Yearly Report 2020 / 2021

SCHOTT
glass made of ideas

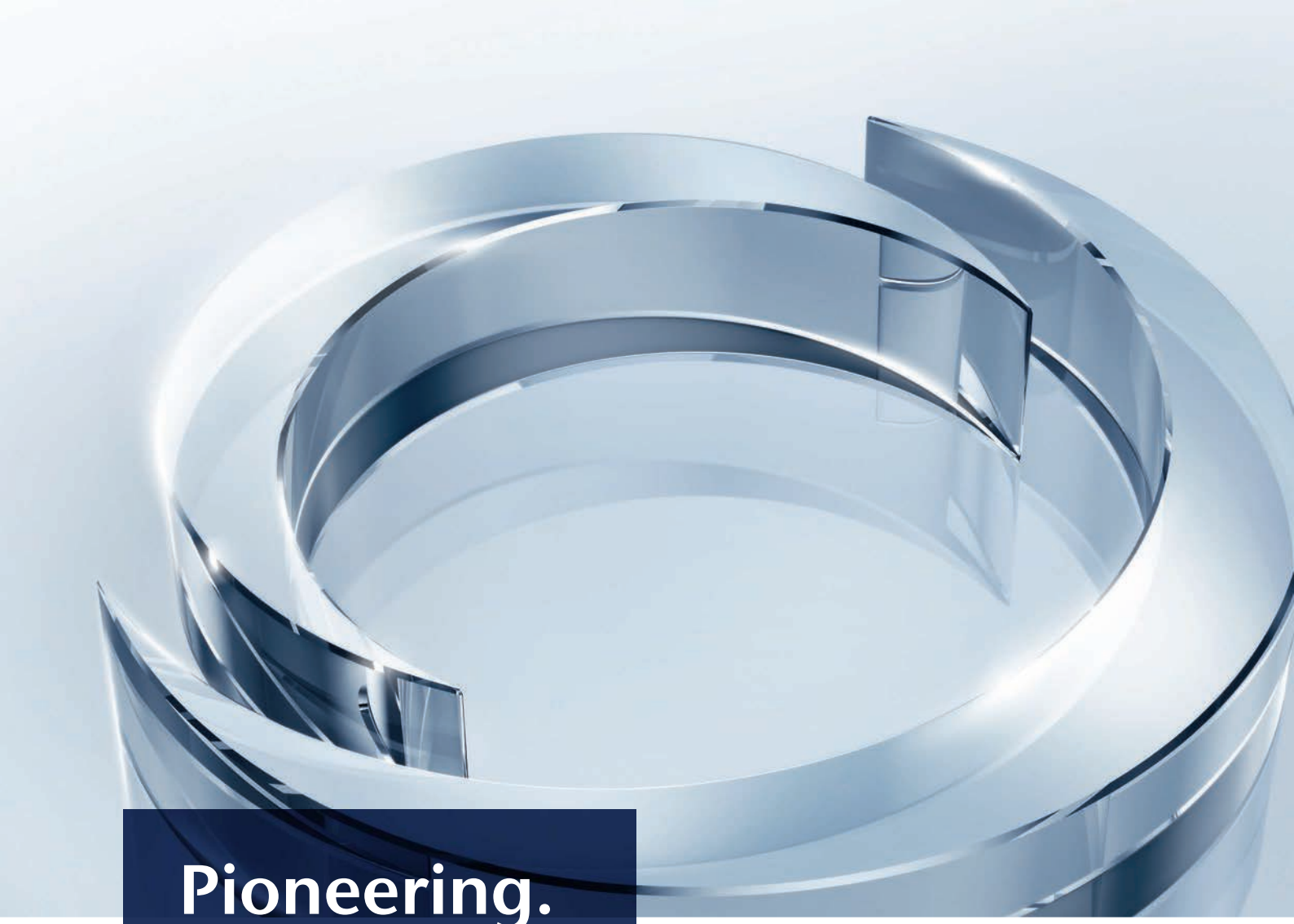
Key Figures
SCHOTT Group

From October 1, 2020, to September 30, 2021

(in million euros, unless stated otherwise)	2020/2021	2019/2020	Change in %
SALES	**2,524**	**2,238**	**13**
Domestic	317	297	7
Abroad	2,207	1,941	14
EBITDA	**565**	**456**	**24**
as a percentage of sales	22	20	
EBIT	**390**	**288**	**35**
as a percentage of sales	15	13	
Income from continuing operations before income taxes	**373**	**277**	**35**
Group earnings	**289**	**199**	**45**
Cash flow from operating activities	**494**	**393**	**26**
Capital expenditure on property, plant and equipment	**333**	**318**	**5**
Total assets	**3,269**	**2,961**	**10**
Equity	**1,351**	**997**	**36**
Equity ratio (%)	41	34	
Long-terms funds available [1]	**2,555**	**2,352**	**9**
as a percentage of total assets	78	79	
Net financial assets [2]	**79**	**–11**	
Expenditure on research and development	**93**	**92**	**1**
as a percentage of sales	4	4	
Employees as of the balance sheet date (number)	**17,313**	**16,466**	**5**

For computational reasons, rounding differences of +/– one unit (EUR millions) may occur in the table.

[1] Equity, long-term provisions and long-term liabilities.
[2] Cash and cash equivalents and funds less financial liabilities.



Pioneering. Responsibly. Together.

These attributes characterize SCHOTT, a company that manufactures specialty glass, glass-ceramic, and other trendsetting materials. The company founder Otto Schott is considered the inventor of specialty glass and became the pioneer of an entire industry. With a pioneering spirit, insatiable curiosity, and a passion for innovation, the company has been conquering new markets and applications for over 130 years. Represented in 34 countries with production and sales sites, the specialty glass experts are skilled team players for numerous high-tech sectors, incuding healthcare, home appliances and living, consumer electronics, semiconductors and data communications, optics, industry and energy, automotive, astronomy, and aerospace. With 17,500 employees, the company generated sales of €2.52 billion in fiscal year 2020/2021. With the best teams supported by the best digital tools, we want to continue growing. As a wholly owned subsidiary of the Carl Zeiss Foundation, SCHOTT uses dividends it generates exclusively for scientific and social projects. As well as the company's passion for glass its responsibility for its employees, society, and the environment are firmly anchored in SCHOTT's DNA. The company's ambitious goal is to become a climate-neutral company by 2030.

A strong year with a positive outlook

Facts about the fiscal year

€ 2.52

billion

in revenue

€ 390

million

in consolidated net profit for the year

€ 333

million

capital expenditure on property, plant and equipment

41

percent

equity ratio

Dear readers,

SCHOTT closed its second year of the coronavirus pandemic with record key figures, which made it the most successful fiscal year in our company's history. Group sales increased by 13 percent to €2.52 billion compared to last year. The operating result (EBIT) also improved by €102 million to €390 million – an increase of 35 percent. Consolidated net income also increased to €296 million and the equity ratio reached 41 percent.

All SCHOTT Business Units contributed to our success, and our employees outdid themselves in many areas. We would like to thank them as well as our customers and business partners, with whom we are working more closely than ever in these challenging times.

Despite the ongoing global COVID-19 pandemic, we have invested boldly over the last two years and were able to reap the benefits of these investments this fiscal year. All of our projects remained fully on track in spite of the coronavirus thanks to the extraordinary commitment of our teams. For instance, we built a plant for pharmaceutical tubing in China in record time, which also became SCHOTT's first melting site in the country. We also expanded our FIOLAX® glass tubing manufacturing in India. And we invested several million euros in a new, modern flat glass processing unit in Bolu, Turkey.

Key drivers of our growth, such as pharmaceutical industry solutions and household appliance products, had a particularly positive impact on earnings. During the pandemic, more time spent in the private sphere led many consumers to invest in high-value economic goods. For us, this meant double-digit growth rates for CERAN® cooktop panels and flat glasses for household appliances. We also recorded a strong increase in sales of vials for COVID-19 vaccines and pre-sterilized or coated pharmaceutical containers. Our long-standing cooperation with the pharmaceutical industry has become even more intensive, resulting in a series of collaborations in the production area. For example, Serum Institute, the world's largest vaccine maker, became our joint venture partner in India.

We continued to drive our growth through M&A activities. With the acquisition of Applied Microarrays, Inc. initiated in 2021, we decisively expanded our biotech expertise in the profitable diagnostics market and added a manufacturing site in the United States. A strategic realignment in flat glass for household appliances led to the successful sale of SCHOTT Gemtron, also in the US. This will allow us to focus even more strongly on further growth in Europe, South America, and Asia.

Climate protection remains particularly important to us. SCHOTT plans to be a climate-neutral company by 2030. By switching to certified green electricity, we took a major step toward this goal in 2021. We took on some challenging projects, which will develop new ways to operate our melting furnaces without relying on fossil fuels. This will enable us to set new standards for the specialty glass industry.

The new fiscal year is off to a promising start. We expect further growth in the mid-single-digit percentage range, even as rising energy, raw materials, and transport costs will impact our earnings. We intend to counter this by increasing our efficiency, as well as through price increases.

Fortunately for us, demand for specialty glass remains strong worldwide. It is not without reason that the United Nations has designated 2022 the International Year of Glass. After all, glass offers unimagined solutions to the social challenges of our

Dr. Frank Heinricht

Chairman of the
Board of Management
and Labor Director
since 2013

Dr. Jens Schulte

Member of the
Board of Management
since 2016

Dr. Heinz Kaiser

Member of the
Board of Management
since 2016

Hermann Ditz

Member of the
Board of Management
since 2016

time: In the field of e-mobility, glass-ceramic powder is ready for the next generation of batteries. High-precision FLEXINITY® connect glass wafers add computing power to in-demand computer chips by replacing polymer as a substrate. In our fast-developing focus markets in China and the United States, we are pursuing new customers with augmented reality glasses and ultra-thin glass for space applications. And leading smartphone manufacturers will be launching the first devices with our extremely break-resistant Xensation® α (Alpha) cover glass.

Our record investment of over €340 million in 2021 will be exceeded yet again in the new fiscal year. Most of these funds will be invested in pharmaceutical projects. For instance, we will be opening a new production facility in Müllheim, Germany, and tubing plant expansions are planned in China, India, and Mainz.

A solid balance sheet and our investment projects show the strength of our growth strategy. In line with our motto “Pioneering. Responsibly. Together.” our 17,300 #glasslovers are on track to turn the goals we have set into reality.

December 2021

SCHOTT AG
The Board of Management

Innovative pioneer

Architecture

SCHOTT produces specialty glass for architecture – from fire protection to true-to-original glazing of historic buildings.

Aviation, Astronomy, and Space

SCHOTT has been working with the aerospace industry for many years to drive design, safety, and efficiency. Mirror substrates from SCHOTT play a key role in telescopes for astronomy and enable extremely sharp images from outer space.

Health

With its pharmaceutical packaging and components for use in medical technology and diagnostics, SCHOTT makes an important contribution to people's health – from safe packaging of high-quality drugs to rapid and precise diagnoses.

Industrial and Energy

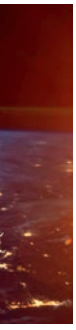
Industrial plants and energy systems must be reliable, economical, and durable. Thanks to its experience, SCHOTT is an important development partner with its electrical feedthroughs, melting glasses, and battery solutions.

Retail and Gastronomy

Glass solutions from SCHOTT are helping retailers and restaurants to stand out from the crowd with their quality and design – for example with attractive and energy-saving commercial cooling cabinets.

Automotive

SCHOTT is a driving force when it comes to the technological development, safety, and aesthetics of cars. Every year, the company supplies billions of highly reliable components, from hermetic sealings for sensitive electronics to stylish interior lighting.



Consumer Electronics

This highly competitive market constantly requires innovations. SCHOTT is working on robust and flexible cover glasses for the smartphones of the future and filter glasses that deliver outstanding images, to name two.

Home and Living

We want our homes to be stylish, warm, and safe. Whether it's components for kitchen appliances or design solutions for the bathroom, living room, and back-yard, SCHOTT products help to combine functionality with creative design.

Optics

More than 130 years of experience in the field of optical glass enable SCHOTT to offer its customers both a broad product range and a comprehensive service.

Semiconductors and Datacom

The role of datacom and electronics in our lives is growing daily. Here, SCHOTT offers a wide range of innovative components which allow faster data transmission and progressive miniaturization.

Active for climate protection

SCHOTT is planning to become a climate-neutral company by 2030. In fiscal year 2021, the specialty glass manufacturer reached an important milestone. It now supplies all of its electricity at all of its locations worldwide using renewable energy sources.

SCHOTT meets

100

percent[1]

of its worldwide electricity needs using renewable energies

Climate change is one of the greatest challenges of our time. Everyone must take responsibility: policy makers, business, and society as a whole. As an energy-intensive specialty glass manufacturer, SCHOTT wants to live up to this task. With its Zero Carbon program, SCHOTT aims to become climate neutral by 2030. Based on the "Avoid – Reduce – Compensate" principle, the technology group is pursuing an action plan with four goals: technology change, increasing energy efficiency, switching to green electricity, and compensating remaining greenhouse gases. The road to becoming climate neutral has some major challenges. However, SCHOTT achieved an important milestone in fiscal year 2021: the company now supplies all of its global electricity from renewable energies, such as wind and solar power.

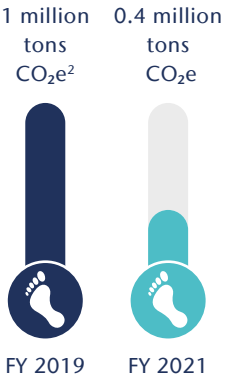
"The switch to 100 percent green electricity marks a first important achievement in our long-term climate strategy," explains Dr. Jens Schulte, Member of the SCHOTT AG Board of Management, who leads the Zero Carbon program. "This change has enabled us to reduce our climate-harmful emissions by around 60 percent since 2019."

SCHOTT employees collected over

1,400

ideas

to reduce carbon emissions in an internal ideas competition



Compared to base year 2019, we have reduced our carbon emissions by approximately

60 percent

through the switch to

100 percent green electricity[1]

Initially, the company is making the switch to green electricity by purchasing green power certificates. Known as EACs (Energy Attribute Certificates), these certificates confirm the origin and amount of electricity produced with renewable energies and fed into the grid. Here, SCHOTT places particular emphasis on ensuring a high-quality certification and thus making a sustainable contribution to the energy transition.

As a next step, SCHOTT also plans to use Power Purchase Agreements (PPA), i.e. long-term power purchase agreements with certain renewable energy systems. Here, the focus is also on quality: by entering into PPAs, SCHOTT wants to support the expansion of renewable energies and thus contribute to increasing the availability of green electricity.

Flagship projects for technology change

In the long term, SCHOTT plans to use new technologies to reduce the use of fossil fuels as much as possible. This change, however, requires the company to fundamentally rethink glass production. This will necessitate groundbreaking innovations. Developing new melting technologies that no longer rely on fossil fuels will take time, involve high research and investment costs, and depend on external factors. Therefore, the technological transformation process is the biggest hurdle on the way to climate neutrality. Scientists and melting experts are working on different technological solutions in various development projects. SCHOTT is particularly focusing on hydrogen and electrification technology to heat its melting tanks.

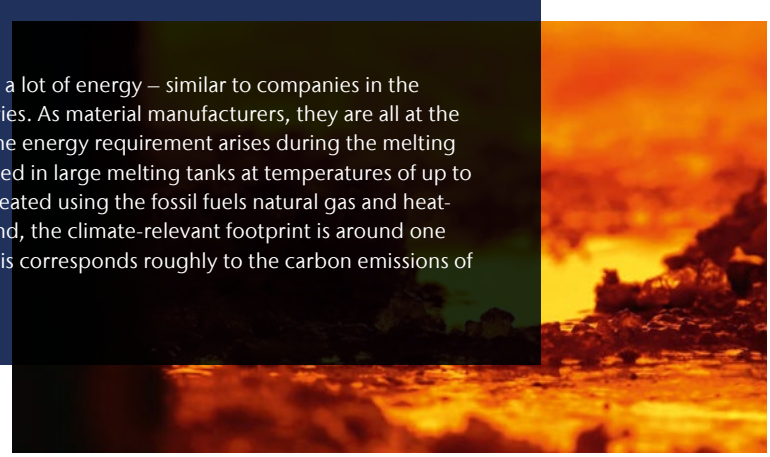
Beginning at the end of 2021, the German Federal Ministry for the Environment (BMI) provided grant funding of €4.5 million for two development projects to support climate-friendly glass production. Grants from the "Decarbonization in Industry" program will fund electrification projects.

In the PROSPECT project, a concept is being developed for a pharmaceutical tubing glass melting process in which the melting units are almost entirely heated using electricity instead of the fossil fuel natural gas. The PLANET 1 project concerns industrial research into the complex interactions in the melting process for specialty glasses for technical applications when the electrical heating component is increased to over 60 percent. In both new technologies, only green electricity will be used in order to reduce carbon emissions.

"With these flagship projects, we plan to lead the way as technology pioneers," explains Dr. Frank Heinricht, Chairman of the SCHOTT AG Board of Management. "We want to pave the road for the specialty glass industry with innovative solutions."

Glass production is energy intensive

As a specialty glass manufacturer, SCHOTT requires a lot of energy – similar to companies in the plastics, steel, paper, and building materials industries. As material manufacturers, they are all at the beginning of the value chain. The largest share of the energy requirement arises during the melting process. Specialty glass and glass-ceramics are melted in large melting tanks at temperatures of up to 1,700°C. Up to now, the melting tanks have been heated using the fossil fuels natural gas and heating oil, or electricity. Due to the high energy demand, the climate-relevant footprint is around one million tons of CO_2e (CO_2 equivalents) per year[2]. This corresponds roughly to the carbon emissions of a city in Europe with 150,000 inhabitants.



More information

Would you like more information about the climate neutrality strategy of SCHOTT? You can find more information at **schott.com/environmental-responsibility**

[1] The switch to green power was achieved through the purchase of green power certificates (EACS).
[2] Calculations made in 2019 based on the market-based method of the Greenhouse Gas Protocol (GHG). The exact location-based carbon footprint for fiscal year 2019 was 641,081 t CO_2e. SCHOTT currently includes emissions from its own production (Scope 1 GHG) and from purchased energy (Scope 2) in the calculation.

With Xensation® α, SCHOTT is entering the competition for the best smartphone cover glass in the world.

Cover glass redefined

Smartphones are an essential part of our everyday lives. Always on board is advanced cover glass. Whether as an extremely strong front or back cover or a flexible display of a foldable device, specialty glass from SCHOTT makes unprecedented designs and functionalities in the premium segment possible.

When Apple introduced the first generation of its iPhone back in 2007, a glass cover protected the novel touch display from the daily challenges of life for the first time. Where protective plastic covers were once used, glass now fills users with pride. Since then, glass has become the standard material to secure smartphone or tablet screens. SCHOTT has produced its Xensation® cover glass product range since 2010.

The story of SCHOTT's cover glass innovations continues in 2021 with a completely new glass type. SCHOTT unveiled Xensation® α (Alpha), a chemically strengthened lithium alumino-borosilicate (LABS) cover glass that is formulated and manufactured to compete with the best smartphone cover glasses in the world.

The new LABS glass innovation contains the semimetal boron in addition to industry-standard ingredients lithium and aluminum. The resulting advantages produce an extremely strong high-end cover glass for smartphones. The product's key advantages include significantly improved drop resistance especially on rough grounds, as well as improved scratch performance.

UTG

Ultra-Thin Glass

is mass-produced in the exact thicknesses required by the industry

Optimized for chemical strengthening

A deeper chemical strengthening augments the glass and protects it in case of drops, a result made possible by an improved ion exchange capability as compared with lithium aluminosilicate (LAS) glass. Added to this are the advantages of the element boron, which also improve scratch performance. The result is a significantly improved drop resistance from double the height* (also "set drop performance" or "drop performance") compared with other LAS-based premium cover glasses – especially on impact with rugged or sharp-edged, rough surfaces. Additionally, the new cover glass is less susceptible to scratches than the commercially available aluminosilicate (AS) and LAS cover glass types, as Knoop-diamond indenter lab tests show.

A special side fact: vivo's flagship phones will be the first to feature the new Xensation® α cover glass.

Flexible glass for foldable phones

In addition to extremely strong cover glass, SCHOTT also produces a type of glass used for display covers that is completely different in structure and appearance, and is becoming increasingly relevant in consumer electronics: ultra-thin, flexible glass that can be chemically strengthened. This highly specialized, bendable glass enables a bending radius of less than two millimeters after proper post-processing, and has been selected as a cover component for foldable smartphones (also known as foldables). The specialty glass from the Ultra-Thin Glass (UTG) family, called Xensation® Flex, is used in premium smartphones with flexible screens, such as Samsung devices.

SCHOTT has produced UTG since the 1990s using a down-draw production process. There are several different types of ultra-thin glass. With continuous development, a UTG thickness of 16 µm has already been achieved in the laboratory. By comparison, one red blood cell is 8 µm thick! SCHOTT is thus working on the edge of what is physically possible with its ultra-thin glass.

One unique aspect of SCHOTT's proprietary production process is that it can produce UTG that does not have to be slimmed down before it reaches the device. Competitors have to shave their glass down to reach the appropriate thickness, which costs valuable time and money, and threatens the integrity of the glass itself. Many of these companies use high volumes of hydrofluoric acid – an extremely harmful substance — to slim thicker glass to the desired thinness. These process steps are unnecessary with Xensation® Flex, which is an important advantage in bringing this foldable, new device category to the mass market through competitive pricing.

In 2022, Samsung could be followed by other major brands with their own foldable devices. SCHOTT is optimistic that it will continue to play a fundamental role in this high-tech area of glass production – being part of future models and concepts.

Sophisticated cover glass from SCHOTT makes unprecedented designs and functionalities possible.

** This testing process, which is designed to reflect the everyday use of smartphones, uses a smartphone dummy dropped from increasing heights onto a hard surface covered in sandpaper. Xensation® α can survive drops without breaking from up to twice the maximum height as compared to LAS cover glass.*

Smart cooking

Light creates emotions. It brings glamor and color into the kitchen and inspires kitchen appliance manufacturers to create ever more unusual products. A new generation of glass-ceramic helps them to achieve unprecedented designs: SCHOTT CERAN Luminoir™.

The kitchen is the heart of every home. This is where people come together, whether it's for cooking, eating, living, or – more recently – for working, because of the last two years spent working from home. This development is reflected in interior design trends and appliance designs that combine aesthetics and functionality. Here, light plays a key role. It creates a modern atmosphere suitable for everyday use and makes radiant ways of interacting with kitchen appliances possible, first and foremost through the cooktop. Whether it's through digital controls, displays, or flexible cooking zone markings, light allows people to communicate intuitively with technology. And that makes cooking (and working) more exciting.

For cooktop designers, the brightness and brilliance of light are particularly crucial. But color fastness and variety also constitute important distinctive features. For its CERAN EXCITE® lighting portfolio, SCHOTT has already developed a variety of coatings and filters that leading household appliance manufacturers such as Siemens and LG use to make their glass-ceramic cooktops more interactive and exciting. So far, these products are mainly available in the premium segment. But a new generation of black glass-ceramic for cooking called CERAN Luminoir™ will bring fancy light features to even more households in the future.

Creative lighting design – with glass-ceramic

This is thanks to a completely new composition of the material. It optimizes the

CERAN EXCITE® makes cooktops interactive and exciting.

In 2021, SCHOTT CERAN® celebrated its

50th birthday

CERAN® will be voted Brand of the Century for the second time in

2022

CERAN Luminoir™ brings pure elegance into the kitchen. It appears deep black and allows all visible colors to shine through.

transmission process, i.e. the light transmittance of the glass-ceramic, while also making it jet black. That means that additional filters and coatings are no longer necessary. This simplifies the production of cooktops and makes them more cost-efficient.

"Our latest product generation acts like an optical gray filter," explains Dr. Jörn Besinger, Head of Product Management & New Business Development of SCHOTT CERAN®. "Unlike previous glass-ceramics, which have a high transmittance especially in the high, red range of visible light, our new material has a uniformly high transmittance across the entire range of visible light."

White and blue light as well as color combinations can therefore penetrate the glass-ceramic better. Colors appear brighter and contours even sharper, even with diffuse light or color gradients.

"While red has been prevalent in the cooking zone area and in cooktop digital displays, white light will play a greater role in the future," Besinger predicts. In either case, all conceivable options are open to the lighting design. And the same applies to appliance design. In addition to better light transmission, the new formulation also affects the appearance of the material. Instead of having a slightly reddish shimmer depending on the light conditions, the built-in glass-ceramic cooktop surface looks deep black at any time of day. This makes for a classy design statement in the kitchen.

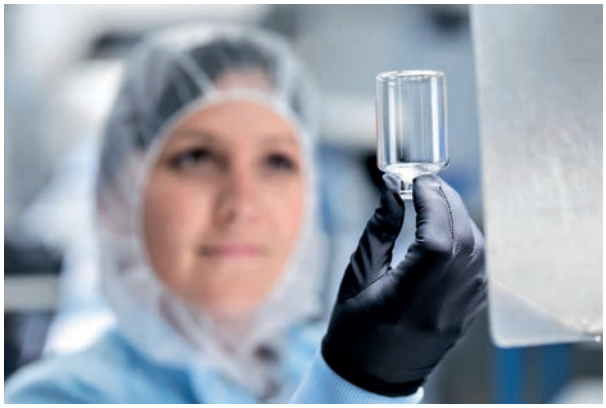
New cooking experience for everyone

Soon, the new product will be used in many kitchens around the world. This is because its properties make CERAN Luminoir™ ideal for mass production. "The new material formula enables our customers to save on production effort and costs. Bright and multicolor light features can also be achieved without additional filter layers. This not only saves material and production steps, but also makes innovative lighting solutions in cooktops interesting for a broader group of buyers," explains Dr. Matthias Bockmeyer, Head of Development in the Cooking division at SCHOTT.

Half a century ago, black glass-ceramic for cooking caused a worldwide change in thinking and quickly became the standard material for radiant, induction, and gas cooktops. Up until now. How impressive would it be if, after 50 years, CERAN Luminoir™ marked the beginning of a new, radiant era in kitchen design? In any case, this new glass-ceramic has what it takes to make the cooktop of tomorrow smarter and bring a new kind of cooking experience to as many people as possible in kitchens around the world.

Hidden champions

The coronavirus pandemic has brought people and products to light that normally operate backstage. One of these hidden champions is the borosilicate glass vials produced by SCHOTT's workforce that hold the vaccines.



COVID-19 vaccine: In the future, vials made of borosilicate glass will be partially replaced by prefillable syringes made of polymer.

As people around the world waited for the development and roll-out of COVID-19 vaccines, the role of the pharmaceutical supply chain received an unexpected amount of public attention. For SCHOTT, this was rewarding and challenging at the same time. "Since we are at the very beginning of the supply chain, our vials play a crucial role, yet often go unnoticed by a wider audience," explains Fabian Stöcker, VP Global Strategy and Innovation for SCHOTT's Pharmaceutical Systems business unit. With the biggest vaccination campaign in history underway and demand for such vials doubling within weeks, suddenly all eyes were on these tiny vials and their production network.

In the initial phase, the vaccines were filled in ISO standardized borosilicate glass vials ranging from 2 milliliter (mL) to 10 mL. This is something that SCHOTT mass produces in the millions every day at production sites around the globe. "Manufacturing a vial only takes a matter of minutes. If you add up all the different packaging types, we manufacture 30 million pharma containers a day," says Stöcker. The preferred base material for these vials is FIOLAX® borosilicate glass tubing, invented by the company's founder Otto Schott around 1890. Since then, it has been the gold standard to produce high-quality pharmaceutical containers to package drugs. Its chemical inertness preserves the drug's effectiveness. "The pharmaceutical industry has a lot of experience with this specialty glass and knows how it behaves towards different drug formulas," states Jörg Döscher, VP Strategic Marketing and Innovation for SCHOTT's Tubing business unit. During the pandemic, borosilicate glass proved its strength, with the vast majority of COVID-19 vaccines relying on this glass type. "It's very important to have high-quality glass to package the vaccine because nothing should get into the vaccine itself," explains Sierk Poetting, COO at BioNTech. "We were very happy to work with SCHOTT and bring our vaccine to the market in SCHOTT glass."

New challenges enable new approaches

Yet the pandemic confronted SCHOTT with unprecedented situations that no one could have imagined in their wildest dreams. For example, when the borders between Germany and the Czech Republic closed overnight, more than 120 colleagues suddenly faced the question of whether they should move to Germany for their jobs and risk not being able to return home for an indefinite period. In France, authorities confiscated personal protective equipment (PPE), such as masks, for the general public, even though these were also essential for the team's cleanroom production. This all happened almost simultaneously all over the world and required individual and quick solutions. "We're proud and thankful that our company's spirit helped the teams through these times and that everyone pulled together to meet our COVID-19 vial supply targets," comments Dr. Frank Heinricht, CEO at SCHOTT. "To highlight another example: Despite the pandemic, a team of German and Chinese experts managed to complete and start production of our new tubing factory in Jinyun, China in a record-breaking time of just 15 months."

By the end of 2021, SCHOTT will have delivered enough vials to hold over five billion COVID-19 vaccine doses. "With sophisticated hygiene measures and coordination with authorities, pharma companies and our own production, we were able to manage the demand and increase the global output," says Stöcker. Moreover, forming well-integrated teams and relying on processes that are well-established within the industry helped to make a running start when COVID-19 appeared. Also, a global investment of $1 billion from the company in its pharmaceutical business in early 2019 played an important role. It includes expansion activities around the globe, including in China, Germany, Hungary, India, Mexico, Switzerland, and the United States, and made a quick production ramp-up possible.

A joint look into the future

The story does not end there. The experts are already evaluating the next steps of how to package COVID-19 vaccines together with pharma manufacturers. Based on the typical drug lifecycle, SCHOTT expects that at least a part of these will be stored in prefillable syringes in the mid-term. "We are foreseeing a shift toward prefillable syringes and have compiled comprehensive datasets, for example, for low-temperature storage, to support vaccine manufacturers in their next steps," confirms Stöcker. By offering both glass and polymer prefillable syringes (namely cyclic olefin copolymer), a holistic approach can be taken together with customers to help find the best solution to safely store drugs.

Throughout the pandemic, high-quality primary packaging solutions paired with tuned-in supply chain performance and the company's workforce have proven to be true hidden champions. SCHOTT will continue to do its utmost to support customers and partners with advanced solutions. After all, close cooperation is essential, especially in times like these.

The future of electromobility

On the road to the electric vehicle world of the future, the automotive industry is increasingly relying on new types of solid-state batteries. SCHOTT is one of the pioneers of this promising storage technology and has developed a high-tech material for this purpose: glass-ceramic powder.

Glass-ceramic powder for solid-state batteries promises improved range, charging time, and safety for electric vehicles.

Solid-state batteries promise ranges of more than 500 kilometers, shorter charging times, higher operational reliability, and lower costs. They could soon outstrip lithium-ion batteries, as the auto industry has signaled their industrialization. OEMs such as BMW, Daimler, Ford, Toyota, and Volkswagen have now invested millions of euros in the emerging technology or in startups developing these batteries. According to a study by French market company Yole Développement, the first solid-state batteries for passenger cars could be on the market by 2025.

Solid-state batteries operate using lithium cells. Unlike lithium-ion batteries, however, they use solid electrolytes for ion conduction rather than liquids. In short, this enables the use of alternative electrode materials for the anode and cathode. This increases the energy density and storage capacity of the cell, and provides advantages in range, charging time, and safety.

Glass-ceramic: the key material

“We have been working on solid ion conductors since 2011, when hardly anyone in Europe was talking about solid-state batteries,” says Dr. Andreas Roters. An expert in SCHOTT's central research department, Dr. Roters is leading projects to develop glass-ceramic material as an ion-conducting solid electrolyte. A team of experts from SCHOTT has developed materials for this purpose and has proven in two research funding projects that they are suitable for solid-state battery cell systems.

The glass ceramics are manufactured using the classic melting process with subsequent ceramization, which offers cost advantages due to high scalability and increased freedom in material design. In this way, SCHOTT researchers developed materials for pure oxide, sintered cell systems and polymer hybrid systems with plastics and glass-ceramic particles.

Race for materials and technologies

In the meantime, there has been a trend toward a wide variety of hybrid systems to combine the positive properties of different materials in one cell. Partners for ceramic materials and ceramic-based products are becoming increasingly important for early battery marketing. Here, SCHOTT has key advantages due to its global network and participation in pioneering development funding projects.

FLEXINITY® connect offers the semiconductor industry almost limitless, unprecedented possibilities.

A new era of chip packaging

Semiconductors are one of the world's most in-demand electronic components, used in a vast range of technology, from the smallest smartphone chip to the largest data center. Traditionally, they have been manufactured using printed circuit boards and silicon interposers, but the combination of silicon and copper-clad laminates is expensive, and has poor electrical performance and limited reliability.

Industry game-changer

The newly introduced SCHOTT FLEXINITY® connect is an ultra-fine structured glass that could have a game-changing effect on the semiconductor industry. Its combination of physical properties, highly accurate dimensions, design flexibility, and cost-effectiveness make it ideal for a broad range of electronic components.

Since semiconductors are now a key component in much of the world's advanced technology, the scope for FLEXINITY® connect is almost limitless, from autonomous vehicles and medical diagnostics to domestic and commercial equipment connected to the Internet of Things (IoT). As the world progressively moves towards automation, its reliance on electronics will increase even further.

Properties to be proud of

The advantages of FLEXINITY® connect for advanced packaging lie in its range of physical properties. The use of glass offers improved signal performance and a reduction in signal latency, while maintaining virtually the same build-up as the interposer package. The ability to embed passive components also minimizes the thermal load of the package while shrinking the overall package size.

Another key advantage is the highly flexible positioning of through-glass vias (TGV), which gives manufacturers the capability to design packaging featuring millions of holes with radii as small as 25 µm. Adding a thickness range of 0.1-1.1 mm and a maximum size of 600 mm makes this one of the most versatile packaging materials on the market.

Manufacturer benefits

All this adds up to a host of benefits for the manufacturer. Not only does FLEXINITY® connect deliver the design freedom for complex challenges, it also increases efficiencies for higher computing power with large thermal loads. This is a key advantage for high-performance applications such as data centers and artificial intelligence (AI).

In mobile and IoT applications, FLEXINITY® connect offers fast, reliable, and ubiquitous wireless communication. This is delivered by the integration of antenna in package (AiP) for higher frequencies in the GHz regime and optimized materials for broad bandwidth in all climate zones.

In all sectors, FLEXINITY® connect provides a faster ramp-up in manufacturing with higher yields, as well as the highest I/O counts at the lowest costs. With the global production of semiconductors increasing every day, FLEXINITY® connect will become increasingly important as a key component for this vital industry.

Into the unknown

From telescopes to satellites to aerospace travel, humans have long sought to expand their knowledge of the universe. Specialty glass plays an essential role in these endeavors. In helping to advance design, safety, and efficiency, SCHOTT products have made significant contributions to the emergence of space travel technology, and the company continues its work on groundbreaking new projects.

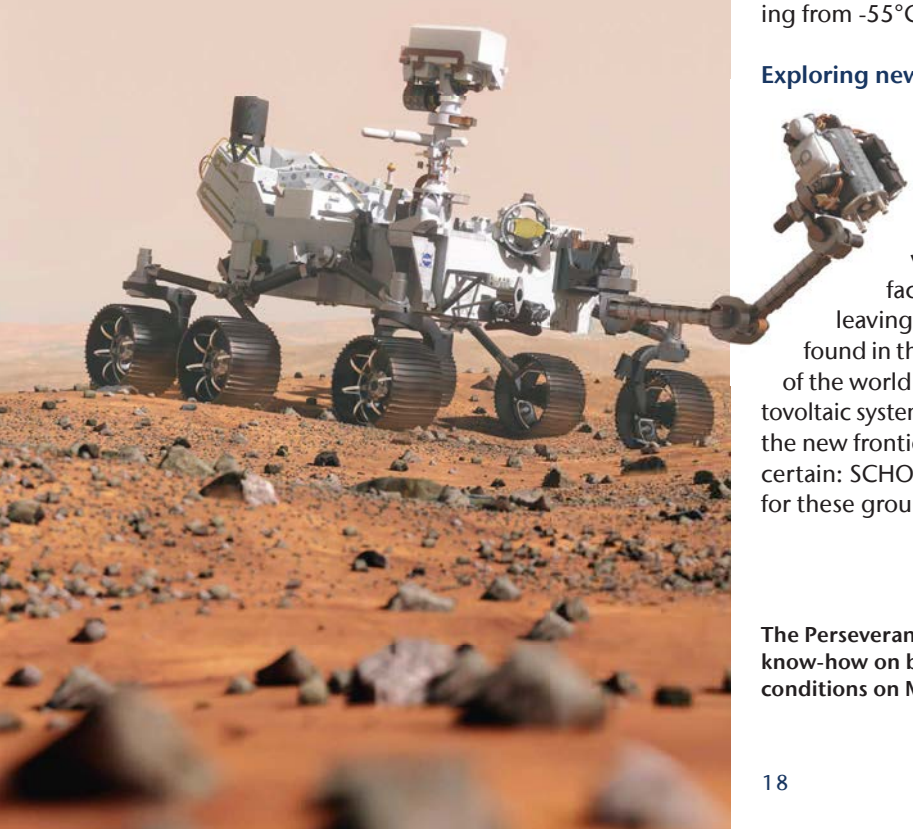
2021 turned out to be an exciting year for space exploration. In October, space enthusiasts were thrilled to see Captain Kirk himself fly into space on one of Blue Origin's sub-orbital al spaceflights. But this was only one of the remarkable spaceflights this year. In February, three countries landed spacecraft on Mars, including NASA's Perserverance Rover, as well as the first Mars missions from the United Arab Emirates and China. In November, NASA marked the fastest turnaround in human spaceflight, with only two days separating the return of a SpaceX mission from the International Space Station, and the launch of a second. And in June, China sent its first manned mission to its Tiangong space station, followed by a second one in October.

Breathing on the Red Planet

These achievements are the result of longstanding collaborations between space agencies and technology companies such as SCHOTT. "We are a reliable partner for the aerospace industry in supporting their work in space exploration, and our products have applications in some really innovative areas," explains New Venture Business Development Manager Boris Eichhorn. Onboard NASA's Mars rover, for instance, is an instrument featuring SCHOTT's glass powder technology. The Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE) aims to convert carbon dioxide from the atmosphere into breathable air. On its journey through space, specialty glass-ceramic sealants from SCHOTT help to maintain the MOXIE's efficiency. Its solid oxide electrolysis stack must survive extreme conditions, such the rocket launch and landing impact, and temperatures ranging from -55°C to over 800°C.

Exploring new frontiers

Whether on Mars or in other extreme environments, SCHOTT products serve to maintain high efficiency in a number of different astronomy and space applications. For spacecraft, they provide thermal protection shielding for exterior surfaces to resist extreme temperatures on entering or leaving the Earth's atmosphere. On Earth, they can be found in the mirror substrates and instrument optics of some of the world's best telescopes, and in space, they protect photovoltaic systems on satellites. Although we do not yet know what the new frontiers in space exploration will bring us, one thing is certain: SCHOTT experts will continue to provide their insights for these groundbreaking endeavors.



The Perseverance rover has SCHOTT know-how on board that can withstand conditions on Mars.

Boosting bioscience

Bioscience capabilities play a key role in the diagnostics and lifesciences industry and are crucial in enabling next-generation diagnostic "consumables". To further deepen the company's expertise in this field, SCHOTT acquired AMI, an Arizona-based microarray solutions company, expanding its manufacturing presence in the United States.

The diagnostics and lifesciences industry is increasingly shifting towards "point-of-care (POC) microarray consumables", which are used in applications such as infectious disease detection. "POC diagnostics is going to drive further innovation. We believe this market needs a partner that truly understands the science behind their product and has the bioscience capabilities to bring it to life and manufacture on greater scale," explains Edward Wilkinson, Head of Global Sales and Business Development at SCHOTT MINIFAB.

SCHOTT MINIFAB, a subsidiary of SCHOTT, is known for its glass and polymer microfluidic capabilities and has been on a journey to develop its bioscience capability over the last few years. Functioning as an integrator, the team offers customers a single end-to-end source for diagnostic and life science microfluidic consumables. "We pride ourselves on supporting the global diagnostics industry through all stages from development to manufacturing scale-up. Our expansive offering allows us to provide an integrated single-source collection of value-intensive services and products," states Greg Wolters, Head of SCHOTT MINIFAB. The subsidiary has had a long-standing close customer relationship with Applied Microarrays, Inc. (AMI). Together, they develop biotech substrates for diagnostics applications. "With the added bioscience knowledge of more than 20 years at AMI, we are becoming an even stronger partner," says Wolters.

The joint knowledge and technical expertise will greatly accelerate SCHOTT MINIFAB's capability development in bioscience, while allowing to offer a more holistic approach. For customers, this means tapping into a rich and unique portfolio of bioscience capabilities, including surface modification, functionalization, and deposition for both glass and polymer products.

The AMI team will soon be moving to a larger facility in the Phoenix, Arizona area. Its new location will greatly increase SCHOTT's manufacturing footprint in the United States, as one of its key growth regions to serve its global customer base.

Consolidated Statement of Income

From October 1, 2020, to September 30, 2021

(in EUR thousands)	2020/2021	2019/2020
SALES	**2,523,909**	**2,238,394**
Cost of sales	–1,648,346	–1,470,747
GROSS PROFIT	**875,563**	**767,647**
Selling expenses	–269,060	–249,226
Research and development expenses	–92,590	–92,362
General administrative expenses	–159,697	–152,682
Other operating income	42,561	49,916
Other operating expenses	–21,407	–41,185
Income from investments accounted for using the equity method	14,241	6,058
RESULT FROM OPERATING ACTIVITIES	**389,611**	**288,166**
Interest income	1,457	1,698
Interest expense	–14,719	–13,655
Other net financial income/expense	–3,413	345
FINANCIAL RESULT	**–16,675**	**–11,612**
RESULT FROM CONTINUING OPERATIONS BEFORE INCOME TAXES	**372,936**	**276,554**
Income tax expenses	–86,086	–61,828
RESULT FROM CONTINUING OPERATIONS	**286,850**	**214,726**
Result from discontinued operations (after taxes)	2,335	–16,101
CONSOLIDATED PROFIT FOR THE PERIOD	**289,185**	**198,625**
of which attributable to non-controlling interests	13,989	5,262
of which attributable to the owner of SCHOTT AG	275,196	193,363

Consolidated Statement of Financial Position

As of 30. September 2021

Assets

(in EUR thousands)	Sept. 30, 2021	Sept. 30, 2020
NON-CURRENT ASSETS		
Intangible assets	124,621	123,987
Property, plant and equipment	1,375,713	1,221,354
Investments accounted for using the equity method	89,258	77,519
Deferred tax assets	287,679	331,001
Other financial assets	12,838	17,211
Other non-financial assets	2,530	3,106
	1,892,639	1,774,178
CURRENT ASSETS		
Inventories	433,227	418,962
Contract assets	82,134	84,922
Trade receivables	420,269	376,581
Income tax refund claims	6,952	6,547
Other financial assets	28,015	19,262
Other non-financial assets	68,786	46,910
Cash and cash equivalents	280,781	233,784
	1,320,164	1,186,968
Assets held for sale	**56,212**	**0**
TOTAL ASSETS	**3,269,015**	**2,961,146**

Equity and Liabilities

(in EUR thousands)	Sept. 30, 2021	Sept. 30, 2020
EQUITY		
Subscribed capital	150,000	150,000
Capital reserve	322,214	322,214
Generated Group capital	846,372	511,815
Accumulated other Group capital	–51,360	–69,258
Non-controlling interests	83,614	82,505
	1,350,840	997,276
NON-CURRENT LIABILITIES		
Provisions for pensions and similar commitments	876,794	994,296
Provisions for income taxes	43,428	30,092
Other provisions	83,453	92,387
Deferred tax liabilities	36,640	29,959
Other financial liabilities	143,580	200,213
Other non-financial liabilities	20,378	7,504
	1,204,273	1,354,451
CURRENT LIABILITIES		
Provisions for income taxes	15,900	14,399
Other provisions	61,516	57,056
Accrued liabilities	207,806	175,646
Trade payables	247,963	223,908
Tax liabilities	15,520	14,938
Other financial liabilities	93,602	87,433
Other non-financial liabilities	54,317	36,039
	696,624	609,419
Liabilities in connection with assets held for sale	**17,278**	**0**
TOTAL EQUITY AND LIABILITIES	**3,269,015**	**2,961,146**

Consolidated Statement of Cash Flows

From October 1,2020 to September 30, 2021

(in EUR thousands)	2020/2021	2019/2020
Group earnings after taxes	289,185	198,625
Depreciation and amortization/impairment reversals on non-current assets	174,827	168,377
Increase/decrease in provisions and accrued liabilities	45,582	38,408
Other non-cash expenses and income	–19,436	–10,935
Gain/loss on the disposal of intangible assets and property, plant and equipment	1,434	543
Gain/loss from financial assets	1,900	–1,591
Increase/decrease in inventories and prepayments made on inventories	–19,424	–19,826
Increase/decrease in contract assets (IFRS 15)	2,788	–13,261
Increase/decrease in trade receivables	–62,699	–22,194
Increase/decrease in other assets	–13,454	4,532
Increase/decrease in prepayments received	21,902	9,484
Increase/decrease in trade payables	30,830	22,142
Increase/decrease in other liabilities	16,836	–2,758
Increase/decrease in deferred taxes	24,032	21,120
CASH FLOW FROM OPERATING ACTIVITIES (A)	**494,303**	**392,666**
Cash inflow from the disposal of property, plant and equipment/intangible assets	2,722	3,019
Cash outflow for investments in property, plant and equipment/intangible assets	–321,057	–296,929
Cash inflow from the disposal of financial assets	630	436
Cash outflow for the acquisition of consolidated companies and other business divisions	–9,283	–6,538
Cash outflow for investments in financial assets	–1,349	0
Dividends received	6,278	2,667
CASH FLOW FROM INVESTING ACTIVITIES (B)	**–322,059**	**–297,345**
Dividends paid	–11,935	–21,169
Increase/decrease of non-controlling interests in the capital reserve	–10,867	–10,533
Raising of loans	5,654	40,653
Repayment of loans	–44,281	–3,675
Allocation of plan assets	–27,515	–7,671
Increase/decrease in financial receivables	–3,148	2,104
Raising/repayment of financial liabilities	–5,077	–8,050
Payment of principal portion of lease liabilities	–19,290	–17,160
CASH FLOW FROM FINANCING ACTIVITIES (C)	**–116,459**	**–25,501**
CHANGE IN CASH AND CASH EQUIVALENTS (A+B+C)	**55,785**	**69,820**
OPENING BALANCE OF CASH AND CASH EQUIVALENTS	**233,784**	**171,548**
– Checks, cash on hand	252	213
– Deposits with banks	233,532	171,335
Change in cash and cash equivalents due to exchange rates	1,819	–7,501
Changes in cash and cash equivalents due to changes in the scope of consolidation and recognition	–10,607	–83
CLOSING BALANCE OF CASH AND CASH EQUIVALENTS	**280,781**	**233,784**
– Checks, cash on hand	50	252
– Deposits with banks	280,731	233,532
ADDITIONAL NOTES TO THE CONSOLIDATED STATEMENT OF CASH FLOWS**		
Interest paid	–4,446	–3,894
Interest received	1,457	1,698
Income taxes paid	–44,407	–33,310

* Restricted cash and cash equivalents have been reported under other assets since fiscal year 2020/2021
** Included in cash flow from operating activities

Specialty glass: The digital experience

The metaverse is to Facebook founder Mark Zuckerberg what digitization is to industrial companies. At SCHOTT, digitization is being used to tackle complex topics – whether it's using big data for systematic data analysis in research, artificial intelligence in production, or cloud collaboration for remote work. Recently, the company has also achieved a big digital milestone in its online communications.

New website strengthens customer loyalty

Through its revamped web presence, SCHOTT enables the same user and purchasing experience that customers expect in their private lives. This is a big step forward for the B2B company. "In a business context, a large part of the purchasing decisions today are made before the first contact is made with a potential business partner," says Martin Meyer, Marketing Manager and Scrum Master of the agile Online Experience project at SCHOTT. While search engine research is essential for companies, social networks also play a very important role in the journey of potential customers. "This is exactly where we are starting with our new website. It serves as a point of entry into a digital experience for our customers," Meyer says. With content relevant to the target group, product selectors, configurators, online stores, and customer portals, SCHOTT provides a digital platform that addresses the needs of visitors by delivering personalized solutions.

Unusual narrative formats with a surprise effect

Also evolving is the specialty glass expert's narrative approach to external communications. For example, users can now also experience innovations interactively through a digital exhibition, called SCHOTT World of Innovations. On social media, the emotional #glasslovers campaign shares the company's passion for glass with the world. A key piece of this corporate messaging is the funny but clumsy SCHOTT receptionist Fritz Klein, played by comedian Michael Kessler. The short film format, unusual for the B2B sector, was recently awarded the German Prize for Online Communication, the Digital Communications Award, and the PR Report Award. In addition, the company has more storytelling formats in the planning: "We are currently working on a new online magazine that will take a journalistic approach to the material glass and the passionate people behind it," says Michael Müller, Head of Innovation PR & Storytelling at SCHOTT. As part of the new web concept, the magazine will help link the company's digital worlds together. If you add up all these initiatives, the bottom line is that the metaverse may not be that far away for SCHOTT either.

An attractive gateway to the digital SCHOTT world: The new website sets standards.

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