developing cracks or other faults." Pressing, forging, rolling, bending, drawing, cutting, punching or stamping: No matter what the process, the tools from the Plansee Group will continue to tame the tough metals molybdenum and tungsten and shape them to the customer's ends. ■

A glance at the expertise in the toolmaking shop:

- powder press tools • multiple operation tools • cutting tools
- dies • forging tools
- design • calculation • programming • manufacturing • hard turning and milling
- vacuum hardening • surface grinding, cylindrical grinding and profile grinding • jig grinding
- wire EDM and die-sinking EDM • assembly • quality assurance



New plant in China

Dream job and adventure

In September 2013, Plansee opened a plant in Shanghai. Project manager Mathias Hochstrasser takes a look back – and forward to the future.

To start with, it was all just plans. And later, there was a rather boggy building site in a newly developed industrial zone 40 kilometers outside the vast city of Shanghai. All that was needed was someone who could transform the plans of the headquarters in Reutte into an operational factory in China. A dream job? An adventure? A step up the career ladder?

As far as Mathias Hochstrasser is concerned, it was no more or less than an overseas posting. “I wasn’t thinking about furthering my career when I went to China,” says the 31-year old. “Earlier trips to Australia, Canada and Thailand somehow didn’t feel genuine. I have always thought that you have to work in a country to experience it properly. This

is what I have been aiming at ever since I started work.”

Unexpected opportunity.

And his big chance came during annual refresher training with the Swiss Army in Lucerne/Switzerland in February 2011. Hochstrasser remembers: “My boss at the time called me to ask whether I



Planned from start to finish with end-to-end production lines.

would accompany him to China for a supplier evaluation when I had finished the training course.” The details were to follow later. Plansee wanted to build a brand new factory in a greenbelt area to service the Chinese market. It was to concentrate on three groups of products: Heavy metal products for the medical industry, furnace components and crucibles for the LED industry, and tungsten-copper and copper-chromium switch contacts for power transmission and distribution.

Wasted no time

Mathias Hochstrasser had already been in charge of the production line for copper-chromium switch contacts in Seon, Switzerland, for three years and was now going to set up the production line in Shanghai. This was the job for which his boss took him on the first trip to China. The next surprise came only a short while later: The job of project manager for constructing the new plant was advertised on the Plansee Group’s global intranet. Hochstrasser: “I wasted no time in applying.”

A generalist in demand

He may appear a little reserved when you first meet him, but Mathias Hochstrasser has never hesitated at any point in his career. He’s always been at the right place at the right time:

He trained as a polytechnic engineer (machinist) at the power engineering division of ABB, which later became Alstom. Six months were spent in recruit training for the Swiss Army. One year as a programmer for milling centers for turbine blades at Alstom. One year officer training, which he completed at the age of 22. And he is now a captain. He perfected his English and French in Australia and Canada, and in Thailand he polished his Thai boxing skills.

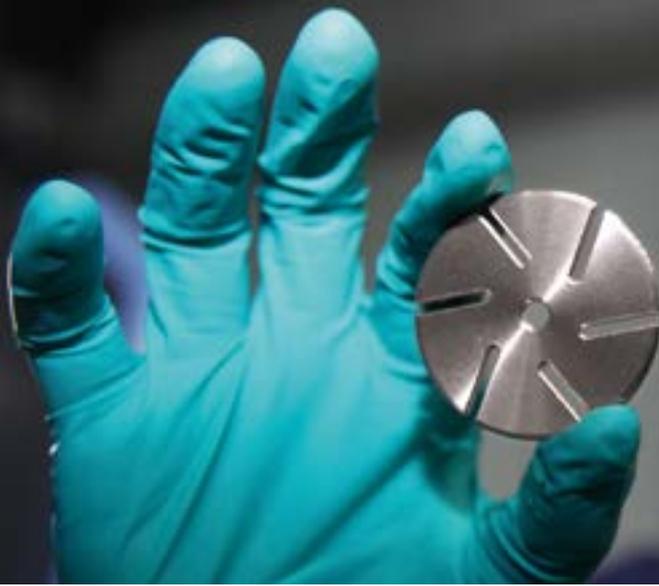
After a year of this, Hochstrasser found himself drawn back to Switzerland. He registered with an employment service and, a day later, was offered an interview with Plansee. “Even though I grew up in a neighboring village, I had not heard of Plansee, a highly specialized factory with a few dozen employees at the time. They were looking for a production planner. Hochstrasser impressed with his knowledge of SAP from his time with Alstom. “At that time, SAP was due to be introduced in Seon. I was a generalist, helping out in a number of different areas and supporting the introduction of SAP. This gave me an insight into the most important business processes.” This was followed by years of strong growth. And as the factory grew, the workforce increased and took on more demanding tasks. From 2008, Hochstrasser took charge of the production line for copper-chromium switch contacts. Alongside his

career, he first studied as an operations engineer for three years at an institute of higher education, followed immediately by a two-year diploma in business administration. During his studies, he reduced his working hours to 90 percent. Plansee allowed him to work flexible hours during this period of training to enable him to take days out for project work and ultimately, his diploma.

Days cannot be planned

As a technician with a knowledge of business administration, he has a good grounding, but is that enough to set up a plant in China? Hochstrasser: “As soon as you start wondering whether you have taken the right decision, you are bound to fail.” And so he left his ▶





Every day, there are new systems to bring online, and new staff to employ and train for the complex processes.

► comfortable life in Switzerland with plenty of leisure time for his hobbies behind him and embarked on life as an expat, arranging his life around his work. With a “serviced apartment” and driver. Days can no longer be planned. Regular weekend shifts. Contact with friends and family via Skype. Intercultural training to prepare him? Hochstrasser shakes his head: “I never went that way,” and is convinced that training of that sort would not have prepared him for solving problems on the site or when visiting suppliers. His experience leading a platoon in a mountain unit of the Swiss Army was more valuable in that respect: “You learn to lead people under difficult conditions and have to deal with all sorts, from football hooligans to doctors.” And he watches how his Chinese colleagues deal with situations and imitates them.

Clear division of tasks

He knows his limitations. “I still don’t speak Chinese,” confirms Hochstrasser. What he means is that as a foreigner you have to adapt to the customs of the country and accept that you will not always understand exactly what’s going on. He believes that it is extremely important to clarify the objectives, to agree on how to go about things and to distribute the various tasks. “Then I have to rely on the employees working

for the good of the company.” And there was plenty of support from the service departments at the headquarters in Reutte. From procurement and engineering through to legal aspects and controlling.

Coordination of the construction work took up a lot of time. The construction site for the former Plansee sales office in the center of Shanghai was some 70 kilometers away. “Day or night, we were always ready to travel out to the site and deal with problems.”

At the same time, suppliers were being selected for the systems and machines. And again, Reutte provided a lot of support. After all, the primary objective of Plansee was to manufacture products locally for the Chinese and Southeast Asian markets in the same Plansee quality that our customers throughout the world have come to appreciate. Staff from the USA, Germany, Austria and Switzerland were heavily involved from the very inception to put everything in place to fulfill these high aspirations. Their work included specifying and selecting the plant and equipment, running in the processes and giving on-site training to the new Chinese workforce that is now nearly 120 strong. And despite all the support, the task in Shanghai is without parallel. Hochstrasser: “The other Plansee plants have evolved over time. Here

in Shanghai we had the opportunity to build a factory from start to finish, where the molybdenum or tungsten powder goes in at one end and the pressed-sintered crucibles come out at the other.” A new technology was even developed for the switch contacts for medium-voltage power distribution applications. This makes it possible to manufacture the components, which withstand high thermal and electrical loads, to their final shape and size. The pressed parts need no further machining.

Seeing the factory really buzz

And even three years after the start of the project, no two days are the same for Hochstrasser. Every day, there are new systems to bring online, and new staff to employ and train for the complex processes. Which is why Hochstrasser recently extended his work permit for China for another five years. “My job here is still not finished,” he says, and constantly has to remind himself that large parts of the plant are still only beginning to ramp up production. “The majority of our production staff has been with Plansee for less than a year and all the manufacturing systems are new. The product and process training laid the foundation for high-quality production. Now I want to see the factory really start to buzz. The next step will then be to optimize the processes.” ■

75 percent

Companies of the Plansee Group in the USA are firmly convinced that medical care must be affordable. In the USA, GTP, Plansee and Ceratizit bear some 75 percent of the basic medical insurance costs for their staff. Employees also receive favorable conditions for supplementary insurance for dental care and eye care as well as support for life insurance.

Well-prepared for the afternoon

At Ceratizit India, eating together at lunch time is an important part of a successful day at work. Around 90 percent of the 200 employees in Kolkata make use of the varied menu on offer. The company bears 70 percent of the cost. There is a huge variety – meat, fish and vegetarian dishes with rice, bread and pulses are available Monday through Saturday.

In-house sports in the prime of life

Sports have a long tradition at the Reutte location in Austria, enjoying high levels of participation. Since 1974, the company and the works council have encouraged the positive use of leisure time to promote good health and improve teamwork among the employees. And 40 years on, the range of sports offered is still as diverse as it was at the beginning. It includes weekly training and annual competitions in football, downhill skiing, cross-country skiing, skittles and summer and winter variants of Austrian curling. Alongside competitive sports, there are regular courses in yoga, tai chi and zumba, back exercises, and body workouts.

A picture of health

Professional training, affordable healthcare or sporting activities: The Plansee Group invests millions of euros each year in well-qualified, healthy, efficient employees.

2500 euros

The 'Fondation Nicolas et Jean-Paul Lanners' sponsors talented young engineers. Worth 2500 euros, the award is given annually by Ceratizit in Luxembourg and is intended to support young engineering students through their degree and to promote interest in studying engineering.



Thesis work

The atomic world of molybdenum

Why do molybdenum products crack?
Katharina Babinsky is investigating this question for Plansee.

Katharina Babinsky is trying to find answers as to why problems arise at grain boundaries in molybdenum products.

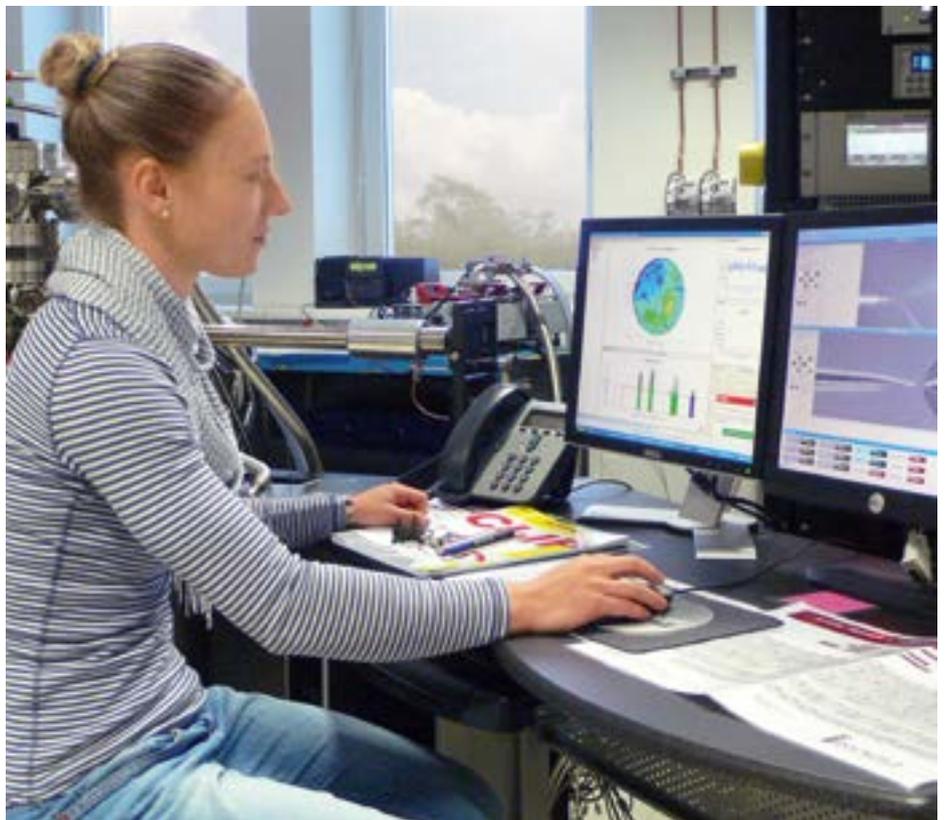
livingmetals: What are the problems that can occur during processing of molybdenum?

Katharina Babinsky: The appearance of cracks at grain boundaries in molybdenum products is the “Achilles’ heel” of this fascinating material. The problem of grain boundary cracks in particular is still not well understood.

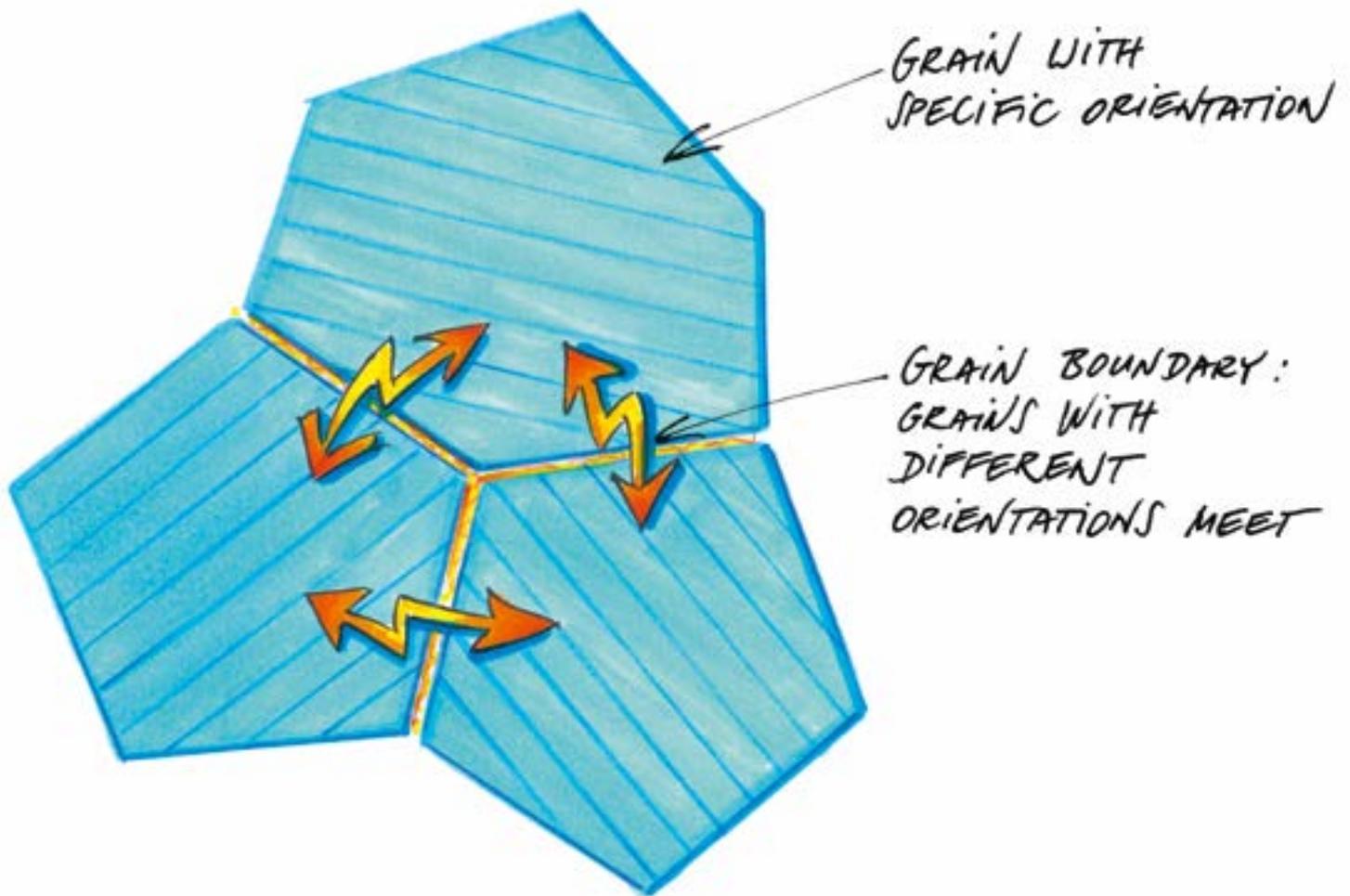
livingmetals: What does grain boundary mean?

Katharina Babinsky: Each metal has a well-defined crystal structure. In the case of molybdenum, it is a so-called body-centered cubic system. At the microscopic level, every metal consists of individual grains with different orientations of these crystals. However, the orientation difference between two adjacent grains causes a misorientation at the interface. This misorientation area is termed “grain boundary”.

livingmetals: So what is the exact problem at grain boundaries?



Katharina Babinsky works at the Department of Physical Metallurgy and Materials Testing at the Montan University of Leoben/Austria. Her Ph.D. thesis is aimed at understanding grain boundaries in molybdenum and their properties. Babinsky presented the results of her diploma thesis on the same topic at the 18th Plansee Seminar 2013 in Reutte.



Katharina Babinsky: This misorientation induces a small mismatch in the crystal structure. We assume that these regions tend to favor the accumulation of impurities. These impurities may weaken the bonds at grain boundaries and therefore influence the mechanical properties by causing so-called intercrystalline fracture.

livingmetals: So your work is focusing on the nature of grain boundaries?

Katharina Babinsky: I isolate tiny conical-shaped samples out of the bulk material containing single grain boundaries in their volumes. Later on, these needle-shaped specimens with a tip radius of less than 100 nanometers are analyzed in an atom probe.

livingmetals: What is an atom probe?

Katharina Babinsky: In simple terms, it is possible to detect individual atoms with the atom probe. For a successful measurement, the sample has to be cooled down to 60 Kelvin (-213 °C) and a high electric

field is applied. With additional voltage pulses individual atoms from the apex of the tip are evaporated and accelerated towards a position-sensitive detector. This technique enables analyses of a volume of around $100 \times 100 \times 200 \text{ nm}^3$, which contains a few millions atoms. With a time of flight mass spectrometer and a position-sensitive detector, it is possible to determine the type and location of the atoms in the sample. With this method we are able to acquire precise information about the type of atoms which are present at grain boundaries.

livingmetals: What are the beneficial aspects of your investigations for commercial use?

Katharina Babinsky: The application engineers at Plansee and their customers want to know how to improve the mechanical properties of semifinished products made from technically pure molybdenum. They want a clear understanding of how microstructural changes to the material or the manufacturing process affect the

material's properties. For that reason, I am investigating the positive and negative effects of impurities at grain boundaries and furthermore, what types of grain boundaries are likely to include impurities. ■



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talented young people. The Plansee Group wants to secure the loyalty of talented young people as early as possible. Students gain an insight into day-to-day professional life and obtain some initial experience of their future field of activity during their hands-on thesis work. It is quite common for postgraduate students to open up new areas of development and productive work, and in the process secure their future jobs. 193 interns and postgraduate students were working for the Plansee Group worldwide in 2013.

Good neighbors

Help and support that really makes a difference: How staff at our production plants across the globe are getting involved with people and projects in their neighborhood.

London to Paris

42 members of staff from WNT in England, Italy, France, Germany, the Czech Republic, Hungary and Poland met up near London to take part in the London to Paris charity bike ride to raise money for the “British Heart Foundation”. Together with teams from other companies, the aim was to cover the 300 kilometers and 1000 meters of climbs in three days. The riders from WNT spent weeks training to prepare themselves thoroughly. The fruit of their labors was a donation to the value of 17,000 euros.

Learning after dark

Ceratizit India supports a number of organizations working for children in need. Managing Director Ashwani Sareen explains the background: “We feel obliged to share our good fortune with others. We make sure that the support we provide goes directly to the people in need. It is important to us that we are not only donating money, but also things that are really needed. For example, we support ‘Children In

Need India’. They help to provide children in need with health care, good nutrition and education. This year, we made it possible for children to attend school and gain the qualifications they will need in the workplace. Among other things, we distributed books, dictionaries and clothes. And to allow them to study in the evenings, we have installed 60 solar lamps.”

Donations in place of gifts

Staff at Günther Wirth in Balzheim, Germany, have donated 4500 euros to the St. Nikolaus children’s hospice. To do this, they chose to forgo Christmas gifts. Apprentices created information boards explaining the work of the hospice: If a child is diagnosed with an incurable, life-shortening illness, the hospice provides families with a short respite from the challenges of caring for their child, and allows them to

recover from the demands of daily family life. Because the costs of a stay are not fully covered in Germany, the hospice depends on donations. And staff at Ceratizit Italia also believe that it is more important to donate than to give Christmas gifts. At Christmas, 2013, they donated to help the organization “La Nostra Famiglia” to purchase a minibus. “La Nostra Famiglia” especially helps people with disabilities.





Little rascals in the research center

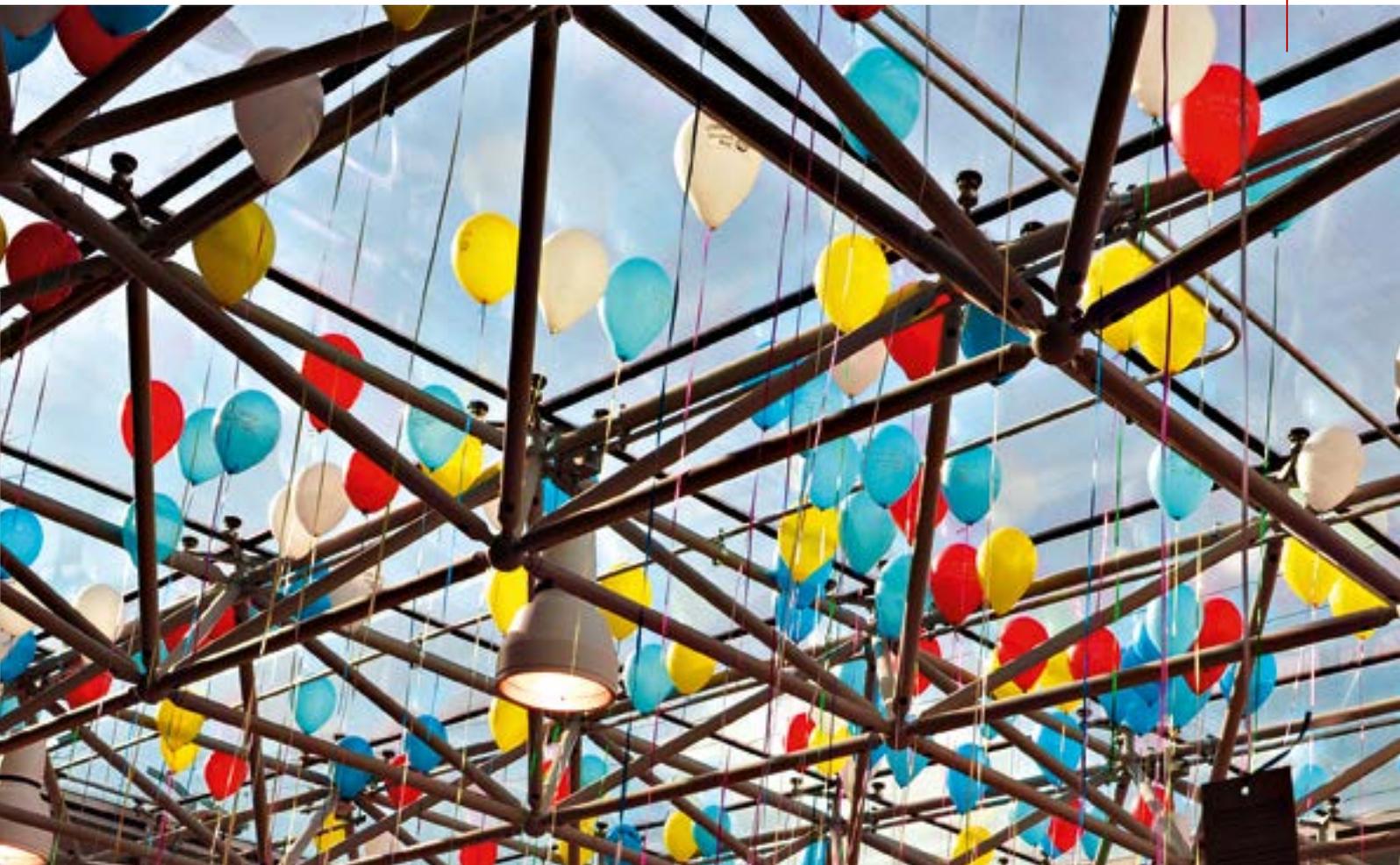
Ceratizit Germany is introducing pre-school children to science and technology by play and has been supporting “The Little Rascals” kindergarten for many years. In a discovery corner, the children experiment with light, air and magnets. The apprentices at Ceratizit also invite the kindergarten once a

year and show them how to use drills, bending tools and milling tools. Last year, the apprentices prepared a special surprise: Equipped with work shirts and safety goggles, the apprentices and the children assembled the aluminum parts of a small locomotive.

Balloons for a good cause

Every year, GTP’s employees donate a part of their salary to “United Way” to support families in need in Bradford, the county in which their township is located. Last year, they raised more than 50,000 dollars in this way.

United Way provides support to more than 44 associations that have instigated a range of aid programs. In order to encourage donations, GTP held a balloon event. Every employee could buy balloons and write a message on a card. Then hundreds of balloons were launched in the atrium at GTP. Guests and employees were able to read the messages.





Digital projection lamps

A real movie experience with tungsten

For more than 100 years, the movies have been about popcorn and grand emotions. But the technology has changed beyond recognition. It was only a few years ago that operators had to heave heavy reels of film onto the projectors. Nowadays, the latest Hollywood blockbuster is copied to tiny hard discs and inserted in the projector, all ready to roll. Another revolution is much better light that comes from xenon short-arc lamps in almost all the movie theaters around the world. The lamps generate a lot of light in a small space as a result of gas discharge between two tungsten electrodes. This not only generates temperatures in excess of 3000 °C, but also creates that magic light that is needed to transform moving pictures into a real movie experience.



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