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formnext magazine



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Kim Francois'  
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China  
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Heygears expands  
to 320 employees  
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The best time  
to plant a tree was  
20 years ago.  
The second-best  
time is now.

[ Chinese proverb ]

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## EDITORIAL

Since the global outbreak of the Covid-19 virus, it has taken just months – or mere weeks, in some regions – for our world to undergo fundamental changes. As people everywhere fight to prevent the further spread of the coronavirus, these events have demonstrated AM's pivotal role in saving lives. Our community has provided real assistance by quickly coming up with solutions in simple, selfless, and transcendental ways. We'd like to take this opportunity to thank them all for their work.

Meanwhile, the coronavirus has also led to some dramatic developments with regard to the overall economic situation. The lockdowns many countries have imposed have brought companies' operations to a standstill almost overnight; in some areas, this has caused supply and demand to plunge. It will take time and effort on all our parts for the world's economic activity to recover. On the other hand, new opportunities are also arising – including for AM.

We're also starting to rethink our working lives, which are now taking place largely in the digital sphere. With the right digital tools, working from home is proving very viable, indicating that hybrid models of home- and office-based employment will be the future of work. The same applies to trade fairs, as well. People are social creatures that will find their way back together to organize such events and experience them in person. That said, digital offerings designed to complement physical events all year round will make the difference in trade fairs

from this point forward. Both formats present their own advantages, and Formnext – the leading exhibition in its field – looks forward to combining them in the best possible ways.

With China, we've chosen a partner country for 2020 that is not only one of the fastest-growing AM markets, but also the first nation to be heavily impacted by Covid-19. The People's Republic experienced the suspension of public life, the shutdown of entire industries, and the restarting of its economy several weeks before the rest of us. Its AM industry continues to feel the effects. As the articles in this special edition show, however, AM is providing us with technologies that can enable all manner of sectors and companies to rise again and take on the future.

With the help of additive manufacturing, the realm of industrial production will emerge from this crisis retooled and re-energized. We invite you to be part of this resurgence and hope you enjoy this edition of FON-Mag!



Sincerely, Sascha F. Wenzler  
Vice President Formnext



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## »DO YOU SEE THE RIVER PEBBLE?«

In developing its latest mechanical press, Andritz Kaiser GmbH took advantage of the innovative potential of additive manufacturing and bionic design. The unique combination of its corporate strategy, a passion for industrial 3D printing, and sources of inspiration in the natural world has proved valuable in a number of ways.

Standing amidst other steel colossi as tall as buildings at the front of the production facility, the 30-ton ToP-Line 2000 has the look of a stylish design installation. Here, in an exhibition area set up specifically for this cutting-edge mechanical press, its progenitor points up at the machine's 3,5-ton plunger with a cryptic question. »Do you see the river pebble?« Paolo Matassoni asks.

With the smell of oil and industry permeating the air and the scene dominated by huge units that will spend the next 20-plus years forming sheets of metal with thousands of kilonewtons of pressing force, the image of a river pebble seems a little out of place. That type of smooth, round stone – along with various flora and fauna – was nevertheless the inspiration that informed Matassoni's efforts in designing the machine before us. Indeed, many of the components of the latest generation of presses made in Bretten, Germany, were created this way. »Plenty of designs are already found in nature – we're just copying them!« Matassoni, the head of development at Andritz Kaiser GmbH, explains. The 52-year-old engineer has been able to implement the components' flowing transitions and bionic forms



Based in Bretten (Baden-Württemberg), Germany, Andritz Kaiser GmbH has belonged to the international Andritz group since 2004. It currently employs around 140 people. The company, which has been building on a tradition of excellence for 75 years, manufactures products that include stamping and metal-forming presses capable of generating up to 25,000 kilonewtons of force and eight megawatts of drive power. In the automotive industry (for example), a single press can produce as many as 2.5 million body components per year.

Text: Thomas Masuch

Photos: Thomas Masuch

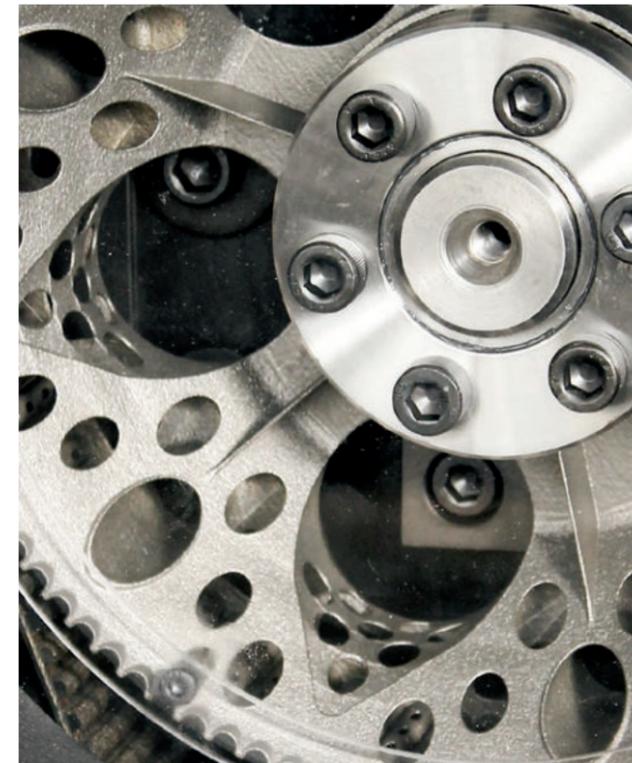


Photo opposite page: Paolo Matassoni points out the 3.5-ton plunger.

Photo left: The weight of this titanium belt wheel has been reduced to 700 grams, which enables feed rates that are up to 30 percent faster.

Photo below: Andritz Kaiser GmbH started its 3D printing journey 10 years ago with ball sockets; their internal surface is applied using AM.

in the industrial realm thanks to his own excitement about the possibilities of 3D printing and the additive mindset his team has adopted.

A full 150 of the parts that go into the ToP-Line 2000 were created with the help of 3D printing. They range from a casting weighing several tons (whose form was printed) to the oil drip pan, an array of mounts and gears, and a titanium belt wheel that, in addition to its actual purpose, decorates the imposing-yet-elegant machine behind a covering of clear plastic.

### »A CONNECTION TO WHAT SURROUNDS US«

When I first met Paolo Matassoni at Formnext 2019, he told me about the tremendous possibilities 3D printing held in store for engineers like him. He also spoke of his own unique approach, which takes inspiration from nature and »the sense of connection to what surrounds us«. He described how this was enabling him to design parts optimized for additive purposes using relatively simple means thanks to the »tension it creates between the engineer and the component«.



Matassoni was happy to reveal his heartfelt passion for the subject – an amiable combination of technical sophistication and philosophical techniques.

I came away from our first meeting admiring a person who was clearly and completely fulfilled by his profession, yet also maintained a hint of skepticism. Can industrial 3D printing

be that simple when you have Matassoni's »chakra« for additive design? And if so, do you really need software solutions for component optimization – no matter how many awards and accolades they might have won?

### IT ALL STARTED WITH BALL SOCKETS

These are the questions I'm looking to have answered during my visit to the Andritz Kaiser headquarters in Bretten, which lies just a few kilometers northwest of a well-known Cistercian abbey that dates back to the Middle Ages. Along with the assembly area for large machine presses, we pass by thousands of spare parts and components as we make our way through two much bigger halls. One of the countless shelves contains ball sockets around 40 centimeters wide – Matassoni's first venture into the world of 3D printing 10 years ago. Using a laser cladding technique, he applied an additive layer of bronze that bonded to the socket's internal surface. An array of tests then put this coated ball socket on its path to becoming the current standard in Andritz Kaiser presses.

In addition to Matassoni's unflagging enthusiasm for the technology, his chosen workplace is a key reason why a company whose history stretches back more than 70 years then began manufacturing more and more parts using additive methods. 3D printing is also integral to its latest generation of products. »Back then, I wasn't in the position I am today,« explains Matassoni, who nevertheless managed to win over the development and controlling departments, along with the executive board. »It wouldn't have been possible at any other company; the project would have gone dormant.« Having made a name for himself as a free thinker, Matassoni »was given the freedom I needed,« as he puts it. »Then I started shocking the executives with parts that actually worked,« he adds with a grin.

It didn't take long for managing directors Stefan Kaiser and Joachim Bolz to be intrigued by the possibilities of additive manufacturing. »After attending Formnext, we bought a 3D printer without knowing exactly what components we wanted to make with it,« Kaiser recalls. Besides giving their engineers the chance to get acquainted with 3D printing, they wanted to make the jobs at the company more attractive to the technically minded. Andritz Kaiser is based in the Stuttgart region, after all, where it has to compete with industry »



+ A hydraulic block made of high-strength aluminum

giants like Porsche, Daimler, and Bosch for skilled personnel.

### A COMPETITIVE EDGE IN ADDITIVE INNOVATIONS

The company's applications of additive technology are also driven by business concerns, of course. A large share of its customers operate in the automotive industry, where the rise of electric vehicles in particular had put many firms in a challenging economic situation even before the onset of the COVID-19 pandemic. For optimists like Paolo Matassoni, however, difficult circumstances like these provide »strong impetus for innovation«. In that sense, Andritz Kaiser's business interests dovetail perfectly with its passion for additive manufacturing.

Innovative thinking is a high priority for Stefan Kaiser, as well. That's why he's sure to include the company's 3D printing room when giving customers the tour of its facilities. »Customers obviously aren't going to buy machine presses just because we've built them with 3D-printed parts, but these components do enable us to demonstrate how innovative we are,« the managing director points out. At the end of the day, he believes that can indeed encourage a customer to make a purchase.

This is how Andritz Kaiser, which manufactures around 35 presses each year, wants to use technical advancements to set itself apart from the low-cost production its competitors favor. That said, the ToP-Line 2000 represents more than just a technological improvement on the previous model. »It's the first time we've ever redesigned a machine from the ground up,« Matassoni affirms, adding that past advancements had mostly been driven by customer requests.

### DESIGN IMPROVEMENTS IN 150 ADDITIVE COMPONENTS

In evaluating potential innovations, Andritz Kaiser takes a clear, mathematical approach: Ideas are assessed based on individual weighted criteria that allow for a maximum score of 110 points. »We've gone on to implement everything that scored over 100 points,« Kaiser reports. »In the past several years, most of these ideas have involved 3D-printed parts.« Using a diagnostic matrix, the company has selected around 150 parts, improved their design, and produced them using AM methods.

»This has lowered our production costs in some cases, but above all, it's led to a lot of technological improvements in our presses,« Matassoni reveals. The company has employed

bionic design to achieve less rigidity, for example, which in turn has reduced the amount of vibration in its machines. In units that perform dozens of strokes per minute, Matassoni says this translates into a great deal of added value in terms of maintenance and useful life. Meanwhile, the ToP-Line 2000's oil drip pan now has interior ridges that recall the pattern of human veins; these are designed to reduce consumption. »They keep lubricant from flowing upward, which can happen at high stroke rates,« explains Matassoni, who has been an active paramedic for 25 years in addition to his day job. Finally, the eye-catching titanium belt wheel has been trimmed down to 700 grams, which facilitates feed rates that are up to 30 percent faster. »Depending on the application, this can also increase the performance of the entire press by up to 30 percent,« Matassoni continues. These enhancements can be applied to presses that have already been delivered, as well.

### ADDED VALUE FROM UNEXPECTED SOURCES

Andritz Kaiser's forays into additive manufacturing have tapped into further sources of value that Matassoni hadn't even been counting on. The bionic shape of the ToP-Line

### LESS THAN FIVE EUROS PER HOUR

The operational center of AM production at Andritz Kaiser is located in a 20-square-meter space at the end of an office hallway. Here, we find a row of five FDM desktop printers that Matassoni and his young colleague Manuel Motzer use to produce test components, along with all the plastic parts they need. »These machines operate at a rate of less than five euros per hour,« Motzer says. »Other technologies just can't compete.«

Corresponding CAD models are created on screen two doors away in the development and design engineering department. While the AM departments of other companies use specialized software to calculate bionic optimizations, Matassoni and Motzer are entirely old-school: They do things »by hand and gut instinct« with the conventional (and parameter-free) CAD program One Space Designer and figure out the rigidity of their creations using the finite element method. For Matassoni, this saves both time and money, which can be decisive factors for a traditional midsize company when it comes to adopting new technology.

»I wouldn't have thought so in the beginning either, but we don't need those additive optimization programs,« he says. »After all, all the problems we run into in mechanical engineering are exactly the same in nature.«

This is what inspired the creation of the oil drip pan, the titanium belt wheel, and the curves of the press's plunger. Matassoni crossed paths with the belt wheel's design, which resembles a tortoise's shell, while on a hiking vacation in Spain.

Many more components are sure to follow at the company's headquarters in Bretten. »Additive manufacturing is a passion of mine; it fits the way I think,« explains Matassoni, who continues to take inspiration from the technical possibilities and creative freedom AM offers in new projects. All his ideas have led to a bit of a problem, however: »I've had to accept the fact that I'll never be able to realize them all in my lifetime!«

### + FURTHER INFORMATION:

» fon-mag.com

» andritz.com

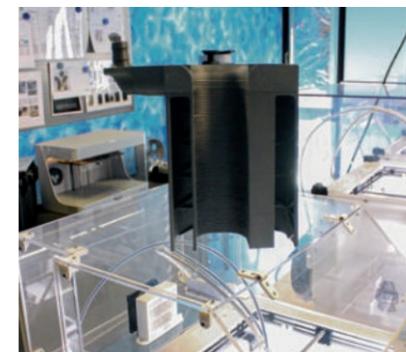


Photo on top: A glimpse of the AM center and its five FDM desktop printers. Interior ridges have been applied to this oil drip pan to reduce consumption.

Photo right: A visit to the exhibition area at Andritz Kaiser GmbH (in February 2020): The additive developments devised by Paolo Matassoni (center) and Manuel Motzer (right) have also impressed Uwe Behm (left), executive board member at Messe Frankfurt GmbH.



## »THERE'S A BIT OF »ARTIST« IN ALL OF IT«



How additive manufacturing is bringing a free-thinking tech head closer to his true purpose

If the wizard Merlin had practiced his arcane arts in the 21st century instead of back in the early Middle Ages, it's possible he would have tinkered with 3D printers instead of brewing up eldritch potions. As for his modern sanctum of magic, it probably would have looked a lot like the studio inhabited by Stephan Henrich. After crossing a rear courtyard, we enter the first floor of a long-standing edifice in Stuttgart and find ourselves in a trove of technological wonders. Here, Henrich has collected an array of inspiring 3D-printed ideas and innovations – from a bionically formed wallet and a 3D concrete printer a meter and a half tall to the futuristic model of a chair that would fit right in on the Starship Enterprise.

The diverse range of subject areas and technical aspects covered by all these individual objects makes it difficult to capture what the 41-year-old does in a single job description. The motto »Robotic Design and Architecture« adorns his label, but Henrich wears various hats – architect (his field of study), designer, engineer – depending on the task at hand.

»There's a bit of »artist« in all of it,« he adds.

When he enters a narrow adjacent room separated from the rest of his studio by a plastic curtain, he's usually about to work on something more technical in nature. Amidst desktop sandblasting equipment and a collection of jars of dark powder, we find a Sintratec S1 – the SLS plastic printer Henrich uses to produce smaller objects, such as the aforementioned wallet or components for his other projects.

From the outside, the building offers few indications of just how much technological creativity lies within in Henrich's additive workspace. In the five-meter-wide window that faces the street, passers-by only find numerous black-and-white photos of various objects, along with a pale yellow model of a 3D-printed robotic gripper. The latter represents part of Henrich's Fungus concept, which involves a robot that will serve as an autonomous gardener on a wall of mushrooms.

When he first moved into this location in 2014, Henrich offered more glimpses of his

Text: Thomas Masuch

Photos: Thomas Masuch



studio's inner workings. »Some projects demand a certain amount of confidentiality, though, so I had to block up the window somehow,« he explains. Henrich designed the necessary protection on his own laptop, of course. Sheets of milky, translucent plastic now hang from a delicate framework of thin metal rods and black, 3D-printed connectors. The black top of his elegant desk rests on a similar construction of his own design.

Before Henrich moved into his studio in southern Stuttgart, he had worked at various architecture firms, including in Berlin and Paris; he had also taught at universities in the United States and Austria. He had already come into contact with 3D printing in 2004 and gone on to incorporate the technology into a skyscraper concept.

Henrich's affinity for 3D printing has since resulted in a great many other concepts and projects that run a long gamut between art and real-world application. They include a lightweight 3D-printed gripper, a 3D printing head that can create objects on its own in open

space, and a pen holder he designed for the robot of an artist in Paris. Attendees also had the chance to marvel at other projects – involving »The Infinity« (a futuristic bicycle), the fungus robot and wallet, and various 3D-printed surfaces, for example – at Sintratec's booth at Formnext 2019. This Swiss start-up, which develops compact SLS 3D printers, is happy to be working with Henrich because he and his complex designs are an ideal representation of its philosophy, »Print your mind.« »In his works, Stephan Henrich does an impressive job of combining what we consider to be the primary advantages of selective laser sintering,« affirms Sintratec CEO Dominik Solenicki. »Shorter production times, a great deal of design freedom, and the outstanding mechanical properties of SLS constructions are just a few ways in which this technology has opened up all-new design possibilities for creative minds like Stephan.«

Although that creativity has certainly resulted in a wide variety of works, Henrich's efforts seem to be taking on a more practical focus since he put down roots in Stuttgart. »You have to have a few products that are adaptable enough to sell,« he points out. Luckily, Henrich can tap into a wealth of ideas far larger than the collection of creations that already inhabit his workspace. This is another area where 3D printing has helped him along. He has the option to produce small quantities of objects quickly, either on his own or through a service provider. »For me, this is a dream job,« Henrich says.

Indeed, additive manufacturing has brought this free-thinking tech head closer to his purpose in life. It has been more than two years

since Henrich used his earnings from a robotics project to purchase his Sintratec S1. »In some way, it was always a dream of mine to not just design or build things, but do everything in-house – from development all the way to sales,« he reveals.

### + FURTHER INFORMATION:

- » fon-mag.com
- » stephanhenrich.de



Stephan Henrich has used 3D-printed connecting components to create both a screen in his office (above left) and an elegant desk (above). His 3D-printed wallet (below) also stands up to everyday use.



# A FAREWELL TO BLUE COLLARS

Although the COVID-19 pandemic has turned the global economy upside-down and rendered every 2020 forecast all but useless, one thing is certain: The world of business will ultimately keep turning and in particular, seeing a recovery and upswing. This is where China presents tremendous opportunities, especially for partners and companies from other continents. The numbers speak for themselves: China accounts for more than 16 percent of the world's economic output and has contributed around a third of global growth in recent years. The country was also where Volkswagen, the largest automobile manufacturer in the world, registered 40 percent of its vehicle sales in 2019.

The times in which China served as the world's low-cost factory definitely seem to be coming to an end. The general economic conditions there have changed considerably of late, and one can assume that this process will continue in the future. Among other developments, China is turning its focus increasingly inward as it «rebalances» its economy. This is reflected in the country's trade balance, where its huge surpluses have undergone a constant decline over the past five years. At the same time, wages in China have continued to rise: The average per-capita income in cities increased by over 30 percent between 2015 and 2019.

## THE SIGNIFICANCE OF «MADE IN CHINA 2025»

Prioritizing quality over quantity is one of the key maxims China is committed to following in «Made in China 2025», its current plan for the future. Here, the country wants that the Chinese economy's image is increasingly shaped by entrepreneurs, engineers and researchers instead of blue-collar workers. This strategic economic program, which was initiated by

Premier Li Keqiang and the Chinese State Council in 2015, is also closely connected to the rapid development of China's AM industry.

While «Made in China 2025» was inspired by Germany's forward-thinking «Industry 4.0» project, it seeks to go quite a bit further in upgrading the Chinese industry. Besides improving the quality of products, the plan will increase both the integration of IT and the country's innovative capabilities. The 10 key industries China has pinpointed include the aerospace sector, new mobility, intelligent machine tools and robots, and new basic materials – in other words, fields that often overlap with additive manufacturing.

The first city chosen for the implementation of «Made in China 2025» was Ningbo, which is home to millions around 200 kilometers south of Shanghai. Nearly half of its 1.2 million working citizens are employed by manufacturing companies. Numerous pilot cities have followed since then, including the economic hotbeds of Chengdu, and Hefei.

## THE RISE OF CHINA'S AM INDUSTRY

In China, additive manufacturing began

developing somewhat later than in the United States or Europe. Industrial 3D printing wasn't a good fit for the world's center of production 20 years ago, when its focus was on churning out maximum quantities as cheaply as possible. The amount of investment required to build up industrial AM facilities was very high compared to the cost of labor.

This isn't to say that China doesn't have its own pioneers in additive manufacturing: Unitech was founded back in 2000, and HBD and Farsoon followed in 2007 and 2009, respectively. Then there's the Ninth People's Hospital in Shanghai, where physicians like Dr. Bowen Jiang have been gathering an impressive amount of experience in applications of medical additive manufacturing for 20 years (see page 18). However, it wasn't until around five years ago that AM really got rolling in China. A large part of the country's current AM industry was established in this period. Young AM entrepreneurs like Luo Xiaofan and Heyuan Huang, co-founders of Polymaker and Heygears, point to the prominent role the government's support has played in the successful development of their companies. China, accor-

Text: Thomas Masuch

Photo: eyetronic – stock.adobe.com



Shanghai is considered the latest «New York» of Asia.

ding to Wohlers Report 2020, is home to 32 industrial AM system manufacturers (19 of them in the metal sector). It ranks second worldwide behind the USA (47) and ahead of Germany (25). Some of these AM companies have grown to a considerable size, employing hundreds of employees and selling up to 500 units per year. BLT is now listed on the tech stock exchange STAR Market, and the aforementioned start-up Heygears secured more than US\$60 million in series B1 funding last December.

Although China's manufacturing industry discovered industrial 3D printing a bit later than other parts of the world, more and more of its firms seem to be recognizing the possibilities it affords. In a market study published in late 2019, the Belgian AM company Materialise found that 63 percent of the production companies it surveyed viewed additive manufacturing as mature enough to create visual prototypes. Meanwhile, 34 percent believed that AM could be used for functional prototypes, as well. The latest developments have been much more dynamic in the eyes of Kitty Wang, who has been keeping a close eye on the Chinese AM industry for years through her platform, 3D Science Valley (which is involved in media, consulting, and market research). «Particularly this year, there's a much greater awareness of 3D printing and its potential within the manufacturing industry than before,» she reports. «Companies are opening up more and more to the idea of finding out how AM might benefit them.»

As some of the companies and applications in this edition of FON-Mag show, China's AM industry is already highly advanced. Consider the functional prototypes being 3D-printed for

the automotive sector (see Farsoon, page 26), for example, or the way AM is helping build functional components for electric vehicles (Polymaker, page 22). The country has also come up with countless real-world applications that range from mold making and aerospace innovations all the way to bridges made of 3D-printed plastic. And while industrial users

## Insiders view the Chinese mentality as a competitive advantage.

spent their first few years buying AM systems from the United States and Europe, the 3D printers that now populate China's factories are increasingly (and sometimes almost exclusively) home-grown.

## WHY DOES WORKING WITH CHINESE PARTNERS MAKE SENSE?

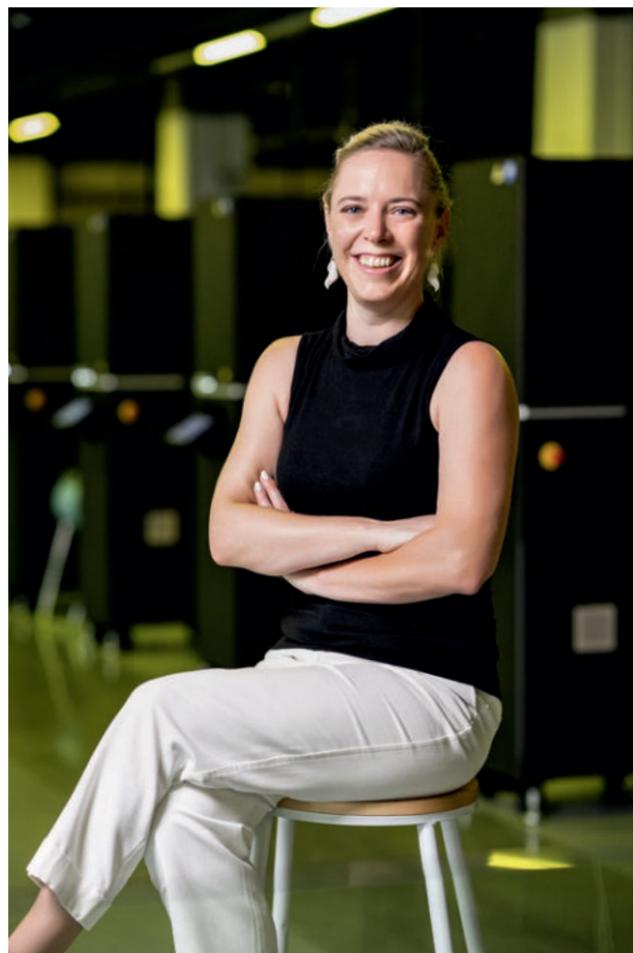
Nevertheless, China still presents so much potential that it should remain (or become) a strong sales market for AM companies from other countries. Its most important user industries – automotive, aviation, and healthcare, including the dental sector in particular – are virtually the same as in the rest of the world. If the use of AM continues to spread apace in

production operations (in the field of mold making, for example – see pages 17 and 19), we should also see strong growth in the demand for corresponding equipment, software, and material, as well as for specialized solutions and expertise.

China is an intriguing destination in terms of more than just sales, however. More and more international corporations are entering into bilateral development cooperations with Chinese companies and research institutions. It should be noted, of course, that every international collaboration comes with a certain amount of risk – with regard to data security, for instance. «At the end of the day, there are always risks you have to weigh against potential developments and opportunities to gain access to a new market,» points out Dr. Dirk Simon, who heads Farsoon's trading and service subsidiary in Europe.

Another major advantage that often comes up in conversations with European experts in China relates to how the country's AM industry benefits from its dynamic start-up mindset, dizzying development pace, and the speed with which decisions are made. Kim Francois, director of global business development at Heygears, sees this as «a kind of Silicon Valley mentality» (see page 14). Dr. Simon also has a particular admiration for the «passion the Chinese have for offering solutions quickly». He adds that while some people in Germany tend to resort to hand-wringing, «the focus in China is much more on finding an approach that will work». According to Dr. Simon, the Chinese mindset represents a chance for Western companies to gain a competitive edge back home, too.

## TALKING ABOUT



Text: Thomas Masuch

*Ms. Francois, you've been living in China for almost 11 years and have discovered both the Chinese culture and the country's AM industry. What was your initial motivation, and how did you get settled in?*

**FRANCOIS** My dream was always to move to China, and after such a long time, I'm not completely thinking like a full-blown European anymore. After 10 beautiful years in Shanghai and at Materialise, I decided to move to Guangzhou to join Heygears. I'd been working closely with them for the last two-and-a-half years and admired their drive to get things done; I also wanted to dive even deeper into the Chinese culture and market. When I first moved to Shanghai with my husband, it was quite easy to get to know people, whether it was foreigners or local Chinese. From my perspective, the Chinese are also very open and curious people. During the last 10 years, Shanghai has become one of the most booming cities in Asia, and we have seen it turn more and more into »the New York of the East«. Guangzhou, on the other hand, is a bit less westernized, but I love the local Chinese culture of street food and am curious to explore the city further after the pandemic.

## »The Chinese and I Discovered AM Together«

Kim Francois has been living in China since the end of 2009. Besides having long been known as the face of Materialise in the country, she has now been working as Global Business Development Director for the young and successful AM company Heygears in Guangzhou since early 2020. We talked to her about her career, the development of the AM industry in China, and opportunities for international cooperation.

Photos: Heygears

In China, you can find a kind of »Silicon Valley« mentality. People constantly push the boundaries and do a lot of trial-and-error, which is something Europe can benefit from.

*How did your adventure within the Chinese AM industry develop?*

**FRANCOIS** When I first came to Materialise, I wasn't familiar with 3D printing; they were just looking for a Chinese-speaking foreigner who understood the Chinese culture. My background is sinology, which made me one of the few non-technical people who joined Materialise back in the day. During that time, the Chinese were still focusing on traditional manufacturing driven by cheap (or cheaper) labor, so from one point of view, you could say that the Chinese and I discovered AM together. When I look at the current status of the market and companies like Heygears, it's incredible how fast it has developed over the last five years.

*But then things changed quite quickly ...*

**FRANCOIS** Yes. When Xi Jinping came to power as China's new president in 2012, he saw the need to change what people associate with »Made in China«. The new plan was to make sure that China's industry combined smart manufacturing with traditional manufacturing in order to achieve the »Made in China 2025« plan. Additive manufacturing is

still regarded as one of the main drivers in reaching this goal. China embraced the technology, which started the rollercoaster ride we're on now. As you're probably aware, once the Chinese government throws its weight behind something, it offers platforms, provides funding for companies that are doing related research or activities with the programs they're setting up, and enables both research and commercial companies to adopt the new technologies as soon as possible. This also means that existing manufacturers are free to combine smart manufacturing with their traditional technologies, which is where dental labs offer a perfect example.

*What specifically did that mean for additive manufacturing?*

**FRANCOIS** All of a sudden, there was a lot of hype behind it. In 2013 and 2014, we saw many desktop 3D-printing companies popping up out of nowhere. Since China's government follows five-year plans, it's always super interesting to see how everything changes in that span of time. If we look back at the situation in 2013, we see that the market landscape has completely changed and the majority of its desktop 3D-printing companies now no longer

exist. Their business plans and setups weren't ideal for the Chinese market; the beauty of it, however, is that they tried and the government was an enabler in the process. Others, like Heygears, BLT, Uniontech, and many more, have been able to establish a firm customer base by leveraging their technology, strength, and service-oriented mindsets. Right now, we're seeing a maturing market in which the companies that are still in business are really serious and have grown tremendously over the last five years.

*So, the AM industry in terms of equipment manufacturers has grown significantly. What's your impression of the industrial applications and users of AM?*

**FRANCOIS** In the past few years, I've been lucky enough to visit a lot of the companies involved in AM. I've been to small start-ups and giant manufacturers like Geely, and to both hospitals and research institutes. I was often on the road more than half the time, and obviously loving it. Visiting companies gives me new ideas and energy, and seeing what the Chinese have built up in the last five to 10 years is incredible! Every company adopts the technology a bit differently, and business



models also differ by region. Take the south, for example: A large part of the CNC machines have been replaced with stereolithography technology, which is why we're now seeing thousands of SLA machines running in that part of the country. As a result, if you place your order before noon today, you could get a prototype delivered to your company by six o'clock this evening at the latest. Isn't that amazing?

#### And what about metal?

**FRANCOIS** I've been impressed by how fast they have picked up metal printing here. Currently, it's mainly being used in the aerospace and aviation industry, as well as in the medical field. There are service bureaus with more than 100 metal machines, and some of them offer really large build platforms – up to a meter and a half in height, in fact.

We're seeing metal applied to the dental and shoe-molding industries, as well. All the dental labs are starting to use a completely automated workflow involving both plastic and metal 3D-printing machines – depending on the application at hand, of course. In the shoe

industry, Materialise worked closely with Uniontech in Shanghai to enable machines to print a molded texture directly onto midsoles.

*For Europeans and Americans, China and its industry are quite far away from both a regional and a cultural standpoint. Do you think that people in these Western regions are aware of what's happening in the Chinese AM market and how it could affect the entire industry in the future?*

**FRANCOIS** Last year, I was invited (and, of course, honored) to speak at the Women in AM industry forum in Berlin. I was surprised that so many activities going on in China hadn't reached the Western countries and a lot of people still weren't aware of what the country has been doing in recent years. I'm looking forward to changing that, and one thing that will help is China's status as a partner country for Formnext 2020.

*What do you have your eye on as the main reason why we should pay more attention to China?*

**FRANCOIS** I often have the feeling that people are afraid of the unknown, and China is something of an unknown for Europeans. It's still common for China to be cast in a negative light in the Western media, and it's very unfortunate that the positive things that have happened here in the last few years (and decades, for that matter) are often not mentioned or don't get sufficient coverage. As a foreigner who has been working in China for more than 10 years – first for a Belgian company and now for Heygears, a Chinese company (as the only foreigner, by the way) – I believe that China and Europe can make each other stronger through collaboration. Of course, you need to find the right path and respect the different cultures. A Belgian company applying the same business model in China as it does in Belgium wouldn't succeed, and it wouldn't work the other way around, either. Examples like Best Buy (editor's note: a US chain of big-box retail stores that sell consumer electronics products) teach us how one shouldn't operate in China; companies like Siemens, on the other hand, are success stories that show how the German and Chinese cultures can go hand in hand.

*How could both sides benefit from working together more closely?*

**FRANCOIS** In China, you can find a kind of »Silicon Valley« mentality. People constantly push the boundaries and do a lot of trial-and-error, which is something Europe can benefit from. In my experience, Europeans often start by making plans for different options, work on those plans for a long time, and then – after careful consideration – start implementing the one they choose. The Chinese work more ad hoc: They try different options and move quickly. If an option doesn't work, they discard it and go to the next one while learning from what went well and what didn't along the way. It's a very different way of working and neither one is better than the other, but the latter approach encourages a more entrepreneurial style.

*Ms. Francois, thank you very much for this interesting interview.*

**+** FURTHER INFORMATION:  
» fon-mag.com



Text: Ketty Zhong & Thomas Masuch

Every month, Zhuhai Gree Precision Mold prints 240 kilograms of metal powder alone.

## More Than 50 AM Systems for Making Molds

The mold-making subsidiary of the electronics group Gree Electric Appliances has built up its internationally successful 3D Printing Application Center within five years

The speed at which the Chinese AM industry has grown can be seen at Zhuhai Gree Precision Mold Co. Ltd., whose 1,800 employees make it one of the largest mold-making companies in the country. In 2015, this subsidiary of Gree Electric Appliances, Inc. entered the additive manufacturing sector and acquired three AM systems: one for SLM, one for SLA, and one for SLS.

These initial machines were purchased from EOS and 3D Systems. In the meantime, the machinery at the company's 3D Printing Application Center has grown to include more than 50 systems, and the technology is no longer imported. Zhuhai Gree Precision Mold now sources not only its 3D printing systems from domestic manufacturers, but its software and materials, as well. »In recent years, China has been making continuous efforts in these areas and has gradually caught up with European and American manufacturers,« reports Mr.

Ruzhou Huang, technical director of the company's AM department.

Zhuhai Gree Precision Mold uses other technologies in addition to additive manufacturing, but 3D printing is what enables it to produce molds with conformal cooling. »We keep discovering these applications to help our injection molds cool faster, increase injection production efficiency, and reduce the deformation of parts. On the whole, it improves our product yield,« Huang explains. The company, which is located in the city of Zhuhai (Guangdong province), also uses 3D printing to produce breathable parts that solve the problem of trapped gas in injection molds, as well as to repair molds. »In addition, we use 3D printing to reduce scrap from mold parts and our mold production costs,« Huang reveals.

#### OUTPUT HAS INCREASED SIGNIFICANTLY

The successful development of the 3D Printing Application Center has enabled Zhuhai Gree Precision Mold not only to meet the internal needs of its parent group, but also to fulfill orders from other companies. At present, its strategic partners include the Commercial Aircraft Corporation of China Ltd. (Beijing). The company has also received mold inquiries from Europe, Africa, southeast Asia,

North America, Japan, and other parts of the world. Its customers hail from the 3C, automotive, and household appliance industries, among others.

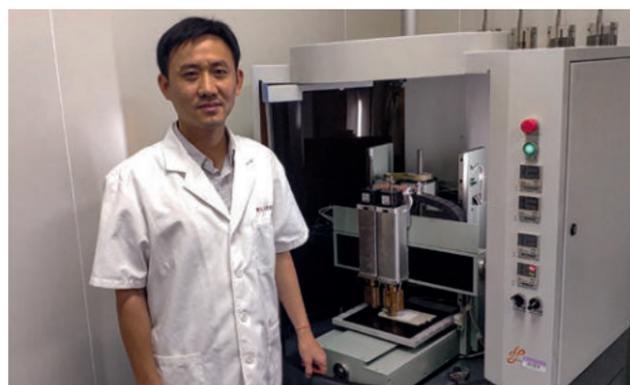
Following the expansion of its machine park, Zhuhai Gree Precision Mold's output has also increased significantly. Prototypes made of plastic represent an important product area in this regard. The company produces about 1,500 of these prototypes per month, amounting to a total weight of around 1,100 kilograms. In the metal segment, it 3D-prints around 240 pieces (240 kg) per month. These parts are mainly mold components or used for other industrial purposes.

In the area of mold making, Ruzhou Huang expects a further significant increase in demand for 3D printing technology. »Several service providers are already operating in the market for metal parts, but in the future, more and more big mold enterprises will purchase metal 3D printing equipment,« he predicts. In the field of plastic 3D printing, the market has clearly matured further. »We're now seeing fierce competition everywhere in China, and it's almost come to a bottleneck. New equipment, new technology, and new materials are needed to satisfy new demands,« Huang reports in conclusion.

Photos: Zhuhai Gree Precision Mold Co., Ltd.

# 3D-Printed Implants for Hips, Knees, Shoulders, and More

Shanghai's Ninth People's Hospital has been working with 3D printing for about 20 years. Since 2013, it has also been developing a powerful laboratory that now employs 15 doctors and engineers and uses 20 3D printers based on different technologies.



At Shanghai's Ninth People's Hospital, Dr. Jiang and his colleagues produce prosthetics and implants themselves.

The lab fabricates a relatively wide range of parts. »We use our SLA systems to produce models for surgical preparation, along with an SLS process to create surgical guides that enable precise operation when cutting bone, for example,« explains Dr. Bowen Jiang (Ph.D). Dr. Jiang is the executive deputy director of the Clinical Translational R&D Center of 3D Printing at Ninth People's Hospital, which is affiliated with the School of Medicine at Shanghai Jiao Tong University. The hospital's most important application of AM, however, is 3D-printing metal implants – for hips, knees, and shoulders, for example. Using a titanium alloy, the individual components are produced on metal printers (including EBM and SLM machines) at the Center of 3D Printing. »In our hospital, the customized implants we fabricate using 3D printing technology are mainly used for patients with very complicated and large

bone defects where the traditional standard implant wouldn't achieve the best results,« Dr. Jiang explains.

At Ninth People's Hospital, Dr. Jiang and his colleagues have established a process that enables the independent production of the required prostheses or implants. This starts with a CT scan, which is used as a basis for developing an initial 3D model. »This is always done in coordination between the doctors and engineers; each medical component can only be produced after the doctor gives his or her approval,« Dr. Jiang continues.

Additive manufacturing in medicine is no longer an exception in Shanghai, but rather a frequently applied technology. Over 100 implants are produced and operated on annually at Ninth People's Hospital alone, along with more than 200 prostheses and over 1,000 surgical templates.

Dr. Jiang and his colleagues also pass on their extensive expertise and experience to other hospitals throughout China. There, the 3D printing of surgical models (for example) is often already established. »We then help other

hospitals with things like additive implant production, which is often the next step,« Dr. Jiang adds.

Research is also an important field of activity for Ninth People's Hospital's Center of 3D Printing – one in which a considerable part of its additive equipment is used. »We're currently working on a new material solution for implants,« Dr. Jiang reports. Bioprinting is also high on the research agenda, even though there is still a considerable way to go before it can be used in medicine. »This will certainly take another 10 to 20 years,« Dr. Jiang predicts. However, the potential of this technology is immense: Even in China, where the waiting times for organ transplants are relatively short compared to the rest of the world, the corresponding lists are long. 3D printing could significantly increase the chances of recovery regardless of the availability of potential donor organs.

Text: Thomas Masuch

Photos: Dr. Bowen Jiang

Engineers optimizing AM equipment at HBD



Text: Thomas Masuch

Photos: HBD

# Dental and Mold-Making Sectors Continue to Drive Growth

As life in China returns more and more to normal, the SLM machine manufacturer HBD has already been firing on all cylinders since late February. »Business in China is getting back on track, but I'm afraid that overseas markets might need more time. I hope that the world economy's recovery will be swift and strong after the epidemic, especially in Europe,« says overseas manager Nicolas Yao.

The company, which employs around 160 people at its two locations in Guangdong and Shanghai, is one of China's leading firms in SLM machines, having sold over 100 machines in 2019. While its home country, with its important dental and molding industries, is still its key market, overseas sales are becoming more and more significant. Yao reports that after starting its international business in 2017, HBD managed to sell 20 machines to five different countries outside of China just two years later.

Since 2007, HBD has made a name for itself both in China and around the world. The company sold its first machine in 2014, and more recently, dental and mold making in particular have proven to be growth drivers. In the dental sector, mass production is the order of the day; meanwhile, more and more of the around 30,000 Chinese companies involved in tool and mold making are recognizing the importance of conformal cooling and acquiring the necessary expertise. »The potential here is huge,« says Nicolas Yao.

In order to further increase its market share and attract new companies to AM, HBD is not focusing primarily on offering the lowest possible prices. Its machines range from EUR 100,000 to EUR 900,000 for the largest units.

According to Nicolas Yao, quality is much more important. »HBD employs its own experts in mold making to help customers improve their applications and establish the right processes,« he explains. This is where HBD faces hurdles similar to those of other manufacturers in the rest of the world. »For users, it isn't easy to transition from a traditional manufacturing process to modern, integrated additive manufacturing without the assistance of metal 3D-printing vendors,« Yao continues. »You have

to follow a different concept and realize that metal 3D printing won't completely replace your traditional manufacturing process; it merely complements CNC machining. It's important to establish new designs here and come to terms with the more narrow range of materials available in the AM sector.« This process, however, is also becoming increasingly popular among China's mold makers. HBD has thus won over many customers in the tooling industry, including the well-known home appliance manufacturers Gree (see page 17) and Midea.

»In addition, continuous innovation research and development is an important driving factor of HBD's ability to remain highly competitive,« Yao states. For example, the hybrid additive technology LACM (Laser Additive and Cutting Manufacturing, an HBD invention) is now integrated into its metal 3D printers. »This makes these already popular units even more powerful,« the manager affirms.

## TALKING ABOUT

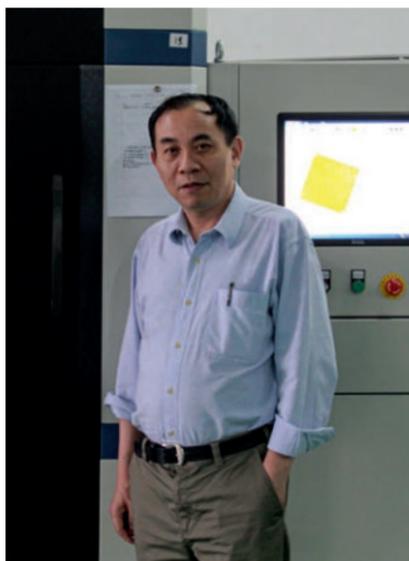
## »An Essential Production Method for the Aviation Industry«

China is considered the world's most important market for air transport. Boeing and Airbus both have strong presences there, and the country also maintains its own civil aviation program. In the future, additive manufacturing is all but certain to play an increasing role in this industry across the globe. We recently spoke with Tao Feng, a Chinese aviation specialist and vice president of Shining 3D Additive Manufacturing, about the developments currently taking place in China.

*Mr. Feng, how has the importance of additive manufacturing evolved in Chinese aviation, and what role is it playing in this industry today?*

FENG China's aviation companies set great store by additive manufacturing technology and have made a major effort to establish their own AM centers. Large supplier companies have also obtained AM machines. The quantities of 3D-printed parts being purchased have increased constantly in recent years, and their designs have been adapted to the requirements of the aviation industry. Standards for materials and processes are also being developed. The aircraft industry has gained a lot of importance for Shining 3D in the past several years as well, including in terms of both the metal powder bed fusion machines we have installed and the components they produce. It's clear that additive manufacturing has become an essential production method for the aviation industry – and there's still room for improvement and further advancements in the future.

*Which aircraft components are being 3D-printed in China right now, and*



Tao Feng is one of China's pioneers in additive manufacturing. Since graduating from Beijing's renowned Tsinghua University, he has supported AM advancements in the use of metal, plastic, wax, and sand. Mr. Feng is now the vice president of Shining 3D Additive Manufacturing, where he and his team possess a total of nearly 30 years of experience in the AM industry.

*which are soon to follow? Where is Shining 3D's technology involved in these activities?*

FENG Shining 3D's metal powder bed fusion technology is very often used for engine components, which include a number of smaller parts. Fuel nozzles, fuel filters, and hydraulic valve bodies are some of the components produced. Our newly developed M450 and M650 models will also make it possible to print various midsize and large parts, such as guide wheels, casings, and deflectors.

*In some cases, the use of AM in aircraft manufacturing is also having an impact on how the supply chain is organized. Are you seeing similar developments in China?*

FENG The suppliers that provide 3D-printed parts to the aviation industry are OEM suppliers, research and development facilities, and professional providers of 3D printing services. At the moment, components produced by professional service centers are dominating the market.

Text: Thomas Masuch

Photos: Shining 3D



Aircraft turbines have several nozzles like these for injecting fuel. They need to be robust and capable of withstanding high temperatures.

*Maintenance is another key application area for AM in the aviation industry. Has additive manufacturing taken hold here in China, as well?*

The quantities of 3D-printed parts being purchased have increased constantly in recent years.

FENG China has started experimenting with the use of AM in aircraft component maintenance. We've worked with one particular aviation company to develop mobile shelters for aircraft maintenance. They're based on our EP-M250

metal printers and designed specifically for repairing and replacing aircraft components. This has involved implementing the production of metal parts in vehicle shelters. In collaboration with another company in aviation maintenance, we're exploring how we might use SLM technology to repair larger quantities of turbine blades.

*Is there a corresponding certification system, and if so, to what extent has it been developed? How is it being coordinated at the international level?*

FENG Right now, there's no relevant form of certification for the airworthiness of components manufactured by MPBF systems. We are, however, engaged in in-depth discussions regarding the development of such certification, and the process is already under way.

*How are the current circumstances in aviation – including the significant decline in global air traffic – affecting the industry's development efforts?*

FENG The situation in China has largely

returned to normal. While the country's activities in aviation development weren't hampered, the restrictions on international travel and the reduced number of flights have led to installation delays for our customers overseas.

*Mr. Feng, thank you very much for talking with us.*

Founded in 2004, Shining 3D now offers technology in 3D digitalization and additive manufacturing. It employs some 1,000 people around the world and holds more than 300 patents, as well as over 100 copyrights. The company, whose headquarters is located around 100 kilometers southwest of Shanghai, is currently listed on »TC Market«.

## + FURTHER INFORMATION:

- » fon-mag.com
- » shining3d.com

# MADE FOR MAKING SPECIAL MATERIALS

Polymaker specializes in the development of special AM plastics that enable the production of 3D-printed electric cars, pedestrian bridges, and more.

When the Italian-Chinese vehicle manufacturer XEV presented the first 3D-printed electric car for the mass market, which was assembled mostly from 3D-printed parts in Shanghai around 18 months ago, the material manufacturer Polymaker had played a decisive role in its creation. »We developed dozens of kinds of engineering plastics for XEV to meet the needs of their practical applications,« reports Dr. Luo Xiaofan, the

co-founder and CEO of Polymaker. »Customized nylon-based plastics and other materials made a holistic design change possible.« XEV was thus able to reduce the number of plastic components in the car from more than 2,000 to 57. In addition, the two-seater – named YoYo – ended up weighing just 450 kilograms.

Apart from the chassis, seats, and glass, most of the car's visible parts are made of 3D-printed Polymaker materials. The Shang-

hai-based company is »still one of the few companies that was founded exclusively on the idea of developing materials for 3D printing,« Dr. Luo proudly explains. »In contrast to other competitors who use part of their portfolio for additive manufacturing, we follow a bottom-up approach: We start from the market's needs and develop special materials to meet them.« These applications are either based on Polymaker's own trend forecasts or driven by customer requests.

Having grown to a workforce of around 150 since its foundation in 2013, Polymaker specializes in materials for extrusion-based 3D printing and describes itself as one of the world's largest suppliers in this field. For its specific material developments, the company buys raw materials from major plastics manufacturers, develops its own recipes, and uses them to compound new materials specially optimized for the requirements of additive manufacturing. At its Suzhou factory, over 20 custom-designed extrusion lines are available for this purpose, providing an annual capacity in excess of 1,500 metric tons.

Among Polymaker's various creations, Dr. Luo highlights a 3D-printed pedestrian bridge weighing 5,800 kilograms that now spans a watercourse in a Shanghai park. For this project, the company developed an ASA composite plastic for the Shanghai Construction Group

Text: Thomas Masuch



Photo opposite page: Dr. Luo Xiaofan showing off the electric car YoYo

Photo left: Visitors can walk across this 5,800-kilogram 3D-printed bridge at a park in Shanghai.



Photo right: The company's headquarters, and material production operations at its Suzhou plant (over 20 extrusion lines)



Photos: Polymaker

and its partner Coin Robotics, which contributed by building the world's largest plastic 3D printer (at 24 meters long).

Even though these reference projects were completed on Chinese soil, Polymaker's business is predominantly international. »Europe and North America are our most important markets,« Dr. Luo affirms. This is why the company maintains branches with service teams and material warehouses in the Netherlands and the USA.

Polymaker's 35-year-old co-founder hadn't really expected to become an international player in the world of AM materials. Indeed, Dr. Luo only came into contact with 3D printing by chance. In 2008, the plastics engineer was pursuing his Ph.D in the USA in the field of polymers and working with colleagues on developing a plastic for cardiovascular stents. »The project was going very well, and in our search for a manufacturing solution we came across 3D printing, which was then called 'direct writing'. Since the manufacturers of 3D printers at that time did not want to make their systems usable for foreign materials, we built a simple desktop printer of our own.«

Later, Dr. Luo had a brief career in the rubber industry, »but 3D printing kept me busy and also became a personal hobby of mine.« When numerous start-ups emerged in the USA, he was sure that this technology would play an important role in the future, but it wasn't yet clear what that role would be.

»All the start-ups back then were focused on building 3D printers – but for applications, you need materials,« Dr. Luo points out. That was the founding idea behind Polymaker. For personal reasons, he was drawn back to his home country, where he and three other partners founded the company in Shanghai. All of them are still active in leading positions today. Dr. Luo, who has undergone a transition from scientist to entrepreneur, leads the company as CEO.

»The Chinese government did a lot to encourage young people to come back home. We were given free office space, as well as easy access to a manufacturing base,« Dr. Luo reveals. Nevertheless, the founding period was not the smoothest, as there was little certainty in the market at the time. Today, the market and the company are bigger, but according to

Dr. Luo, »it hasn't gotten any easier with the jobs of 150 people now depending on our success.«

In order to ensure this success in the future, Polymaker will strive to continue evolving from a material supplier into a solution provider. Dr. Luo intends to focus even more on select applications in the future. »Our goal is to use 3D printing to reshape traditional industries and make even more new applications possible.«

## + FURTHER INFORMATION:

- » fon-mag.com
- » polymaker.com

# ONE OF CHINA'S AM PIONEERS



Uniontech is one of the longest-established AM companies in China. While most of the country's AM firms have been started within the last three years, Uniontech was founded in 2000 and is thus celebrating its 20th anniversary this year. »This practically makes us the AM pioneer in China,« says Jeffrey Ma, the company's director of overseas sales.

According to Uniontech, the company is now the largest stereolithography (SLA) enterprise in China, with a market share of 55 percent. Its portfolio includes a range of SLA materials, as well as 3D printers with an accuracy of 25 microns and build spaces ranging from 250 x 250 x 250mm to 2100 x 700 x 800mm.

Around 80 percent of Uniontech's customers are service bureaus, but it also serves numerous OEMs. Its 3,200 installed systems produce shoes molds, automotive parts, investment castings, and more for companies such as Adidas, Gree (electric appliances), and JAC (vehicles). One of its largest customers is the AM service provider Fuhan, which already has 500 SLA printers from Uniontech in operation.

Uniontech's 20-year history is also an accurate reflection of how the AM market has developed in China. Until 2012, the market was more or less dormant, with the company selling between one and 15 units a year. It was nonetheless able to lay important foundations, such as collaborations with Materialise (2002) and DSM Somos as a material partner.

## THE CHINESE MARKET HAS BEEN BOOMING

Then things started to take off. Uniontech sold 162 systems in 2015, and by last year, that number had grown to 747. Resin sales were correspondingly high, with the company's sales ballooning from 20.4 tons in 2014 to 531.4 tons in 2019. Uniontech, which has been an exhibitor at Formnext since its debut, achieved a

turnover of US\$45 million last year with its systems and materials.

»The Chinese market has been booming for us so far,« says Jeffrey Ma, who remains optimistic despite the effects of Covid-19. »We're still feeling positive about the market. It might not grow as quickly as before, but we'll increase our business all the same.« For Ma, who has been with the company since 2015, this is essentially due to three things. The first of these relates to the ongoing developments in technology and materials, which has also caused the price of relatively costly SLA resin to drop in recent years.

The second important growth factor is the Chinese government's 2025 plan, in which additive manufacturing plays an important role.

Text: Thomas Masuch

Photos: Uniontech



Photo below and opposite page: A test center, and a glimpse of Uniontech's Shanghai factory  
Photo middle: Examples of products and models created with the help of Uniontech's AM  
Photo below: A reference customer's production operations in Guangdong province (southern China)



tial for further growth in AM in areas that are traditionally very labor-intensive, such as prototyping.

Uniontech has a good deal of confidence in the field of technology, as well. »In terms of the printing process, we've now caught up with Europe and the USA,« Ma states, but also adds that the Chinese AM industry still has catching up to do in the area of applications. »This is where Europe is looking for the best solutions in combination with special software, tailored materials, and a lot of detailed work. There's still a gap in this regard.«

To close it, Uniontech has a quarter of its 200 employees working in research and development. In addition, the company has already set its sights on other ambitious plans. Preparations are under way for Uniontech to go public in 2022 on the STAR market of the Shanghai Stock Exchange, which aims to establish itself as the Chinese equivalent of the NASDAQ.

Among other benefits, companies can receive grants for research and development, or better access to loans or investors. This also has an impact at the local level – for example, by making it easier to find new production facilities or office buildings.

Finally, the rising level of wages in China is giving additive manufacturing a further boost. »Compared to 10 or 20 years ago, labor costs are skyrocketing,« reports Ma, who sees poten-

## + FURTHER INFORMATION:

- » fon-mag.com
- » en.union-tek.com

## »IT'S GOTTEN MUCH EASIER«

International groups cooperate with Chinese companies and research institutions to drive their technological development and gain access to markets. Dr. Dirk Simon, managing director of Farsoon Europe GmbH, has supported numerous collaborations between German and Chinese firms and is now using his experience to advance applications in additive manufacturing.

**A** When Dr. Dirk Simon signed a cooperation agreement in China for the first time in 1999, he says the type of cooperation was »not comparable to how things work today.« That arrangement involved the development of flame-resistant plastics along with the Chinese Academy of Sciences in Beijing. Dr. Simon also describes the manner of communication – along with the feeling-out process and agreements on the eventual monetization of research results – as very different. »It's gotten much easier these days; it's a completely different world,« he says. Dr. Simon goes on to cite the legal regulations that now apply to such

cooperations, and the fact that they've taken on a much more open format. He reports that China is another country where the concept of open innovation has clearly been having an even greater impact on the mindsets of those who work in R&D departments.

As part of his work at BASF and Farsoon Europe GmbH – the European service and sales subsidiary he has headed for the past two years – Dr. Simon has also assisted other collaborations. In 2013, for example, BASF launched its development initiative in China and began working closely with Farsoon. »It wasn't about just application technology; the focus was on

real research, as well,« he explains. The undertaking resulted in a new high-performance material and a machine optimized to work with it – the Farsoon HT251P. »That machine and the Polyamide 6 powder were designed to be a perfect match,« recalls Dr. Simon, who oversaw 3D printing activities as an authorized representative of BASF 3D Printing Solutions GmbH until March 2018.

Among other things, the material required a processing temperature of more 200 degrees (Celsius), which in turn entailed technical adjustments in machine design, seals, remaining oxygen levels, and more. This machine-material tandem has since gone international; its adherents include PATAC, the Chinese development partner of General Motors, which uses the HT251P and PA6 to produce functional prototypes for motor compartments. In Germany, FKM Sintertechnik also uses the pairing for things like manufacturing its own automotive prototypes.

Elsewhere in the field of high-temperature applications, Farsoon has also been cooperating with aviation giant Airbus since 2019. Due to the strict requirements placed on interior aircraft components, the processing temperatu-



Text: Thomas Masuch

Photos: Farsoon

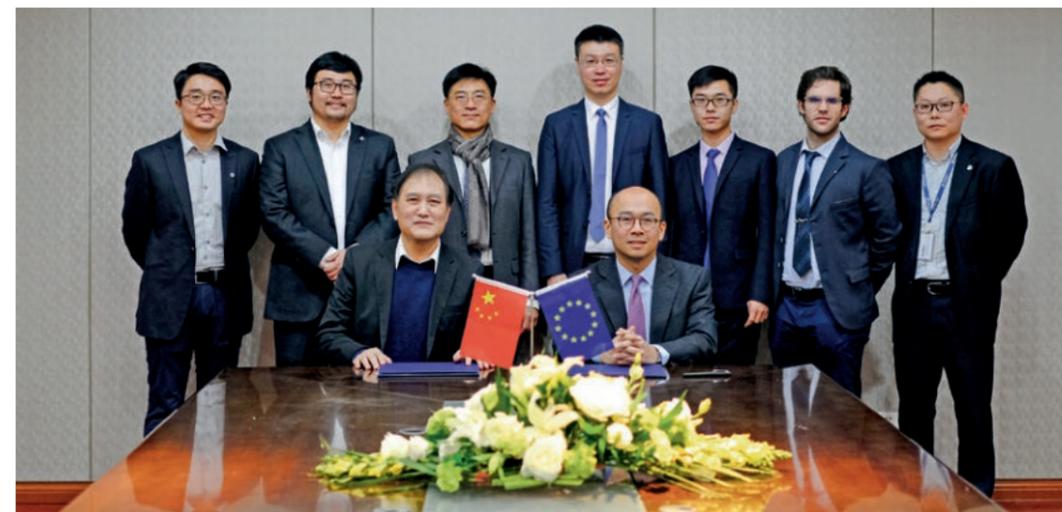


Photo left: Farsoon and Airbus entered into a cooperation in early 2019.

Photo below: Farsoon is headquartered in Changsha, a city of millions in central China.



res involved are even higher – up to 360 degrees (C), in fact. This collaboration has brought forth a new machine that Farsoon will be presenting at Formnext 2020.

The Farsoon Flight HT403P serves as proof that China can now contend with the world's best when it comes to the ability to innovate. While the Flight™ technology came together without international cooperation, Farsoon has since begun working with Western firms again to beta-test its latest creation. Switzerland's Rapid Manufacturing AG is currently analyzing the HT403P's suitability for European environments. The machine has a build cylinder measuring 400 x 400 x 540 cubic millimeters and a 500-watt laser that (according to the manufacturer) is especially fast at shaping the black polyamide powder into plastic components.

It's through international cooperations like these that Farsoon is not only developing its technological expertise, but continuing to bur-

nish its reputation around the world, as well. According to Dr. Simon, this makes it easier for his company to enter Western markets. He points out that it remains difficult for Chinese firms to get a foothold in Europe. Although he believes that their general image has improved of late, Dr. Simon still encounters people in Europe who assume that a Chinese company must surely be selling its machines at a much lower price point than its competition on the

continent. »That's not what we do,« he says before explaining that Farsoon is working to win customers over by »offering more for the same price, like Toyota started doing 30 years ago in the automobile industry.«

To expand its presence further in Europe's crucial marketplace, the company founded the Stuttgart-based Farsoon Europe GmbH in April 2018. Dr. Simon has led the subsidiary from the very beginning, offering Farsoon's entire line of machines and local service and maintenance with the help of 12 employees.

Founded in 2009 by Dr. Xiaoshu Xu, Farsoon Technologies is a full-service provider in the field of plastic laser sintering and metal laser melting technology. Dr. Xu remains the chairman of the company, which employs around 300 people around the world. In the early 1990s, he was the technical director of the laser sintering pioneer DTM (now 3D Systems). These days, Farsoon is making its machines compatible with materials from any manufacturer based on its »Open for Industry« philosophy.

### + FURTHER INFORMATION:

» fon-mag.com

» en.farsoon.com

# THE TRANSFORMATION OF THE WORLD'S FACTORY

In its production operations, Dongguan Keheng Shouban Model has made the transition from manual labor to high tech in around 20 years



In recent economic history, the metropolis of Dongguan – approximately eight million citizens and one million registered companies strong – embodied the »Made in China« brand like no other city in the country. One in every five smartphones shipped out around the world was produced here. After being hit hard by the 2008 financial crisis, the government devised a plan to reinvent itself industrially; its efforts can now be described as a rebirth in high tech. This has included 3D printing, which should help raise China's industry to a new level.

Boasting a history that dates back over 20 years, Dongguan Keheng Shouban Model Co. Ltd. symbolizes the technological development of its home region. »Today, our company is determined to be a high-quality service platform for design, manufacturing, and industrial upgrades in China,« board chairman Binghua Wen proudly states.

These days, the question of whether 3D printing is ready for mass production is no longer an issue for Wen. Located in Chang'an, the mold-making district of the traditional industrial hotbed of Dongguan, his company has achieved internationally unparalleled volumes in industrial 3D printing. Its more

than 500 large-scale industrial 3D printers produce an annual output of more than 10 million pieces for products marketed under the brand name »Fohan«.

The business model followed by Dongguan Keheng Shouban Model is based almost exclusively on 3D printing services that can be ordered online. Although it has now added a number of international customers, the company remains focused on the Chinese market. Its products include prototyping parts, handicrafts, film and television props, and exhibition displays. The 3D printing specialist currently employs 650 people.

Since its foundation in 1998, the company's development has also mirrored the technological awakening of the entire country. For its first three years, Dongguan Keheng Shouban Model manufactured products using primarily manual methods; it then moved on to engraving, milling, and CNC processing machinery from 2004 to 2010.

It was in 2011 that the company began implementing 3D printing. »In this process, the new requirements for programming were the most critical step,« Wen recalls. Dongguan Keheng Shouban Model has quickly undertaken a massive expansion of its machine park,

Text: Ketty Zhong & Thomas Masuch

Photos: Fohan

Keheng 3D prints more than 10 million components every year, including models of video game characters (Photo 1), props and exhibits (Photo 2), and design drafts (Photo 3 and 4).



mainly with the help of Uniontech, a Chinese manufacturer of SLA equipment (see page 24) that has supplied it with more than 500 machines. In addition, nylon material is now processed on HP equipment. »In the future, we plan to expand to 1,000 machines,« a confident Wen reports.

Additive manufacturing has changed this sector to such an extent that much of the production at Dongguan Keheng Shouban Model is based exclusively on 3D printing. Traditional manufacturing methods involving different technologies are still in use, however: They account for 10 percent of the company's overall manufacturing and help meet its clients' needs (while making up for shortages). Dongguan Keheng Shouban Model demonstrates how 3D printing is fueling China's transformation from the world's low-cost factory to a high-tech industry location.

+ FURTHER INFORMATION:  
» fon-mag.com

## TALKING ABOUT

## »3D printers are like vending machines«

Heygears is one of the most impressive additive start-up stories from China. Having grown to become one of the major players in the industry in the last five years, the Guangzhou-based currently employs 320 people. For co-founder Heyuan Huang, high speed has been one of the key factors in Heygears' rise to prominence. We had the opportunity to talk to him about the company's story and its road to success.

*Mr. Huang, Heygears was founded just five years ago. What was your aim when you started?*

**HUANG** When we first started Heygears back in 2015, we were not thinking of going into additive manufacturing. At that time, we had the idea to produce earphones using a different production method. But the design, which we wanted to make as ergonomic as possible, was far too complex for traditional manufacturing methods like injection molding. When we started exploring different manufacturing technologies, we found out that AM was the only way to produce the type of structure we wanted.

*So you had to change your plans?*

**HUANG** Right. We started looking at different 3D printing manufacturers and technologies and ran into a couple of boundaries. They didn't have any experience in assembling components of that complexity, for example, nor did they have the amount of 3D printers required to fulfill our demands. We tried an alternative route by purchasing some 3D printers in those early days, but the materials we needed to use were extremely expensive and



the resolution of the printers couldn't be adjusted because the printers were completely locked.

*But that's no reason to give up...*

**HUANG** That's not in our vocabulary! Instead, we started looking at yet another way to achieve our goals. We decided to take matters into our own hands and started developing our own system, which was a very risky process. Looking back, it was absolutely the right decision because at that time, Apple came out with AirPods, which made a big splash in the wireless earphone business. At the same time, however, our earphone sales dropped quite steeply. Luckily, we had our R&D team working on the printer side of things, so we decided to look for other applications that could be produced using our systems and found some in the dental field. Five years later, we're proud to say that Heygears has developed different verticals using its core technologies in AM, AI, and big data handling.

*Quite an interesting journey, starting out as an AM user and ending up a producer of 3D printers.*

Text: Thomas Masuch

Photos: Heygears

**Heygears**

Officially founded as Guangzhou Heygears IMC. Inc. in 2015 by five friends who are still running the company today (all of whom are still under 30), Heygears has received more than US \$ 100 million in funding. It now has more than 320 employees and offices in China and the United States, which enables the company to produce around 10,000 end use parts per day around the world. According to co-founder Heyuan Huang, that number will double by the end of 2020. The majority of Heygears' customers are based in China, which is said to be the world's leading country in dental manufacturing. Its other customers groups are located in the U.S, Europe, and southeast Asia.

**HUANG** Indeed – but we consider ourselves less a producer of 3D printers than an enabler of applications. Given our background, 3D printing is only one method of manufacturing.

*It sounds like your business concepts differ somehow from those of pure 3D printing manufacturers.*

**HUANG** Heygears focuses on the application and the end product. Even though we bring a high volume of printers to market, our business model is not to sell printers and generate our revenue from machine sales; we want to enable applications and provide our customers with end-to-end workflows. Heygears believes that the only way that additive manufacturing can work is by establishing a very deep vertical application – not by selling printers to industries where we don't even know how they're going to use them. For us, 3D printers are like vending machines. Hence, our strategy is to think about what we can add to a vertical market to enable our vending machines to produce and sell more products. In addition to setting up a whole vertical system from the manufacturing point of view, we've developed our own software system, our own service team, and a

very deep understanding of the dental vertical I mentioned through our dedicated dental teams.

*And how does this strategy inform your business concept?*

**HUANG** First of all, distributed production is our main business model. We actually sell our printers to our partners around the world at relatively competitive prices. These partners, which to a large extent are dental labs here in China, use our systems to produce end use parts. The second part of our business involves being a service bureau with a focus on small- and large-series manufacturing, including for things like dental components and earphones.

*As a Chinese company, what are the benefits you enjoy in your local market?*

**HUANG** Being a high-tech company based in Guangdong Province enables us to maintain an extremely high pace in R&D and machine production. If a customer orders 10 machines, for instance, we can commit to delivering them within two weeks. Meanwhile, the government in China also supports Chinese companies in getting certifications, registrations, and possible funding

for certain inventions and innovation projects. There's also another important thing we shouldn't forget: Everything moves fast here in general. You can try things one day and get results two days later. This kind of trial-and-error is extremely important in product innovation.

*What have you learned from cooperating with your European and international partners?*

**HUANG** It's true that Europe is moving at a different pace than China. Heygears' aim is to collaborate and grow along with its partners across the globe based on our belief that we can all strengthen one another. For me, it's all a collaborative learning process. We need to learn a lot from our partners, and our partners need more input from the market – and from us.

*Mr. Huang, thank you very much for talking with us.*

## + FURTHER INFORMATION:

- » fon-mag.com
- » heygears.com/en

# SHOWCASES OF THREE-DIMENSIONAL CULTURE

The 3D printing museums in Shanghai and Shenzhen are colorful windows into the variety of China's domestic AM industry



In another example of the inevitable meeting the accidental, Shanghai's 3D Printing Culture Museum happens to be located on the site of the Old Shanghai Third Wool Factory, which dates back to 1931. There, its architecture combines traditional manufacturing with a comprehensive exhibition of three-dimensional printing technology and culture in China.

The 3D Printing Innovation Museum in Shenzhen is also concerned with the wide field of additive manufacturing. In addition to displaying comprehensive collections of AM applications, both it and the 3D Printing Culture Museum play an important role as platforms for international academic exchanges.

## OFFICIALLY OPENED IN 2017

When it officially opened its doors in Shanghai's Baoshan District on July 19, 2017, the 3D Printing Culture Museum became the first museum in the world focused on the topic of additive innovation. By serving multiple purposes as a showcase of science, AM technology, 3D culture and education, and 3D consumer products, it has become a window into the country's home-grown AM industry.

The 3D Printing Culture Museum covers an

area of 4,817 square meters at its historic location, which today belongs to the real estate company Wisdom Bay. The owner, Mr. Jian Chen, is also both an investor in and the director of the museum. The exhibition space comprises a permanent exhibition, a seasonal hall, a 3D printing center, an area for children, a training center, and a 3D Material Library that is open to the public. The exhibits span a variety of industries and fields of application, such as fashion, furniture, lighting, medical equipment, jewelry, architecture, and many more.

## MATERIAL RESEARCH LABORATORY IN SHENZHEN

China's second 3D printing museum is located in Shenzhen, Pingshan. Like its counterpart in Shanghai, the 3D Printing Innovation Museum was designed by Xuberance. It received its investment funding from the industrial company Sunshine Laser Technology Co., Ltd, which is also shareholder in Xuberance. The museum's 20,000 square meters of space will feature a 4,000-square-meter exhibition area. The initial stage of construction has now been completed, and around 3,000 digital works have already been collected.

Text: Leirah Wang

Photos: 3D Printing Culture Museum



The 3D Printing Culture Museum in Shanghai has numerous additive applications on display in an inspiring architectural setting.



Besides its regular facilities, the Shenzhen museum is also to include a large-scale service center with a well-equipped R&D team and a complete material research laboratory. R&D team leader Dr. Na Li is also the first director of the museum, where 3D digital model data represents an important collection and asset. The museum has also done research in the field of digital works, IP evaluations of 3D artwork, IP trading, and other cutting-edge disciplines.

## About the author:

Leirah Wang is the CEO of Xuberance Design and the executive director of the 3D Printing Culture Museum in Shanghai.



## OUTSIDE THE BOX



Text: Thomas Masuch

This is where you can usually expect to find an unusual and entertaining article that takes a look at part of the AM world from a very different perspective – one that’s sometimes not entirely serious. In September 2016, the very first of these columns was published on the subject of a 3D-printed case that added wheels to mobile phones. Unfortunately, good opportunities to make observations that indulge in a bit of humor or irony have grown scarcer since then. This is due in part to how developments in the industrial field of additive manufacturing have become more and more specific; the increasingly professional nature of requirements is leaving little space for less sensible applications to germinate.

Now the once-fertile ground for amusing commentary has been left even more barren by

the coronavirus pandemic. The news in recent weeks has been dominated by solemn subjects like infection statistics, ventilation equipment, and face coverings. Uncommon content has still popped up here and there, however: Fish have been spotted in the suddenly limp waters of Venice’s canals, for instance, and the air in the Indian state of Punjab has cleared up to the point that for the first time in 30 years, its citizens can see the Himalayas 200 kilometers away. Panama and Peru have only allowed men or women out on the streets separately on certain days of the week, and a study in Germany found that it has mainly been people between the ages of 18 and 29 who have been causing shortages of toilet paper, soap, and pasta with their hoarding habits. In Italy, meanwhile, the numerous convicts released from

prison have included a mafia boss – a concerned elderly gentleman with the nickname »Bin Laden« whom the authorities didn’t want to expose to the risk of infection.

The news of nature cleansing itself is very good to hear, of course, but some of the rest just makes you shake your head. Is it all right to have a laugh about Covid-related anecdotes like these, even though they involve at least a hint of danger to people’s well-being? I think it is – with a proper degree of respect. After all, humanity has survived many times of crisis, including some significantly more serious than these. They do cause our sense of humor to take a darker turn, but it has always stuck with us nonetheless.

Illustration: feedbackmedia.de, iStock /Liljanakani

## END OF ISSUE – CONTENT CONTINUES



### AM Field Guide

The AM Field Guide is a hands-on introduction and provides an initial, structured overview of the complex, multilayered world of additive manufacturing processes.

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#### @ CONTACT:

- » Hotline: +49 711 61946-810
- » [formnext@mesago.com](mailto:formnext@mesago.com)

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Fax +49 711 61946-91  
[mesago.com](http://mesago.com)

EDITED BY  
ZIKOMM – Thomas Masuch  
[thomas.masuch@zikomm.de](mailto:thomas.masuch@zikomm.de)

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