This transfer crucible for high-temperature furnaces is heat-resistant, thermally conductive and resistant to chemicals. These are all properties that this 3D-printed crucible made of silicon carbide needs, since it must withstand high temperatures. Researchers from the Fraunhofer Institute for Silicate Research (ISG) / Center HTL will use the crucible for testing high-tech materials at 1,200 degrees Celsius in a high-temperature process, which gives the crucible its robust characteristics. Thanks to 3D printing, complex or unusual designs can be realized in an efficient way. Furthermore, it saves a lot of material which would otherwise go to waste. Previously each component had to be milled out of a single block. The material loss was up to 80 percent, and some shapes were impossible to mill. Now the crucibles are produced very close to the final shape, with a material waste of nearly zero percent.
Moving forward requires that decisions be made. And to make decisions, you need a good foundation—a foundation that provides both food for thought and impetus for action.

A vision can provide this sort of foundation. The vision defines a goal, gives the goal meaning and formulates an aspiration. It offers orientation in the flood of decisions and reduces complexity to a tolerable level. And it also helps when things turn out differently than expected, when an idea proves to be the wrong path or even when a simple mistake is made. In these types of situations, a vision can remind you what it’s really all about.

As SGL Carbon we have also made mistakes and suffered setbacks. Our vision of a smarter world spurs us onward all the more: to improve ourselves every day, to continue down our path in order to win over our clients with smart solutions.

We’ve dedicated this issue to the value of vision. In it we introduce people who are constantly pursuing their goals just like we do. We visited our factories in Poland, where the foundation for many of our solutions is created. And we take a look at the fuel cell, the vision for which is in the process of becoming a reality. We’re looking to the future: thinc further!
I’ve only been living in Shanghai for a few months, but I’m already feeling quite at home. My coworkers gave me a very warm welcome, showed me everything and have fully integrated me into living and working here. They’ve given me tips about the most important Chinese apps and interesting cultural attractions, introductions to Chinese cuisine and much more. The hospitality is fantastic and is a super foundation for successful teamwork—and we will need it. SGL Carbon is building a huge expansion of our factory here, to supply the LED industry with high-precision coated graphite components. I’m responsible for the engineering of the production facilities and infrastructure and work in close collaboration with my Chinese colleagues.

I grew up speaking two languages and have strong personal connections to both Germany and the US. I’ve worked for SGL Carbon in Melleingen and Wiesbaden in Germany, and also in the US. Asia is now the third continent that I’ve lived on for the company and this was the point that really convinced me. I love working in international teams and getting to know new cultures and I’d never lived in Asia before for any length of time. I’m learning Chinese right now and starting to find my way around the city. Of course, there’s also the existing technology and the extremely challenging work of being an expert from the US, Germany and China, and colleagues from Shanghai. Together we’re building a real high-tech factory.

When SGL Carbon offered me the job in Shanghai, I was a bit hesitant because I’ve moved around a lot in the past. Ultimately, however, the project’s appeal and my wanderlust were stronger. I grew up speaking two languages and have strong personal connections to both Germany and the US. I’ve worked for SGL Carbon in Melleingen and Wiesbaden in Germany, and also in the US. Asia is now the third continent that I’ve lived on for the company and this was the point that really convinced me. I love working in international teams and getting to know new cultures and I’d never lived in Asia before for any length of time. I’m learning Chinese right now and starting to find my way around the city. Of course, there’s also the existing technology and the extremely challenging work of being an expert from the US, Germany and China, and colleagues from Shanghai. Together we’re building a real high-tech factory.

I’ve only been living in Shanghai for a few months, but I’m already feeling quite at home. My coworkers gave me a very warm welcome, showed me everything and have fully integrated me into living and working here. They’ve given me tips about the most important Chinese apps and interesting cultural attractions, introductions to Chinese cuisine and much more. The hospitality is fantastic and is a super foundation for successful teamwork—and we will need it. SGL Carbon is building a huge expansion of our factory here, to supply the LED industry with high-precision coated graphite components. I’m responsible for the engineering of the production facilities and infrastructure and work in close collaboration with my Chinese colleagues.

When SGL Carbon offered me the job in Shanghai, I was a bit hesitant because I’ve moved around a lot in the past. Ultimately, however, the project’s appeal and my wanderlust were stronger. I grew up speaking two languages and have strong personal connections to both Germany and the US. I’ve worked for SGL Carbon in Melleingen and Wiesbaden in Germany, and also in the US. Asia is now the third continent that I’ve lived on for the company and this was the point that really convinced me. I love working in international teams and getting to know new cultures and I’d never lived in Asia before for any length of time. I’m learning Chinese right now and starting to find my way around the city. Of course, there’s also the existing technology and the extremely challenging work of being an expert from the US, Germany and China, and colleagues from Shanghai. Together we’re building a real high-tech factory.

When SGL Carbon offered me the job in Shanghai, I was a bit hesitant because I’ve moved around a lot in the past. Ultimately, however, the project’s appeal and my wanderlust were stronger. I grew up speaking two languages and have strong personal connections to both Germany and the US. I’ve worked for SGL Carbon in Melleingen and Wiesbaden in Germany, and also in the US. Asia is now the third continent that I’ve lived on for the company and this was the point that really convinced me. I love working in international teams and getting to know new cultures and I’d never lived in Asia before for any length of time. I’m learning Chinese right now and starting to find my way around the city. Of course, there’s also the existing technology and the extremely challenging work of being an expert from the US, Germany and China, and colleagues from Shanghai. Together we’re building a real high-tech factory.

When SGL Carbon offered me the job in Shanghai, I was a bit hesitant because I’ve moved around a lot in the past. Ultimately, however, the project’s appeal and my wanderlust were stronger. I grew up speaking two languages and have strong personal connections to both Germany and the US. I’ve worked for SGL Carbon in Melleingen and Wiesbaden in Germany, and also in the US. Asia is now the third continent that I’ve lived on for the company and this was the point that really convinced me. I love working in international teams and getting to know new cultures and I’d never lived in Asia before for any length of time. I’m learning Chinese right now and starting to find my way around the city. Of course, there’s also the existing technology and the extremely challenging work of being an expert from the US, Germany and China, and colleagues from Shanghai. Together we’re building a real high-tech factory.
Our world is more complex than ever. If you want to move forward you need a vision—and to implement a vision you need above all endurance, flexibility and a comprehensive overview. An essay about the value of having a vision—backed by examples from five real-world visionaries.
When John F. Kennedy appeared before a joint session of Congress in Washington DC on May 25, 1961, he brought along an idea with huge ramifications. “I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the Earth,” Kennedy said, declaring his vision to the legislators. Eight years later, on July 21, 1969, Neil Armstrong became the first person to walk on the moon.

Immense forces were unleashed when Kennedy made his famous speech stating publicly this goal. NASA’s budget was increased by 400 percent. Up to 400,000 people worked either directly or indirectly on the Apollo Project. The US ended up investing more than 24 billion dollars in its space program. The expression of a vision had an impact—and was regarded as a powerful tool for every organization from that point forward.

This situation was quite different in Germany: during the election campaign in 1980, former Chancellor Helmut Schmidt once said that a person with visions would be better off going to the doctor. With these words, Schmidt initially dealt a lasting blow to the notion of the vision. Visionary ideas and visionaries have thus been interpreted very differently in various countries throughout history.

Since that time, the vision has been rehabilitated in Germany and also enjoys a good reputation globally. After all, there are sound arguments for one: something Kennedy proved back in the sixties: a vision can give purpose and combine forces. It can bring focus to a goal and provide perspective necessary in a world that’s becoming more and more complex.

Everything is connected to everything

Around 500 years ago, being a successful baker required just flour, water and yeast, plus heat to transform it into loaves of bread. Some 200 years ago, getting started as a successful producer of household appliances. It can bring focus to a goal and provide perspective necessary in a world that’s becoming more and more complex.

This situation was quite different in Germany: during the election campaign in 1980, former Chancellor Helmut Schmidt once said that a person with visions would be better off going to the doctor. With these words, Schmidt initially dealt a lasting blow to the notion of the vision. Visionary ideas and visionaries have thus been interpreted very differently in various countries throughout history.

Since that time, the vision has been rehabilitated in Germany and also enjoys a good reputation globally. After all, there are sound arguments for one: something Kennedy proved back in the sixties: a vision can give purpose and combine forces. It can bring focus to a goal and provide perspective necessary in a world that’s becoming more and more complex.

Everything is connected to everything

Around 500 years ago, being a successful baker required just flour, water and yeast, plus heat to transform it into loaves of bread. Some 200 years ago, getting started as a successful producer of household appliances. It can bring focus to a goal and provide perspective necessary in a world that’s becoming more and more complex.

This situation was quite different in Germany: during the election campaign in 1980, former Chancellor Helmut Schmidt once said that a person with visions would be better off going to the doctor. With these words, Schmidt initially dealt a lasting blow to the notion of the vision. Visionary ideas and visionaries have thus been interpreted very differently in various countries throughout history.

Since that time, the vision has been rehabilitated in Germany and also enjoys a good reputation globally. After all, there are sound arguments for one: something Kennedy proved back in the sixties: a vision can give purpose and combine forces. It can bring focus to a goal and provide perspective necessary in a world that’s becoming more and more complex.

This makes business decisions extremely complex these days. The technology a company relies on, the country where it builds a new production facility, the sales markets it decides to focus on—every decision has consequences for all other market participants. And that raises two very important questions: How can the right decision be made? And what do you do when the decision was the wrong one? Management science has numerous answers, theories and suggestions for these
questions. Yet as different as the approaches may be, they have one thing in common: they need a vision to work.

But what is a vision and what does it mean for a company? By definition, a vision is first and foremost an idea of an ideal condition in the future. So it’s a strategic goal that provides orientation. A pathfinder in the jumble of constant change. A type of multifunctional tool in the jungle of complexity that can be used to overcome obstacles and head off in the right direction from the innumerable forks in the road.

Yet that’s not everything. There are also aspects of what is called purpose, and for some time now this has come to mean a new concept. It brings together a company’s objective with its understanding of its role in the world. It embodies the idea that employees aren’t just driven by remuneration and career opportunities, but by a sense of meaning and the pursuit of a common goal. A company’s purpose provides answers to the question of why: Why are we doing what we do? What do we want to achieve in the world? Why are we producing carbon and graphite in the first place? What’s the point of all this? Why do we care about sustainability? Why do we want to provide impetus? A vision answers these types of questions because it presents a goal and focal point that goes well beyond mere figures and pure shareholder value. It emphasizes stakeholder value, thereby including all the relevant interest groups in its actions. And, in SGL Carbons’ case, it defines an aspiration for itself: We’re making our contribution to a smarter world!

Clever and flexible implementation

A vision therefore has a high value for companies. It helps guide the company and makes it easier to recruit the best employees. It transforms work by creating a common goal and serves as a reminder, in turbulent times, of what the company is really about. It shows why the hard work and efforts are worth it.

At the same time, every vision also holds a danger. Coordinating thoughts and actions towards a particular goal means an inevitable focus on just that. While searching for data that supports a given thesis, other developments are possibly overlooked, ones that might have opened up other potentials. The world may automatically be interpreted through a certain lens and exclude other potential developments with every decision made.

Every vision is therefore only of value when it is combined with clever and flexible implementation, particularly in a complex world. “It always depends on what you make of the vision,” says economist Nitin R. Joglekar.
“My final project at university was to develop a new type of traffic light sequencing. I made the chip for it myself in the mini-lab at my university. When the traffic light worked, it was a pivotal moment for me—the enthusiasm to set things into motion has stayed with me until this day.

Back then, the internet and smartphones were unforeseeable. In the meantime, they’ve revolutionized entire industries, our whole lives. This demonstrates the power that visionary ideas can have. Real progress only becomes possible when you break free from conventional ideas and think beyond the contradictions and the small details of everyday life. And when you are prepared to accept setbacks, learn from your mistakes and just keep going—as an individual and in a team.

I believe the electronics industry is the most exciting industrial sector. Not least because, this industry generates 80% of innovations but also visionary thinking is part of everyday business. After all, it’s creating technology solutions for the huge technical, economic and social challenges of the future. Medicine, mobility, energy supplies, environmental protection—smart electronics play a role in practically every area of life.

This naturally also creates its own challenges. The number of connected devices will reach the trillions by 2030 at the latest, and the amount of data they generate is growing exponentially. How can this data be put to good use? What business models have a future, where do we need new approaches? How do we manage to provide young people around the world with the necessary know-how for the digital economy? And how can all of this be achieved in a sustainable and environmentally friendly way? SEMI, the global electronics design and manufacturing industry association with over 2,100 members worldwide, is helping to find answers to these questions. For instance, by connecting all the key players and key stakeholders along the value chain.

And—we hope—by providing them with visionary ideas.”

Laith Altimime
President of SEMI Europe, Berlin, Germany

“Climate change is one of the greatest challenges of our time. We’ll only come to grips with it if we stop using fossil fuels in the near future. We need a true energy transition for this and it will only be possible if we can provide sufficient energy storage systems. When I was growing up, lead batteries were the be-all and end-all and cellphone batteries were as large as briefcases. What it meant at the time was low performance for high cost. That’s when my vision was born to make it better and prove otherwise. To show the world that we can power forklifts, buses, cranes, boats, wheelchairs, electric bikes and every other mobility device with efficient and affordable battery packs.

When you set such high goals for yourself, it’s important not to set any limits on your thinking. It’s about strategic planning and learning from the wrong decisions. We’ve been operating at the BMZ Group exactly like this over the past 25 years and recognized the potential of lithium-ion cells as an energy storage medium early on. Today we’re the market leader in Europe and are growing around the world. We’re delivering the energy for the energy transition—and exactly when it’s needed.”

Sven Bauer
CEO and founder of the BMZ Group, Karlstein am Main, Germany
He investigates innovation and management processes at the Boston University Questrom School of Business. In 2012, he and his colleague Edward G. Anderson published the book The Innovation Butterfly. Referring to the butterfly effect, they describe the potentially enormous effects the smallest changes can have in complex systems. Joglekar calls such changes innovation butterflies. They can be ideas or inventions, but also changes in project plans. They first appear as inconspicuous disturbances but then expand into large-scale effects through the interweovenness of complex systems. One example Joglekar cites is Nintendo’s development of the Wii game console. Instead of investing in ever better graphic simulations, Nintendo instead focused on more intuitive controls for the console, developing a completely new controller. What initially appeared to be a small change ended up turning whole areas of the industry completely upside down.

Huge opportunities
To deal effectively with such sudden developments, companies should continually question their vision. Joglekar recommends. Not daily, not every week, but regularly. This requires flexibility, continuous change, perseverance and a comprehensive overview—only then can a company infuse a vision with the life it needs. Joglekar describes in his book what this means in practice: companies should do everything in their power to gain as complete an overview of their industry as possible. They must learn to identify disruptive disturbances early enough with the help of large amounts of data and artificial intelligence so as to then quickly and flexibly react to them. To ensure this works, they must decentralize decision-making, create agile structures and establish a culture in which problems are viewed as opportunities instead of obstacles.

This means a lot of work for companies—but above all else also a huge opportunity. Those who recognize innovation butterflies or other market or technology changes early enough—or even drive such changes themselves—won’t be overwhelmed by the later effects but can take advantage of them. Adapting a vision with agility, flexibility and at the right moment in time means emerging stronger after each change.

View problems as opportunities instead of obstacles

 enormus relief to continue. It’s an point, analyze and a step back at that things and is painful. That’s the nature of a wrong decision. Notice that we’ve made points where we no- we constantly reach building prototypes their best. Everyone in the feels right for me. Being paid for it, it Although we’re not NEXT Prototypes e. V. The whole thing appearing to be a small change ended up turning whole areas of the industry completely upside down.

Huge opportunities
To deal effectively with such sudden developments, companies should continually question their vision. Joglekar recommends. Not daily, not every week, but regularly. This requires flexibility, continuous change, perseverance and a comprehensive overview—only then can a company infuse a vision with the life it needs. Joglekar describes in his book what this means in practice: companies should do everything in their power to gain as complete an overview of their industry as possible. They must learn to identify disruptive disturbances early enough with the help of large amounts of data and artificial intelligence so as to then quickly and flexibly react to them. To ensure this works, they must decentralize decision-making, create agile structures and establish a culture in which problems are viewed as opportunities instead of obstacles.

This means a lot of work for companies—but above all else also a huge opportunity. Those who recognize innovation butterflies or other market or technology changes early enough—or even drive such changes themselves—won’t be overwhelmed by the later effects but can take advantage of them. Adapting a vision with agility, flexibility and at the right moment in time means emerging stronger after each change.

View problems as opportunities instead of obstacles

 enormus relief to continue. It’s an point, analyze and a step back at that things and is painful. That’s the nature of a wrong decision. Notice that we’ve made points where we no- we constantly reach building prototypes their best. Everyone in the feels right for me. Being paid for it, it

Huge opportunities
To deal effectively with such sudden developments, companies should continually question their vision. Joglekar recommends. Not daily, not every week, but regularly. This requires flexibility, continuous change, perseverance and a comprehensive overview—only then can a company infuse a vision with the life it needs. Joglekar describes in his book what this means in practice: companies should do everything in their power to gain as complete an overview of their industry as possible. They must learn to identify disruptive disturbances early enough with the help of large amounts of data and artificial intelligence so as to then quickly and flexibly react to them. To ensure this works, they must decentralize decision-making, create agile structures and establish a culture in which problems are viewed as opportunities instead of obstacles.

This means a lot of work for companies—but above all else also a huge opportunity. Those who recognize innovation butterflies or other market or technology changes early enough—or even drive such changes themselves—won’t be overwhelmed by the later effects but can take advantage of them. Adapting a vision with agility, flexibility and at the right moment in time means emerging stronger after each change.

View problems as opportunities instead of obstacles

 enormus relief to continue. It’s an point, analyze and a step back at that things and is painful. That’s the nature of a wrong decision. Notice that we’ve made points where we no- we constantly reach building prototypes their best. Everyone in the feels right for me. Being paid for it, it

Huge opportunities
To deal effectively with such sudden developments, companies should continually question their vision. Joglekar recommends. Not daily, not every week, but regularly. This requires flexibility, continuous change, perseverance and a comprehensive overview—only then can a company infuse a vision with the life it needs. Joglekar describes in his book what this means in practice: companies should do everything in their power to gain as complete an overview of their industry as possible. They must learn to identify disruptive disturbances early enough with the help of large amounts of data and artificial intelligence so as to then quickly and flexibly react to them. To ensure this works, they must decentralize decision-making, create agile structures and establish a culture in which problems are viewed as opportunities instead of obstacles.

This means a lot of work for companies—but above all else also a huge opportunity. Those who recognize innovation butterflies or other market or technology changes early enough—or even drive such changes themselves—won’t be overwhelmed by the later effects but can take advantage of them. Adapting a vision with agility, flexibility and at the right moment in time means emerging stronger after each change.

View problems as opportunities instead of obstacles

 enormus relief to continue. It’s an point, analyze and a step back at that things and is painful. That’s the nature of a wrong decision. Notice that we’ve made points where we no- we constantly reach building prototypes their best. Everyone in the feels right for me. Being paid for it, it

Huge opportunities
To deal effectively with such sudden developments, companies should continually question their vision. Joglekar recommends. Not daily, not every week, but regularly. This requires flexibility, continuous change, perseverance and a comprehensive overview—only then can a company infuse a vision with the life it needs. Joglekar describes in his book what this means in practice: companies should do everything in their power to gain as complete an overview of their industry as possible. They must learn to identify disruptive disturbances early enough with the help of large amounts of data and artificial intelligence so as to then quickly and flexibly react to them. To ensure this works, they must decentralize decision-making, create agile structures and establish a culture in which problems are viewed as opportunities instead of obstacles.

This means a lot of work for companies—but above all else also a huge opportunity. Those who recognize innovation butterflies or other market or technology changes early enough—or even drive such changes themselves—won’t be overwhelmed by the later effects but can take advantage of them. Adapting a vision with agility, flexibility and at the right moment in time means emerging stronger after each change.

View problems as opportunities instead of obstacles

 enormus relief to continue. It’s an point, analyze and a step back at that things and is painful. That’s the nature of a wrong decision. Notice that we’ve made points where we no- we constantly reach building prototypes their best. Everyone in the feels right for me. Being paid for it, it

Huge opportunities
To deal effectively with such sudden developments, companies should continually question their vision. Joglekar recommends. Not daily, not every week, but regularly. This requires flexibility, continuous change, perseverance and a comprehensive overview—only then can a company infuse a vision with the life it needs. Joglekar describes in his book what this means in practice: companies should do everything in their power to gain as complete an overview of their industry as possible. They must learn to identify disruptive disturbances early enough with the help of large amounts of data and artificial intelligence so as to then quickly and flexibly react to them. To ensure this works, they must decentralize decision-making, create agile structures and establish a culture in which problems are viewed as opportunities instead of obstacles.

This means a lot of work for companies—but above all else also a huge opportunity. Those who recognize innovation butterflies or other market or technology changes early enough—or even drive such changes themselves—won’t be overwhelmed by the later effects but can take advantage of them. Adapting a vision with agility, flexibility and at the right moment in time means emerging stronger after each change.
Since the middle of last year, SGL Carbon has been mass-producing transverse leaf springs made of fiberglass-based composites for the rear axle of the Ford Transit. The leaf springs are used in conjunction with the Transit’s low-frame chassis. They are thus utilized where large payloads and additional loads are required, for instance in motorhomes or in special commercial vehicle versions of the Transit. It is the first leaf spring project for Ford with mass-produced composites. The innovative components are one hundred percent compatible with conventional steel springs, offering a weight savings of around 50 percent and increased safety standards. “The composite transverse leaf springs for the Ford Transit low-frame chassis are another milestone in developing lightweight leaf springs suitable for mass production,” says Sebastian Grasser, automotive director for the SGL Carbon Composites—Fibers & Materials business unit. “They are impressive not only for their special material properties and a partially automated manufacturing process that was implemented from the outset, but particularly for their high degree of compatibility with the customer’s various models.”

Young Talent Secured

Forty-four trainees began their careers at various German and Austrian SGL Carbon facilities in early September 2019. They are preparing for a future as industrial managers, process mechanics, cutting machine operators, machine and plant supervisors, mechatronic engineers and electronics engineers, for example. Furthermore, SGL Carbon also offers dual degree programs with a business or technical focus, such as mechanical engineering. At the start of the new training year, SGL Carbon Group Vice President Human Resources Birgit Reiter said, “The skills and knowledge of our employees are a central factor for our success as a technology company. Our in-house training is traditionally an important source for covering our personnel needs in the commercial-technical field. Our trainees and dual-program students are part of the future of SGL Carbon.”

Cooperation with Solvay

SGL Carbon and the international chemical company Solvay have entered into a joint development agreement to introduce fiber composites based on large-tow carbon fibers to the market for the first time. The materials, which are based on SGL Carbon’s large-tow IM carbon fibers and Solvay’s resin systems for primary structures, are expected to meet all the requirements for modern commercial aircraft in the future: lower costs and carbon dioxide emissions as well as higher production and fuel efficiencies. SGL Carbon’s expertise in the mass production of carbon fibers and Solvay’s leading role as a supplier of advanced materials for the aerospace industry form the foundation for this cooperation. Fiber-reinforced composites in the aerospace industry are a growing billion-dollar market.
Fuel cells are regarded as one of the most important and sustainable technologies of the future. Yet until now teething troubles and high costs have been holding them back. Scientists and manufacturers are working on increasing their utilization—with SGL Carbon solutions and know-how.

The train on track 4 rolls into Bremerhaven Central Station with a quiet hum. This Monday morning, at 9:20 a.m., train RB33 is right on schedule. Outwardly there’s nothing unusual about it: it’s paint-ed blue with white lettering and is several wagons long. Hidden inside, however, is a technology that could largely determine the direction of many transportation concepts of the future.

The RB33, on its route for Bremer-örde via Bremerhaven to Cuxhaven, runs on hydrogen. Two fuel cells on top of the train convert the hydrogen gas and oxygen from the air into electrical energy. The only byproducts are water and electricity: not a bit of harmful fine particulate matter, not a gram of carbon dioxide, but 200 kilowatts of power per fuel cell. The two cells can propel the train at speeds reaching 140 kilometers an hour. There’s enough hydro-gen in the full tanks to cover up to 1,000 kilometers. Two such trains have been rolling across northwest Germany for the past eighteen months. It’s the first time anywhere that hydrogen-powered trains have been running regular routes. The first results from the project are promising: hardly any technical issues, satisfied passengers, and a whole lot of attention.

The hydrogen train in northern Ger-many is just one of a dozen projects world-wide in which the fuel cell is experiencing the beginnings of a renaissance. In the US, Bosch and Nikola Motors are developing a fuel cell for trucks, with more than 1,000 horsepower and a range of 1,600 kilometers. Hyundai has brought an affordable and powerful hydrogen-powered SUV to market with its NEXO model. In the aviation industry, researchers at the American space agency NASA are working with scientists at the University of Illinois on hydrogen-powered aircraft. Out on the water, fuel cells may soon be powering cruise ships, ferries and inland freighters. And bus manufacturers including Wibcibus, van Hool and Solaris are also betting on hydrogen in the meantime.

At the same time, important sales markets are shifting in this new direction. China is planning to build four hydrogen corridors and wants to shift its govern-ment subsidies away from electric vehi-cles and towards fuel cells; by 2030, the government hopes that a million hydrogen vehicles will be operating in the country. The German Chancellor Angela Merkel announced a national hydrogen strategy for aviation. And Japan and California have been strategically driving the develop-ment of fuel cells for years now.

After several decades as a “hidden champion,” the fuel cell may finally achieve the breakthrough its advocates have been hoping for since its invention. After a number of development steps, this fascinating idea of generating clean, sus-tainable and efficient energy from two of our planet’s most basic elements may soon be making a successful leap from niche applications to the mass market.

**Best conditions**

The conditions for this to happen are more favorable than ever: the climate crisis is forcing politicians, society and businesses to shift to new, more climate-friendly energy sources. Battery-based electric mo-tors have found their place in urban trans-port but start to falter over longer distances and in the air, on the water and also by rail. In contrast, the fuel cell has managed to overcome its teething trou-bles and really shines where battery solu-tions have come up short. Yet there are still enormous challenges ahead. The in-frastructure for comprehensive coverage in providing hydrogen supplies is still lagging behind the very ambitious plans in almost every market. And the production costs for fuel cells are much too high for many application fields.

Just a few kilometers north of Mu-nich, Prof. Dr. Hubert Gasteiger is working to help get this technology over the final hurdles. At the Technical
An Idea Reinvents Itself

1839

The Welsh scientist Sir William Robert Grove conducts experiments on the electrolysis of water to form hydrogen and oxygen. He also notices that the process can be reversed: hydrogen and oxygen can be used to produce electricity. He creates the first fuel cell, which he calls the “gas voltaic battery.”

1937

Almost 100 years after its discovery, the technical use of hydrogen experiences a setback. Thirty-five people lose their lives in the Hindenburg disaster, causing hydrogen to fall into disrepute. Yet it wasn’t actually the hydrogen that caught fire, but rather the zeppelin’s outer fabric skin.

1966

The first fuel cell systems are used in spaceflight. Engineers at NASA and from General Electric develop the FGM fuel cell, but the technology takes up far too much space.

University of Munich, Gasteiger holds the Chair of Technical Electrochemistry. He and his team are researching the contributions that fuel cells and lithium-ion batteries can make to solving the great sociopolitical and ecological challenges of our era.

Gasteiger is one of the few specialists who is as comfortable in the realm of lithium-ion batteries as he is in the world of fuel cells. He wrote his doctoral thesis on electrocatalysts for fuel cells and electrolysis. He later spent almost a decade advancing materials development for fuel cell stacks for General Motors and Opel. After an interlude at the Massachusetts Institute of Technology (MIT) in the field of lithium-air batteries, in 2010 he accepted the call from Munich, where he has since held a professorship in both technologies and is continuing that development.

To understand where the fuel cell stands today, it’s worth going on a short excursion with Gasteiger into the past. When he started working for General Motors and Opel back in 1998, there was a “gold rush” atmosphere. There were huge expectations for the fuel cell. Opel and (General Motors) pumped billions into developing the technology. This naturally required resources—and fast. As of 2004, Opel managers were planning for the first 100,000 cars with hydrogen fuel cells to roll off the production lines.

Towards mass production again and again “Our team grew at a breakneck speed during this time,” Gasteiger recalls. His team soon included some of the best researchers. Yet as great as the expectations were, the reality was merciless. The first fuel cells only lasted about 100 hours, consumed too much platinum and didn’t produce enough energy. The target of 100,000 cars was quickly off the table. Despite this, the researchers managed to cure more daunting problems with each new prototype. Each development step brought the technology just a little bit closer to maturity for mass production. As soon as the biggest hurdles seemed to have been cleared, in 2000, the financial crisis finally drove a stake through the heart of the project, marking its end. A short time later, Elon Musk entered the playing field and announced a new era of battery-based electromobility with Tesla. For now, the fuel cell was languishing in obscurity in the US and Europe.

While research and industry direct their focus onto lithium-ion batteries in the years that followed, interest in fuel cells soon began to emerge once again in certain fields. “Today I believe that both technologies will prevail,” Gasteiger says. In urban traffic, electric vehicles are favored due to their low costs, higher energy efficiency and a charging infrastructure that is fairly easy to set up, at least in the beginning. For longer distances and for trains is where the assets of fuel cells come into play: much longer ranges and shorter refueling times.

Gasteiger also lists another argument for fuel cells: if countries convert their electricity supplies to renewable energies to achieve their climate goals, energy storage systems will be needed. “And from today’s point of view, you simply can’t ignore the use of hydrogen for the temporary storage of large amounts of energy,” he says. Once the hydrogen temporary storage systems are built, this in turn would facilitate the expansion of the entire infrastructure—thus paving the way for cars, buses, trucks and, over the longer term, for ships and airplanes as well.

But there’s still another stumbling block: the more fuel cells that are built and the more powerful they become, the greater the need for valuable platinum. The precious metal is used as a catalyst in fuel cells. While years of improving the catalysts have steadily reduced the amount of platinum necessary per cell, at some point there were no more savings to be made in this area. “Then they started to increase the current density of the fuel cells,” Gasteiger says.

This has made the gas diffusion layers made of carbon fibers more important than ever. They act as a buffer in the fuel cell between the bipolar plates and the catalyst, fulfilling many important functions (see the infographic). As long as the current density for the cells remained at a low level, the requirements for the gas diffusion layers were fairly manageable. Now, however, with the higher performance demands, they are rising by leaps and bounds.

The special properties of carbon fibers are up to the task.

Energy from Water and Air

Fuel cells require only hydrogen and oxygen to produce electrical energy. Both gases flow in separately over bipolar plates and through gas diffusion layers. The membrane allows only protons to pass through it and is coated with platinum on both sides. The platinum serves as the catalyst and initiates the chemical reactions. The hydrogen molecules split into electrons and protons at the anode. The electrons flow through an external conductor to the cathode, providing electricity along the way. At the cathode, oxygen molecules react with the electrons and protons to form water, which leaves the cell via the gas diffusion layer and the channels on the bipolar plates and out of the cell.
As Gasteiger explains, any boat is fine when the weather is good. But as soon as storm clouds approach, you’d rather be sailing in a better ship. “In the future will be characterized by both battery and power densities,” he says. “That’s why there’s an exciting future ahead for the gas diffusion layer made of carbon.”

In the Bavarian town of Meitingen, less than 150 kilometers from Gasteiger’s laboratory, Tilo Hauke is standing in front of a meter-long sintering furnace and watching a batch of freshly produced gas diffusion layers roll off the production line. Hauke heads the Central Innovation department of SGL Carbon in Meitingen. He’s been studying the development of fuel cells for years. Hauke, like Gasteiger, believes that the mobility of the future will be characterized by both battery power and fuel cells. And he is also convinced: “The era of the fuel cell is dawning.”

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

After another twenty years of development, Toyota introduces the first mass-produced fuel cell car. The Mirai can cover up to 500 kilometers with a full tank, which takes just three minutes to refill. The use of fuel cells is now also being tested for airplanes, ships and trucks.

The fuel cell is also used during Apollo 11, the first manned Moon landing. One of the technology’s advantages is that it delivers both dependable energy and drinking water for the crew.

Huge growth potential
While the band of material—about as wide as a human arm—is impregnated, coated and insulated inside the furnace behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.

When the fuel cell experienced its first peak at the end of the 1980s, SGL Carbon also entered the gas diffusion layers business. “Today we have quite a lot of experience to draw on; we rely on a close relationship with the sintering line behind Hauke, he lists the advantages of carbon fibers for gas diffusion layers. “They’re permeable to gases, repel water, are easily compressible and conduct both heat and electricity.” All of these are important properties for gas diffusion layers. In the fuel cells, hydrogen gas, oxygen gas and electrons flow through these layers. In addition, they channel off the resulting water and also protect the catalyst membrane layer from the corners and edges of the bipolar plates at the sides of the individual cells.
Flexible, dependable, innovative: At its facilities in Poland, SGL Carbon produces very specific graphite-based materials for our modern world. The sites’ more than 200 employees are constantly reinventing themselves to further develop the applications and their production methods.

Way down in southern Poland, close to the Slovakian border, the landscape suddenly resembles Scotland. The road to Nowy Sącz meanders past a lake that looks like Loch Ness against the backdrop of the panoramic Tatra Mountains. Nowy Sącz, a city with a population of 80,000 located about two hours away from Cracow by car, is home to one of the two SGL Carbon facilities in Poland.

The hall where the largest and most complex graphite components are produced is located right next to the site’s main access road. Automated machining tools made of high-grade steel shape them out of graphite blocks. At first sight, the blocks with their dark grey color and their height of up to two meters seem to be unspectacular, somehow like huge pencil leads. However, they have various extraordinary material properties such as extreme resistance to heat and corrosion, electrical conductivity, and mechanical strength. Thus, they are used for many different state-of-the-art applications in the automotive, semiconductor and chemical industries as well as in the battery sector.

One material, many applications
Site Manager Grzegorz Rogowski—buzz cut, striking face, white shirt—receives us in the machine hall. The 53-year-old has been working for SGL Carbon for almost 20 years. In 2008, he was promoted to site manager in Nowy Sącz and to managing director in 2016. As such, he’s responsible for the partner facility in Racibórz as well. “Graphite has always been my passion,” he says. He studied energy and fuels at Cracow University. “Depending on how you configure the material it can serve many different production fields.”

Parts made of carbon have many advantages. Graphite components can be made very small and can also
SGL Carbon is currently modernizing and expanding its automotive production areas in Both, Germany as well as in Nowy Sącz. “It’s a complex process,” he says walking past one of the baking furnaces in the middle of the hall. He’s heading toward a large hopper mounted on the wall. A lot of improvements have recently been realized at the site in this sector. The innovations have begun with the storage of the raw materials, which are kept in huge new funnel-shaped silos at the edge of the hall. The fully automatic robot arm in front of Pacholczak grabs one piece of material after another and puts it on carts the workers use to transport them to the next production step. “This is a huge efficiency gain for us,” Pacholczak says. The gripper robot relieves the workers from the tedious task.

From the grider, the blocks now go to be baked. Pacholczak and his team are still using traditional baking furnaces. But even this process will soon be accelerated. “This gives us flexibility and is forward-looking,” Rogowski explains. It’s exactly this combination, along with the specialist expertise, that is probably the most important success factor for the work at both facilities, which is characterized by a mixture of innovation, flexibility and stability. “We’ve been producing graphite here for 150 years and we want to do it for the next 120,” Rogowski says. “But we’ll never be doing it without constantly developing ourselves further.”

Wiesław Chlipała co-ordinates the industrial and the automotive production areas in Nowy Sącz.
LEDs are considered the lighting of the future. They save energy, can be modified at will, and have a number of additional persuasive advantages.

ILLUSTRATION: Julian Burford

22 Billion US dollars is the amount of sales projected for what are known as packaged LEDs—LED chips encapsulated in epoxy, including the contacts for assembly.

Goodbye, Moths
In contrast to incandescent bulbs, LED light does not attract insects. LEDs don’t usually emit ultraviolet light—which is exactly what attracts many bugs.

Germ Killer
UV light reliably kills fungi, germs and bacteria. LEDs can produce such light particularly efficiently and inexpensively. For instance, UVC LEDs can help purify drinking water.

UV light reliably kills fungi, germs and bacteria. LEDs can produce such light particularly efficiently and inexpensively. For instance, UVC LEDs can help purify drinking water.

Flexible
Some light-emitting diodes are smaller than a peppercorn, others as big as a postage stamp.

SGL Carbon’s LED Business
LEDs are based on semiconductors. To manufacture them, many producers rely on system components made by SGL Carbon. For instance, the company manufactures wafer carriers made of graphite. During semiconductor production, wafer substrates are placed on these carriers and ultra-thin compound semiconductor layers are deposited onto the wafers. The deposition takes place under extreme conditions and at high temperatures in what are known as MOVCD reactors. The SGL Carbon components made of isostatic graphite easily withstand such conditions.

500 Million tons of CO₂
of carbon-dioxide emissions will be prevented worldwide through the use of LED lamps. That’s more savings than halving the amount of automobile traffic in Germany.

A Hemisphere of LEDs
The global market penetration for LED lamps is estimated to reach 50 percent by the year 2022.

Light-Emitting Diodes illumine the Times Square Ball, which drops every New Year’s Eve in New York City.

32,256
of carbon-dioxide emissions will be prevented worldwide through the use of LED lamps. That’s more savings than halving the amount of automobile traffic in Germany.

Harvest Helper
Specially adapted LEDs are ideal for use in urban farming. The light is optimized to perfectly promote photosynthesis and control plant growth.

Flexible
Some light-emitting diodes are smaller than a peppercorn, others as big as a postage stamp.

Light-Emitting Diodes illumine the Times Square Ball, which drops every New Year’s Eve in New York City.

1,000 h
2,000–4,000 h
10,000 h
20,000–50,000 h

White Light

Gold Wire
Phosphorus Layer
LED Chip
Anode
Cathode
Reflector Dish

Specially adapted LEDs are ideal for use in urban farming. The light is optimized to perfectly promote photosynthesis and control plant growth.

Flexible
Some light-emitting diodes are smaller than a peppercorn, others as big as a postage stamp.
Lightweight construction, battery development, 3D printing and more: SGL Carbon is pooling its resources to advance technology research and development at the Carbon Campus in Metingen, Germany. A tour with the pioneers of change.
The Carbon Campus brings our carbon know-how together

even more closely together. They’re developing and qualifying measurement methodologies for testing small-scale batteries under real-life conditions. Just like Damjanovic, Hammer finds the campus concept a win-win option for the company, “It brings our carbon know-how together.”

The “Innovation Mile” was the working title as the interdisciplinary team began developing the concept for Carbon Campus in autumn 2018. The participants were breaking new ground and weren’t always agreed about the direction to be taken. “A few of us only wanted a fresh coat of paint, while others wanted to change the entire corporate culture,” recalls Partik. Ultimately, both ideas were incorporated into the campus concept.

Once the campus has become established, the experts at SGL Carbon will be able to use and share their expertise in carbon materials even more effectively, much like scientists at a university. Everyone is working with carbon, but they’re developing solutions for different market fields and special applications. “More interfaces mean more benefits for our customers since they will be able to take greater advantage of the company’s full expertise,” Partik says.

Places for exchange

Initial successes have already become apparent. Even the process of putting it all together opens doors. “Collaborating on the campus concept brought me into contact with many of my colleagues for the first time,” says Dr. Christoph Ebel. “Today I have a better overview of what’s going on in the other areas of SGL.” Ebel has been working at SGL Carbon for two years and heads the company’s Lightweight and Application Center. He and colleagues from Central Innovation created the “Composites Path” for the Carbon Campus: visitors learn how carbon fibers are manufactured, then processed into semi-finished products and finally into components. One of the places in a carbon fibers value chain is the Fiber Placement Center, with automated and material-friendly processing. “This combination is unique worldwide,” Ebel says. “Our customers have access to the entire process.” Cooperation with the Fraunhofer ISEV research institute contributes to the high technical standard and offers solid scientific foundation.

It’s this innovative spirit that Ebel wants to strengthen even further and which he hopes will continue to thrive and grow in closer cooperation with other departments—to inspire not only today’s customers but also tomorrow’s colleagues. “The campus idea also increases SGL Carbon’s attractiveness for the next generation of employees,” says Partik. Specialists are in short supply, also in Häfelingen.

A coworking area on the Carbon Campus will also help to fuel this new spirit: a large, open space that will become in equal parts think tank, retreat and collaboration space. The company already held an ideas campaign for the exact design of the Carbon Campus space in a two-day hackathon format with employees and architecture students from the Augsburg University of Applied Sciences. “We want to change both the rooms and our way of working,” Partik says. What you won’t find in the coworking space are fixed workplaces.

Opening up a public face to customers, looking outside the box, offering a better understanding of the various technologies and activities taking place: the goal is clear, the space is being created. Now the employees need to fill the Carbon Campus with life. It won’t happen overnight and Calin Wurm, the manager of the Battery Application Laboratory, has no illusions about it: “We first have to live it for ourselves.” Sometimes the journey is apparent. Even the process of putting it all together opens doors. “Collaborating on the campus concept brought me into contact with many of my colleagues for the first time,” says Dr. Christoph Ebel. “Today I have a better overview of what’s going on in the other areas of SGL.” Ebel has been working at SGL Carbon for two years and heads the company’s Lightweight and Application Center. He and colleagues from Central Innovation created the “Composites Path” for the Carbon Campus: visitors learn how carbon fibers are manufactured, then processed into semi-finished products and finally into components. One of the places in a carbon fibers value chain is the Fiber Placement Center, with automated and material-friendly processing. “This combination is unique worldwide,” Ebel says. “Our customers have access to the entire process.” Cooperation with the Fraunhofer ISEV research institute contributes to the high technical standard and offers solid scientific foundation.

It’s this innovative spirit that Ebel wants to strengthen even further and which he hopes will continue to thrive and grow in closer cooperation with other departments—to inspire not only today’s customers but also tomorrow’s colleagues. “The campus idea also increases SGL Carbon’s attractiveness for the next generation of employees,” says Partik. Specialists are in short supply, also in Häfelingen.

A coworking area on the Carbon Campus will also help to fuel this new spirit: a large, open space that will become in equal parts think tank, retreat and collaboration space. The company already held an ideas campaign for the exact design of the Carbon Campus space in a two-day hackathon format with employees and architecture students from the Augsburg University of Applied Sciences. “We want to change both the rooms and our way of working,” Partik says. What you won’t find in the coworking space are fixed workplaces.

Opening up a public face to customers, looking outside the box, offering a better understanding of the various technologies and activities taking place: the goal is clear, the space is being created. Now the employees need to fill the Carbon Campus with life. It won’t happen overnight and Calin Wurm, the manager of the Battery Application Laboratory, has no illusions about it: “We first have to live it for ourselves.” Sometimes the journey is apparent. Even the process of putting it all together opens doors. “Collaborating on the campus concept brought me into contact with many of my colleagues for the first time,” says Dr. Christoph Ebel. “Today I have a better overview of what’s going on in the other areas of SGL.” Ebel has been working at SGL Carbon for two years and heads the company’s Lightweight and Application Center. He and colleagues from Central Innovation created the “Composites Path” for the Carbon Campus: visitors learn how carbon fibers are manufactured, then processed into semi-finished products and finally into components. One of the places in a carbon fibers value chain is the Fiber Placement Center, with automated and material-friendly processing. “This combination is unique worldwide,” Ebel says. “Our customers have access to the entire process.” Cooperation with the Fraunhofer ISEV research institute contributes to the high technical standard and offers solid scientific foundation.
Up, Up and Away

Lightness, high rigidity and greater efficiency for the aerospace industry: with its innovative lightweight materials and modern applications expertise from an array of industries, SGL Carbon is supporting aeronautics with new approaches—and is also taking a leap towards primary components. A look at seven exciting projects.

Strong Brakes

Giant airplanes like the Boeing 777 need strong and resilient brakes to safely come to a stop after landing. SGL Carbon supplies an important part for these types of brakes. The company produces non-woven materials based on oxidized carbon fibers that are used in the form of subsegments in the brake disc. These non-combustible oxidized fibers or subsegments have an impressively high friction coefficient, as well as an extremely low mass. The material is hard and resilient, making it suitable for life-saving applications, from the front of the engine cowlings to the back of the landing gear. To prevent the engines from powering the plane when it is on the ground, the brakes must be able to hold the plane in place. Thanks to their high friction coefficient, SGL Carbon’s oxidized fibers offer a unique combination of properties and are therefore excellent for braking applications.

Efficient Rotors

Since August 2019, SGL Carbon has been supplying Airbus helicopters with special manufactured, mass-produced glass fiber textiles. The material was a joint development from the outset. Airbus uses the SGL Carbon textiles to strengthen the five-blade rotors of the H160 model to make them even more efficient and powerful. The strain on the material is very lightweight and has a more efficient production than previous processes, because the fibers can simply be wrapped around a pre-shaped core. The TowPregs also score points with their adjustable task—the level of stickiness—and excellent processing properties. They are manufactured at the SGL Carbon site in Willich, Germany.

Fireproof

One of the engine types the A330 fleet from Airbus relies on is the V2530. Aside from powering the aircraft, these engines also help with braking, when thrust reversal pushes air out of the front of the engine. To prevent the engine cowplings from burning they have a special insulation that must be regularly replaced. SGL Carbon manufactured the relevant component, which is considerably less expensive than the original part. The company recently renewed two major orders for it: one from one of America’s largest airlines and one from Turkey’s Onur Air. SGL Carbon’s Arkadelphia plant in the state of Arkansas in the US is responsible for the design and construction of the component in accordance with aviation regulations.

Safe Scaffolding

Europe’s largest aircraft manufacturer, Airbus, assembles the A330 in France. To mount the center wing box, the company relies on SGL Carbon textiles. In Masingen, Bavaria, SGL Carbon produces what are known as the connection rods—special supports that are similar to scaffolding. Due to this material’s high rigidity and low density, the elements can be built in a more compact form and with a much lower weight.

Built for the Future

Flying taxis may soon conquer the skies. To optimize the range of such taxis, every gram is important. To increase the range of weight counts. Since the beginning of 2020, SGL Carbon is mass-producing landing gear made of braided carbon fiber material. The frames will be used worldwide in around 500 flying taxis in the next two years. The finished component will be shaped in SGL Carbon’s component factory in Red im Innkreis, Austria. SGL Carbon developed the special tools and molds especially for producing this frame.

Solid Ground

Resin-impregnated carbon fiber textiles from the SGL Carbon factory in Willich, Germany are an essential component of aircraft floor panels. The company offers a variety of prepreg products. During operations, the panels must be lightweight and stable: countless passengers, hand luggage, flight attendants and trolleys walk and roll over them every day. This is why the composite materials must be reliable and safe, even under extreme conditions. To meet these requirements, the panels are constructed from SGL Carbon’s carbon fiber prepregs using sandwich construction methods. The quality pays off: in July 2019, a contract for these parts was extended by one year to the end of 2020.

Light and Simple

No larger aircraft is allowed to take off without its own water and wastewater systems. SGL Carbon supplies pre-impregnated carbon fiber bundles (TowPregs) that are used to construct the water and wastewater tanks in modern airplanes. The concept, which was developed in close cooperation with the client, is very lightweight and has a more efficient production than previous processes, because the fibers can simply be wrapped around a pre-shaped core. The TowPregs also score points with their adjustable task—the level of stickiness—and excellent processing properties. They are manufactured at the SGL Carbon site in Willich, Germany.

Lightness, high rigidity and greater efficiency for the aerospace industry: with its innovative lightweight materials and modern applications expertise from an array of industries, SGL Carbon is supporting aeronautics with new approaches—and is also taking a leap towards primary components. A look at seven exciting projects.
E
ev

verything is prepared. The operating instruments are sterilized and at the ready, the patient is under anesthesia and on the operating table. Above the patient, two arms stretch out to perform the surgery. Yet the arms aren’t human: they are two metal robotic gripper arms that will operate on the patient. They are being controlled by doctors with a precision measured in millimeters.

This or something like it takes place daily in specialized hospitals all around the world.

So that the surgery robot can see what it’s doing during the operation, the patient is X-rayed numerous times throughout the procedure. “And that’s exactly where we come in, with our composite materials,” says Jürgen Klinger from SGL Carbon. Products made of carbon fiber composites are very permeable to X-rays and very lightweight as well. “The high transparency to X-rays means you only need a very low dose of radiation, which is good for patients,” Klinger explains. Additionally, the composites cast barely any shadows on the X-ray images, which is important because shadows can sometimes lead to misdiagnoses. “With carbon fibers, we can minimize this risk,” says Klinger.

Along with operating tables, SGL Carbon in Meitingen, Germany, also manufactures accessories that can be attached to X-ray devices, including head holders and what are known as clip-on boards that extend the length of operating tables. The company’s expertise along the entire value chain is impressive, and this experience pays off for SGL Carbon customers. “Our clients often have very exact ideas and detailed requirements for their components,” Klinger says. He and his colleagues work through the challenges with the customers in SGL Carbon’s in-house Lightweight and Application Center (LAC). “In the past, we mainly just advised our customers in materials selection,” Klinger explains. “Today, in contrast, we offer everything from engineering to the right material combination to manufacturing, all from a single source.”

This was the case for the cooperation with Getinge, a medical technology manufacturer headquartered in Baden-Württemberg, on its Maquet series of operating tables. Klinger recalls, “We worked closely together from the very start to find the optimal design for the component.” It was a collaboration that paid off for both partners, not to mention patients as well. Bernhard Kulik, the senior product manager for operating table systems at Getinge, explains, “Intraoperative X-rays can improve results for patients and also allow for more complex interventions. Since X-ray technicians require specialized infrastructure for precise visualizations, we at Getinge worked with SGL Carbon to develop an operating table with a carbon fiber table top that offers nearly unimpeded radiation transparency for cardiovascular, orthopedic and traumatological procedures.”

In addition to providing X-ray-transparent products for operating theaters, carbon fiber-reinforced composites are also ideal for prosthetic and orthosis devices due to their extreme stability and very light weight. While these types of components have long been custom-made, particularly in small manufacturers, 3D printing is opening up new business opportunities for larger industrial companies such as SGL Carbon. In our research center in Meitingen, colleagues from the Composites Division and Central Innovation are already working on an in-house startup in precisely this area.

Aside from prosthetic devices and X-ray applications, stretchers are also more commonly being made of carbon fiber composite materials these days. The material properties of these composites really pay off here as well. “The amount of time saved thanks to the reduced weight can save lives,” Klinger says.