

FACTS

INCREASING PRODUCTIVITY IN TOOL AND MOLD MAKING

**COORDINATED
HIPIMS AND DIAMOND COATING SOLUTIONS
FOR THE PRODUCTION OF ELECTRODES,
INJECTION MOLDS, DIES, PUNCHES AND MORE
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FOR LAFER

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AN INTERVIEW WITH THE EXPERT
PROF. DR.-ING. JÜRGEN RAINER HIRSCH

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“Investment in our technology and our employees has made us the **TECHNOLOGY LEADER** in HiPIMS and **DIAMOND COATINGS**. The increased adoption of our **HiPIMS** coating technology by **TOOL MANUFACTURERS** across the U.S. further expands its reach and proves the advantages it provides to our customers. Continued **ADVANCEMENTS** will allow us to both strengthen our position in the marketplace and increase the **CUTTING TOOL INDUSTRY’S** reliance on HiPIMS as a whole.”

Jeffrey Barlow,
2022 President CemeCon Inc.



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COORDINATED HIPIMS AND DIAMOND COATING SOLUTIONS FOR THE PRODUCTION OF ELECTRODES, INJECTION MOLDS, DIES, PUNCHES AND MORE

INCREASING PRODUCTIVITY IN TOOL AND MOLD MAKING

The market situation in tool and die making is more dynamic than ever. Changing markets, ever smaller batch sizes, individual products, continuously increasing quality requirements and shorter development times – the challenges for tool and die makers are manifold. In order to manufacture molds and tools more efficiently, flexibly and economically, processes are being optimized and automated, for example. An essential part of this are high-performance cutting tools for producing the erosion electrodes or for milling the molds themselves. CemeCon has the right premium coating on hand for all cases, making it the ideal partner for tool manufacturers whose customers are active in tool and mold making.

MILLING INJECTION MOLDS, STAMPS ETC.

Increasing competitive pressure is omnipresent in the tool and die industry. For the longest possible service life, the punches, dies and injection molds used in many cases are primarily made of hardened steels and carbide. In order to reduce rework, precision parts are produced in their final dimensions as far as possible. Accordingly, narrow tolerance ranges are specified. Tool and die makers have to react quickly and flexibly, because the high level of product individualization always requires new solutions.

ALWAYS THE SUITABLE COATING FOR MOLD AND DIE MAKERS

For the production of injection molds, tool and mold makers today rely not only on die-sinking EDM with copper or graphite electrodes, but also on direct milling thanks to technological advancements. Which process is used depends, among other things, on the requirements, such as the complexity of the contours, and also on the available resources: "All machining options have one thing in common: Only high-performance cutting tools can meet the requirements for precise, economical and process-reliable production. This applies both to the production of the electrodes from graphite or copper and to the milling of the steel or carbide itself," says Manfred Weigand, Product Manager Round Tools at CemeCon. "With our HiPIMS and diamond coatings, we offer the suitable solution for every application."

For hardened (≥ 50 HRC) and stainless steels

Coating material:
SteelCon®
Coating technology:
HiPIMS
Composition:
TiAlSiN or TiAlN/TiSiN-based
Color:
Red gold
Max. operating temperature:
1,100 °C

For carbide

Coating material:
CCDia®CarbideSpeed®
Coating technology:
Diamond
Composition:
Multilayer, sp^3
Color:
Grey glossy
Max. operating temperature:
650 °C

For unalloyed, alloyed and high-speed steels

Coating material:
FerroCon®
Coating technology:
HiPIMS
Composition:
AlTiN-based
Color:
Anthracite
Max. operating temperature:
1,100 °C

For stainless and medium-hard steels, titanium

Coating material:
InoxaCon®
Coating technology:
HiPIMS
Composition:
TiAlSiN-based
Color:
Red gold
Max. operating temperature:
1,100 °C

MILLING ELECTRODES (DIE SINKING)

For copper, aluminum, titanium and other non-ferrous metals

Coating material:
AluCon®
Coating technology:
HiPIMS
Composition:
TiB₂-based
Color:
Silver
Max. operating temperature:
900 °C

For graphite, carbide green compacts and ceramic green compacts

Coating material:
CCDia®CarbonSpeed®
Coating technology:
Diamond
Composition:
Multilayer, sp^3
Color:
Grey glossy
Max. operating temperature:
650 °C

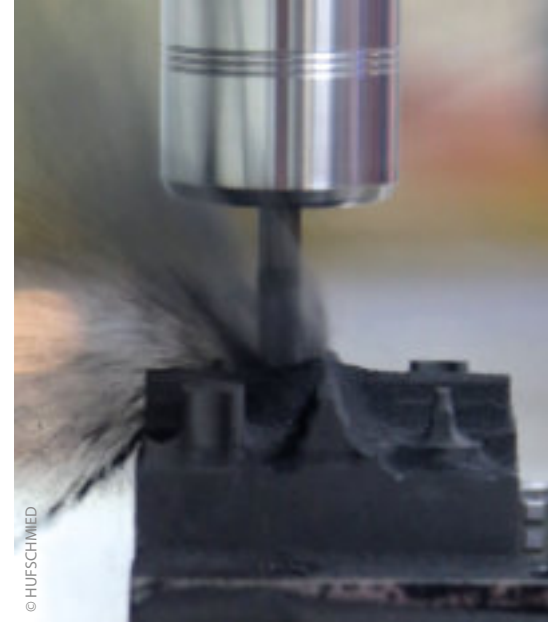
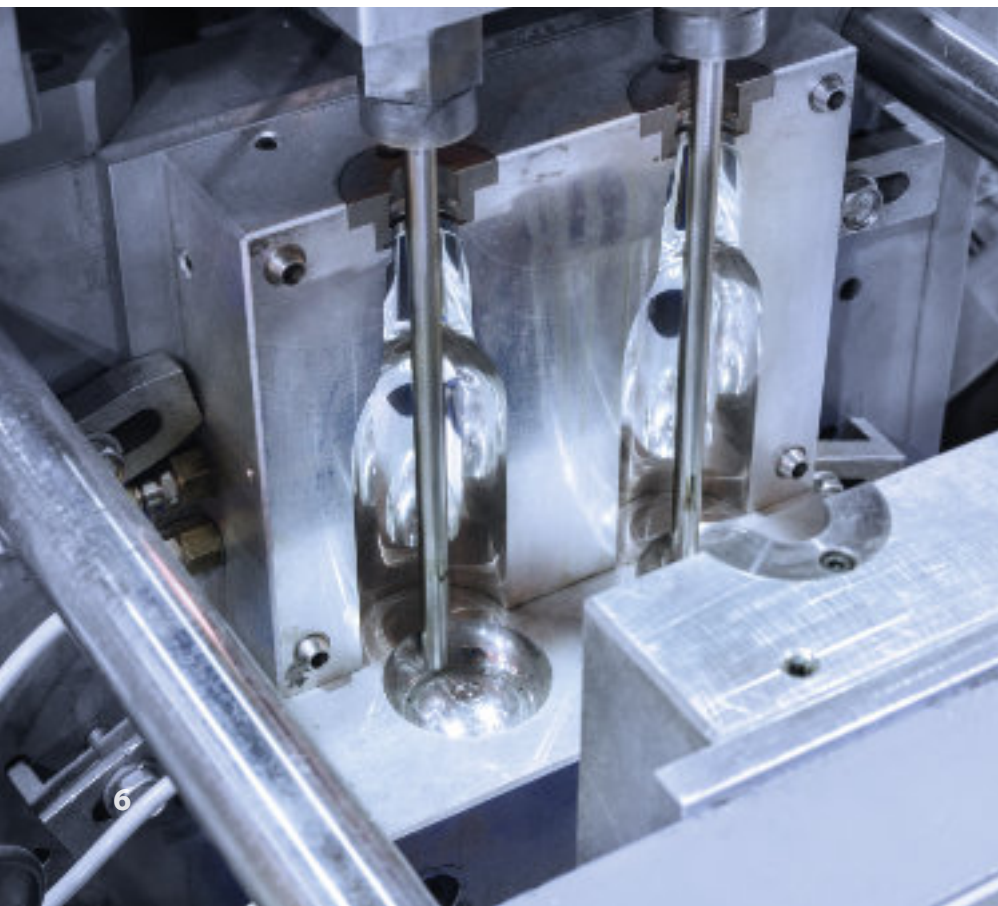
PREMIUM SUPPORT FOR PREMIUM COATINGS

Whether it is during the manufacture of the end product, i.e. injection molding, or during mold construction itself – if anything does not run optimally, the mold manufacturer is in demand as a problem solver. CemeCon supports the companies with advice and assistance in finding the right solution. Manfred Weigand: “Close cooperation with the tool manufacturers is the be-all and end-all in designing the proper coating for a specific application. And we go even further: users – i.e., mold and die makers as well as injection molding experts – are also important sources of information in the engineering process. Because the more we know about the application of the mold and thus of our premium coating, the better we can

optimally match all parameters – pretreatment, coating material, specifications such as coating thickness and finish – to each other, the mold and the requirements. In this way, the precision tools achieve the best performance, long tool life and outstanding results.”

Those who have their tools coated at CemeCon not only find the best solution for every application, but also have other advantages. Whether HiPIMS or diamond – customers always have the same contact persons who know all products in detail and can thus provide competent advice. In addition, both diamond and HiPIMS coating systems are available at the Würselen coating center. This reduces the logistical effort and thus saves time and costs. This also applies to the CemeCon coating centers on the other conti-

SteelCon® achieves best performance when machining hardened steels



Diamond coatings from CemeCon offer the ideal solution for milling graphite electrodes

nents. Mirrored processes and productions worldwide always enable the same coating in the same, accustomed quality.

WEAR-RESISTANT AND LUBRICATING COATINGS FOR INJECTION MOLDS

In addition to the coating of cutting tools, the CemeCon technology is also ideal for extending the service life of highly stressed tools, injection molds and components. The expert for this is CemeCon Scandinavia. Ewa Bienk, Product Manager Mold & Die at CemeCon Scandinavia, says, “Our super-hard and thin ceramic coatings increase wear and corrosion resistance, improve demoldability, reduce sticking and thus release agent requirements, and enable dry running. Product quality increases and there is less scrap. Maintenance and cleaning are also minimized, and maintenance intervals are extended. Thus, our coatings are the key to higher productivity, reduced manufacturing costs and improved competitiveness.”

LEAD IN HARD MACHINING SECURED

With Italy's largest coating service in Piacenza, Lafer SpA has been supplying coatings at the highest level for a wide range of industries for over 30 years. From the very beginning, the company has relied on CemeCon technology to coat cutting tools. In search of a high-performance solution for hard machining, Lafer has now taken its long-standing collaboration to the next level with HiPIMS technology.

Food packaging, medical consumables such as syringes, or connector housings for electrical components – molds for injection molding are needed for a wide variety

of areas. So it's no wonder that mold and die manufacturing is booming worldwide. Economical solutions for hard machining of hardened steels are therefore

more in demand than ever. Lafer, too, was looking for a high-performance coating that would give its experts an edge in this market.



With HiPIMS technology, Lafer has taken the long-standing collaboration with CemeCon to the next level

THE SOLUTION FOR HARD MACHINING: HiPIMS

"In addition, we were approached by a well-known tool manufacturer who, despite having its own coating competence within the company, was not getting anywhere with the processing of hardened steels. We finally found the solution in the HiPIMS coating system from our long-standing partner CemeCon," reports Primo Civardi, head of coating production at Lafer for 20 years and member of the management board.

To be really sure that they had found the best solution, Lafer tested HiPIMS intensively both in-house and externally using the latest measuring technology. The result: when it comes to hard machining in tool and mold making, there is nothing better than the HiPIMS coating material SteelCon®.

Lafer has added the HiPIMS coating material to its portfolio under the name Coral HiPIMS and adapts the coating to the respective precision tools of its customers.

In addition to producing established coatings, Lafer's experts can also develop their own coatings with the in-house coating line. This may sound complicated to some ears, but with CemeCon technology it is quite simple. The open architecture of the HiPIMS machine and full access to all HiPIMS parameters offers complete



© Lafer

Lafer Spa



Lafer SpA, based in Piacenza, was founded in 1986 and is today, thanks to steady growth, the largest coating center in Italy. On an area of 5,000 m², 120 employees produce high-quality PVD and CVD coating solutions for components, tools and molds. The "Lafer Method" means finding the best solution for each application thanks to many years of experience and know-how, offering the customer the excellence for which Lafer is well-known. The research and development department is constantly looking for new technologies to further improve the quality of the coatings offered. Lafer's customers come from a wide variety of industries: mold and die, aerospace, medical, automotive, racing, food technology, and mechanical engineering.

www.lafer.eu

flexibility in tailoring coatings. At the same time, the processes are so well anchored and automated in the control system that (almost) anyone can handle them. The corresponding training for this is part of the CemeCon technology package.

SERVICE LIFE 50 PERCENT HIGHER

Coral HiPIMS significantly improves the performance of carbide cutting tools when machining medium and high strength steel.

The HiPIMS coating is smooth, tough, hard and wear-resistant. This reduces machining time and a better surface finish can be achieved.

Alessandro Bertè, R&D Manager at Lafer, comments: "Machining steel with 62 HRC with a ball end mill is the classic high-end application in tool and die making. Perfect, therefore, to compare our coating with other solutions. The result was amazing and exceeded all our expectations: The tool life of the cutters with Coral HiPIMS was 50 per-

cent higher than with all other tools – and with excellent surfaces. We are thrilled!”

What makes the new coating so successful and powerful? HiPIMS! The combination of the high hardness and toughness is unique. The hardness results from the chemical composition (AlTiSiN). The toughness originates from the new physical properties of the dense coating – this is only possible with HiPIMS.

ENORMOUS POTENTIAL FOR THE FUTURE

“We want people to be able to recognize these exceptional coating properties directly from the name. That’s why our new coating is not simply called Coral, but Coral HiPIMS,” adds Primo Civardi. “With Coral HiPIMS, we have created a unique selling point for ourselves. It allows us to tap into completely new business opportunities in tool and die making. For us, HiPIMS is the breakthrough technology of the future. It is a milestone in our growth strategy.”

Encouraged by the extremely positive machining results, Lafer also sees enormous potential with HiPIMS technology in titanium machining for aerospace applications. Coral HiPIMS is a promising start into new markets. We are looking forward to the things yet to come!

ON THE WAY TO YOUR OWN PREMIUM COATING

Pretreatment of the tools

+

The right coating material

+

The best coating system

☰ Turnkey coating line

+

Technology transfer

☰ 100 % competitive advantage



THE TECHNOLOGY PACKAGE

On request, CemeCon supplies the complete package consisting of substrate pretreatment, coating system and added periphery. The unit of plant engineering, proven process and training of employees in a CemeCon coating center not only facilitates manufacturers to enter the coating technology. It also makes the difference from any other technology supplier!

TECHNOLOGICAL EDGE WITH CEMECON HiPIMS

HiPIMS is the future of PVD coatings. The market agrees on this. The technology combines the advantages of all common coating processes. With CemeCon HiPIMS, tool manufacturers and machinists can open up even greater potential.

WHAT MAKES HiPIMS SO SPECIAL?

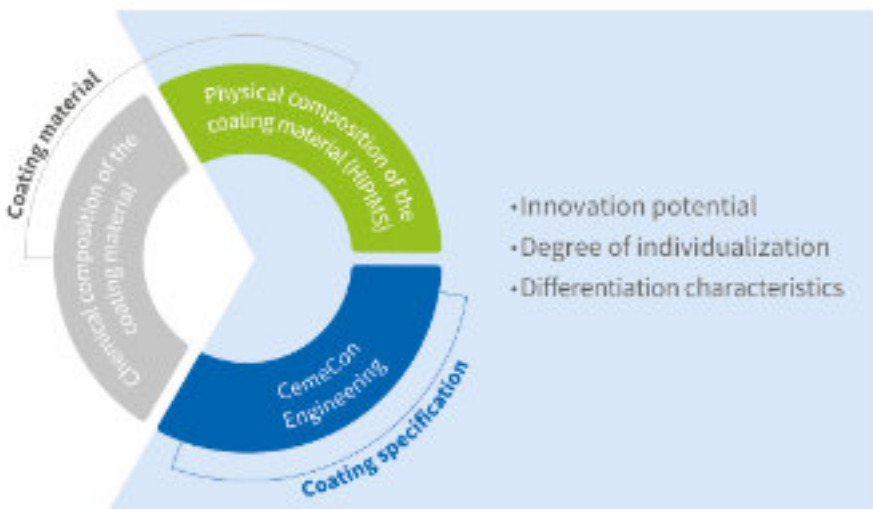
HiPIMS enables the unique combination of the chemical composition of a coating material and new physical properties that are only possible in this form with HiPIMS. HiPIMS coatings are extremely smooth, exceptionally hard and tough at the same time. They have a dense, fine-grained structure, and low compressive residual stresses.

The new combination of hardness and at the same time finely balanced toughness is terrific and makes HiPIMS coatings powerful. Why is this combination so important? Dr.-Ing. Christoph Schiffrers, Product Manager Technology, explains: "If hardness were the only decisive factor, glass would be the ideal coating material. Glass is hard – but also very brittle. Especially in interrupted cutting in milling applications or in grooving, the constant, periodic

peaks of cutting forces on the surface damage any traditional coating that is only hard. This is even more true the smaller the tool. Combined with high toughness, the coating resists the stress."

Since HiPIMS is the logical further development of sputtering, there are no droplets due to the process: This means extremely smooth surfaces without defects in the coating. The technology is very flexible: Almost any coating composition – including TiB₂, for example – can be applied to any substrate, including CBN and ceramics. A wide variety of tool types can be coated. The HiPIMS flexibility ranges from very thin coatings on micro tools to insert coatings with a layer thickness of 12 µm.

CemeCon has tailored the combination of positive properties specifically to the requirements of cutting tools. In joint engineering with the tool manufacturer, the CemeCon experts then match the premium coating precisely to the requirements so that it combines with the substrate and geometry to form an optimum



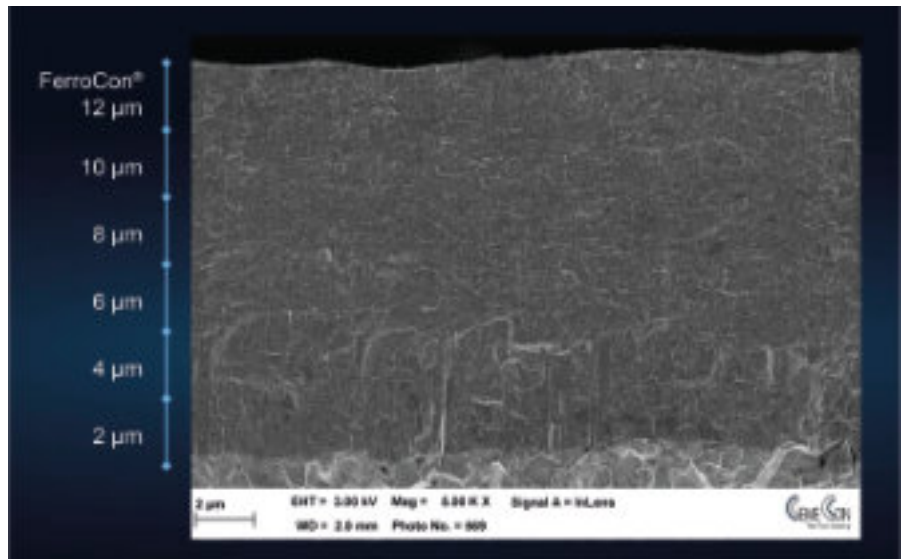
Securing unique selling points with HiPIMS: new physical properties redefine the coating properties

machining solution for the respective application. To do this, they adjust various parameters: in addition to the coating material, also coating thickness, tolerance, pretreatment, finishing and much more. The process steps are sensibly combined and precisely adapted. The result is a customized coating solution. Those who want to precisely design their own innovative coatings to their precision tools with an in-house coating line have full access to all HiPIMS parameters with the CC800® HiPIMS. This enables a high degree of individualization and differentiation from the competition.

WHICH FURTHER ADVANTAGES DOES CEMECON OFFER?

Unlike other processes, HiPIMS uses high-energy power pulses. New and more finely adjustable set screws support the design of a coating solution. The power can be tailored specifically to the tool. CemeCon is constantly optimizing its HiPIMS technology: "Our HiPIMS technology works so well because we build our pulse generators ourselves, and have geared the machine precisely to coating cutting tools. We have a coherent overall concept," adds Dr.-Ing. Biljana Mesic, Technology Development Manager PVD.

Whether in the coating service or with an in-house coating system – the CemeCon experts support tool manufacturers in the design of a dedicated coating solution



HiPIMS makes it possible: the dense layer structure is a quantum leap in coating for cutting tools

A particular CemeCon advantage is the synchronization of the HiPIMS pulses with the substrate table, where the coating grows purposefully on the tools. This reduces residual stresses significantly and enables much thicker coatings than with any other known process – an enormous plus for performance in many applications. The benefit for small and very small tools: sharp cutting edges can be finished with a dense coating with low residual stresses in a process-safe manner.

Christoph Schiffers: "HiPIMS may sound complicated at first glance –

we have perfected this fascinating technology for cutting tools and stored it in the control system in such a way that users can handle it automatically. Anyone can do it. Operation is as simple as, for example, the brake in a car: The driver simply steps on the brake pedal and the ABS works automatically without any action on the part of the user. This is high-tech that adds value for the customer. Just like HiPIMS: The incomparable properties of the dense layer structure are a quantum leap in the coating of premium tools."



THE FUTURE IS ALUMINUM

Electromobility, classic vehicle construction, aerospace, construction, mechanical engineering, electronics, air conditioning and solar technology, packaging and more – we encounter aluminum almost everywhere. From smartphones to bicycles to garden chairs, there is hardly an area of technology and daily life in which aluminum products are not used. And the potential is far from exhausted. According to numerous forecasts, the use of the light metal will continue to increase. An opportunity for machinists and tool manufacturers to open up new markets.

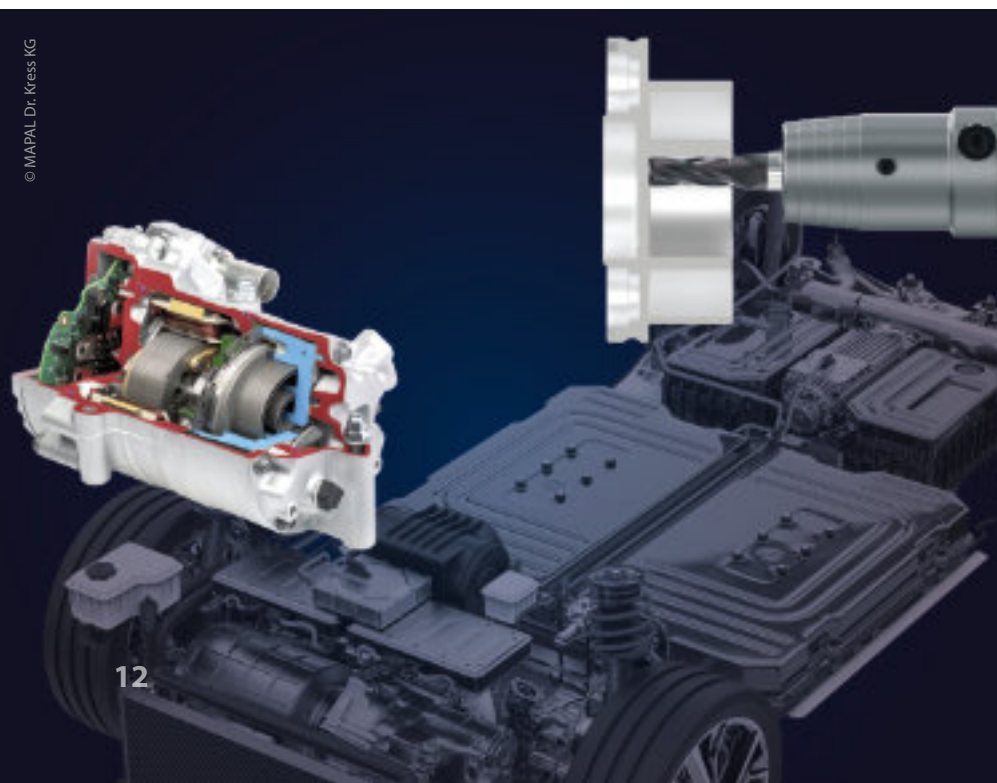
Prof. Dr.-Ing. Jürgen Rainer Hirsch, Associate Professor at the Institute of Physical Metallurgy and Metal Physics at RWTH Aachen University and one of the world's leading experts on the light metal, is convinced that aluminum is the material of the future. But what's the reason for that? "For one thing, as the third most abundant element in the earth's crust, it is available in almost unlimited quantities. And for another, it is very easy to recycle – often without any loss of quality. Around 75 per-

cent (approximately 750 million metric tons) of the aluminum ever produced is still in use today and forms a resource bank for the future. In the process, remelting requires only 5 percent energy and metal loss is low," Hirsch says. "This large availability is important because of the excellent material properties: Aluminum is very light – only one-third the density of steel – and, as an alloy, extremely strong and resilient. It is easy to form and process, immediately forms a protective oxide layer

when scratched, and conducts electricity and heat. It can therefore be used in a wide range of applications: Wherever weight savings, protective function, stability and corrosion resistance are required, aluminum is the first choice."

The strongest growth market for the use of aluminum at present is the transportation segment, followed by construction, electrical applications and packaging. Aluminum is the ideal lightweight for signifi-

Electromobility, aerospace, electrical engineering, machinery and more – aluminum is the material of the future



Prof. Dr.-Ing. Jürgen Rainer Hirsch



Numerous research and development projects in his professional career have made Prof. Dr.-Ing. Jürgen Rainer Hirsch one of the leading experts on all aspects of aluminum. He began his studies in metallurgy at RWTH Aachen University. His graduation was followed by a doctorate and post-doctorate. After a 10-year university career, he moved to the aluminum industry (Alcoa, VAW, Hydro). Since 2001 he has been an adjunct professor at the Institute of Physical Metallurgy and Metal Physics at RWTH Aachen University.

Today, with his company Aluminium Consulting, the internationally recognized scientist advises companies on aluminum metallurgy, production, use and the like for a wide range of applications, and also offers further training on the subject of aluminum materials. Hirsch is, among other things, senior scientist and consultant for SPEIRA Aluminium GmbH in Bonn and CTO of HoDforming GmbH in Düsseldorf (www.hodforming.com). He is involved in various industry and university committees and is co-founder and co-author of the e-learning tool "AluMatter".

cantly reducing the weight of aircraft, cars, buses, trucks, trains and ships without compromising safety. Compared with steel components, for example, aluminum components usually weigh only half as much. This reduces fuel consumption and CO₂ emissions. It also improves handling. It's no wonder that the light metal is used almost everywhere in vehicles – from the body, tailgates and doors to chassis, engine blocks, cylinder heads, transmissions and rims.

Aluminum is also playing an increasingly important role in electromobility. Jürgen Rainer Hirsch says, "Weight reduction through aluminum is a cost-effective way to extend the range of the electric vehicle and will thus become a key factor for electric vehicles to achieve market

acceptance, growth and profitability. The metal's good thermal conductivity also makes it ideal for manufac-

turing battery trays, as it allows for better temperature control."

THE RIGHT ALLOY FOR EVERY APPLICATION

In order to meet the different requirements, the chemical composition and processing of aluminum alloys are adapted to the respective application. The mechanical properties of Al alloys differ significantly from those of pure aluminum. In particular, tensile strength and yield strength are significantly increased by adding elements like magnesium (Mg), silicon (Si), manganese (Mn), zinc (Zn) and copper (Cu) (R_m 300 to 700 mPa).

The naturally hard Al-Mg alloys are used, for example, as sheet metal moldings and structural parts in au-

AT A GLANCE: ALUMINUM...

- is very light (specific weight of 2.7 g/cm³);
- is stable and resilient (alloys e.g. with Mg, Si, Cu, Mn have tensile strength R_m up to 700 MPa);
- is very corrosion resistant;
- is a good conductor of heat and electricity;
- has good reflective properties for heat and light;
- can be formed and processed well;
- is impervious, non-toxic and odorless;
- does not burn (only as a very fine powder);
- is available in almost unlimited quantities;
- is easy to recycle.

tomotive chassis and body-in-white, as well as high-speed ships. The most important materials for general lightweight construction, for example for sheet-metal formed parts as exterior parts of the automobile body, are the age-hardenable Al-MgSi alloys. They are also particularly suitable for the production of complex shapes, for example for applications in the construction industry, in electrical engineering and in many everyday objects as well as, for example, in rail vehicles such as the ICE trains 1 to 3.

Al-ZnMg alloys without copper can absorb energy well and are therefore increasingly used in crash elements and bumpers in automotive construction. Due to the high demands on material quality, design and processing, high-strength Al-Cu and Al-ZnMgCu alloys are used in the construction of aircraft and spacecraft, but also in tool and mold making

“With very **SHARP CUTTING EDGES**, aluminum can be machined well in principle, but it tends to **BUILT-UP EDGES**. In addition, different alloy components also require different **COATING SPECIFICATIONS**. Some alloys are more easily machinable than others. Matched **PRECISION TOOLS** ensure the **BEST MACHINING RESULTS.**”

Prof. Dr.-Ing. Jürgen Rainer Hirsch

and in the production of fasteners such as screws and rivets.

MACHINING ALUMINUM FOR HIGH QUALITY

“Cast aluminum alloys are very easy to cast. That is probably also the reason why they are so frequently used in lightweight construction. Around 80 percent of all aluminum castings in Germany are made from recycled aluminum. The material meets high requirements in terms of strength

and toughness, for example for safety parts in vehicle construction. The most important component is probably the silicon (Si) for high flow and mold-filling properties,” says Hirsch. Often, these castings have to be reworked using machining operations to improve the accuracy of fit.

In principle, aluminum can be machined using all metal-cutting processes. This is particularly important in aircraft construction. Here, for safety reasons, very high demands

With very sharp cutting edges and coordinated coating solutions, users achieve long tool lives and excellent machining results in aluminum machining



AluCon® – perfect for machining aluminum

are placed on the components, of course. For this reason, smaller components are often not simply joined by welding, but the complete component is milled from the solid. Cell phone shells are also made of traditional aircraft alloys and are produced by milling. This is because very smooth surfaces are required for perfect haptics. This is only possible in this quality with machining.

BUT WHAT IS IMPORTANT TO CONSIDER IN THE MACHINING OF ALUMINUM?

With very sharp cutting edges, aluminum can be machined well in principle, but it tends to build up. In addition, different alloy components also require different coating specifications. For example, an aluminum alloy with silicon can be machined better than one with lithium. That's where special solutions are needed. "That's why it's so important that we, as coating experts, also keep ourselves constantly up to date on material trends, tool geometries and machining strategies and work together with experts from a wide variety of sectors. Because only if we know where and how our coatings are used can we develop solutions precisely tailored to the application. The basis and 50 percent of a coating are our coating materials, such as AluCon®. The other 50 percent is made up of various factors, such as coating thickness, tolerance, pre-treatment, finishing and more. Such coordinated solutions then ensure long service lives, excellent machining results and economical production," adds Manfred Weigand, Product Manager Round Tools at CemeCon.

The HiPIMS coating material AluCon® is based on TiB₂. The low affinity to non-ferrous metals and the high hardness make the coating materials such a success in the machining of aluminum, copper and titanium. The HiPIMS process ensures high coating adhesion, density and hardness.

Thanks to the coating thickness of 2 µm and the fine crystal structure, AluCon® is particularly suitable for aluminum machining with sharp cutting edges. The HiPIMS coating material provides excellent protection against built-up edges. The extremely smooth coating surface ensures optimum chip removal. Thanks to the reduced friction, the temperature in the cutting process is reduced. The dense, closed layer structure also successfully reduces diffusion and thus wear at high operating temperatures. The result: significantly longer tool life. The very good adhesion coupled with the high hardness of 5,000 HV_{0.05} and better ductility enables top performance in wet and dry machining – and that with increased cutting data. Thus, tools with an AluCon® coating achieve top performance when machining aluminum, copper and titanium.

Materials:

Aluminum, titanium, copper and other non-ferrous metals

Composition:

TiB₂-based

Max. operating temperature:

1,000 °C

Color:

Silver

Coating thickness:

2 µm

Tool types:

Drills, milling cutters, reamers, threading tools and cutting inserts





“We have perfected our **HiPIMS TECHNOLOGY** for **CUTTING TOOLS** and stored it in the control system in such a way that users can handle it automatically. Anyone can do it. **OPERATION** is as **SIMPLE** as, for example, the brake in a car: The driver simply steps on the brake pedal and the ABS **WORKS AUTOMATICALLY** without any action on the part of the user. This is **HIGH-TECH** that **ADDS VALUE** for the customer. Just like HiPIMS: The incomparable properties of the dense layer structure are a **QUANTUM LEAP** in the coating of **PREMIUM TOOLS.**”

Dr.-Ing. Christoph Schiffers, product manager technology
(read more on page 10/11)

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TRENDSETTER AT IMTEX



“In India and Southeast Asia, the economic upswing is tangible – also in the machining sector. Tool manufacturers are looking for ways to hold their own in the global growth markets. They want to reinvent themselves and develop further. This was also clearly noticeable at IMTEX 2023. The CemeCon coating technology offers them a sustainable investment with which they can react flexibly to the challenges of today and tomorrow. In this way, they secure competitive advantages, for example, in heavy machining, e-mobility, tool and mold making, medical technology and smartphone processing,” says Manish Adwani, Managing Director CemeCon Coating Pvt. Ltd. Manish Adwani (r.) from Germany received active support at IMTEX (from right): Dr.-Ing. Toni Leyendecker, CemeCon Supervisory Board Chairman, Dr.-Ing. Christoph Schiffers, Product Manager Technology, Dr.-Ing. Beate Hüttermann, CMO, and Christoph Heller, Sales Manager.