### Company history A century of expansion and progress



lexander Wacker, born in Heidelberg in May 1846, laid the foundations for the present-day Wacker Chemie AG when, on 13 October 1914, he entered the Dr. Alexander Wacker, Gesellschaft für elektrochemische Industrie, KG company in the trade register kept by the town of Traunstein, Germany. The company started to take shape in 1916-17.

In 1916, the company's headquarters were established in Munich, and construction work started on the first factory building at Burghausen under architect Professor Josef Hoffmann. Production began at Burghausen on 7 December 1916 with the world's first industrial-scale synthesis of acetaldehyde, followed by acetic acid. Construction also began in 1916 on the 16-kilometer Alz canal. The Alz canal was completed in 1922 and it is still used by the Alzwerke power station to generate electricity.

In January 1917, the company started up the world's first full-scale production plant for synthetic acetone. Based on the 1st WACKER Process, the plant made acetone via acetaldehyde and acetic acid. The first garlanded railcar carrying 15 m.t. of acetone—WACKER's very first product—left Burghausen for Leverkusen, for conversion by Bayer into synthetic rubber for use by the German Imperial Navy for its submarines during the First World War.

The Consortium für elektrochemische Industrie moved from Nuremberg to Munich and the company relocated its head office within Munich at the end of 1919, to Prinzregentenstrasse 20/22. This would remain the company's address until 1992.

The company produced the solvent ethyl acetate at Burghausen for the first time in 1920. Alexander Wacker in the same year modified the corporate ownership structure, switching to a family-owned holding company with himself as its first managing director. The agreement establishing this company, signed in December 1920, remains valid to this day—shares in Wacker Chemie AG belong not to individual members of the family, but to the holding company.

The company at that time required capital to expand its output and product range so, in 1921, it sold 50% of its shares to Hoechst AG, a limited liability company at that time, via an increase in share capital. By regulating the company's affairs in this manner, Alexander Wacker, who died in April 1922, rendered his life's work secure for the future.

WACKER was able to manufacture 20 different products at Burghausen by late 1922, all of which were based on acetylene from carbide. Polyvinyl acetate (PVAc) was produced for the first time ever, by reacting acetylene with acetic acid, in 1924, by the Consortium, based on an invention by chemist Dr. Willy Herrmann. The first commercial plant for PVAc, under the VINNAPAS<sup>®</sup> trade name, began operating at Burghausen in 1930. VINNAPAS® products became established in the 1930s, and PVAc was also used to make polyvinyl alcohol under the POLYVIOL® trade name. Dr. Gerhard Beier discovered vinyl acetate ethylene copolymers in 1960.

The first experimental work began in 1929 on the polymerization of vinyl chloride, which was obtained by adding hydrogen chloride to acetylene. The company applied in 1935 for a patent for the suspension polymerization method for polyvinyl chloride (PVC). Dr. Herbert Berg and Martin Doriat had developed the process at Burghausen. Berg later became managing director of WACKER.

The first vinyl chloride plant started up in 1938 at Burghausen, launching the era of WACKER PVC, which the company marketed under the trade name VINNOL<sup>®</sup>. WACKER produced PVC for 60 years, beginning its exit from the business in July 1993—when it merged its PVC activities with those of Hoechst AG to create Vinnolit Kunststoff—and finally quitting the PVC business in 2000.

French, Russian, and US forces occupied WACKER's plants in February-May 1945. The rest of WACKER in Munich and Burghausen was placed under US administration in July 1945 and almost all of the plants were shut down until October, when production slowly restarted. Allied control of WACKER ceased in March 1953 and the company was renamed Wacker-Chemie GmbH on 8 April 1953.

During the 1950s, WACKER began the process of switching from acetylene, to ethylene, feedstock, for its vinyl plastic manufacturing operations. The switch was in line with the overall industry trend of shifting from coal to crude oil as the starting material for production.

Dr. Walter Hafner developed the corresponding synthesis method, directly oxidizing ethylene to acetaldehyde, which became the 2nd WACKER process to cement its place in the history of chemistry. In 1957, WACKER bought land in the Merkenich district of Cologne to build an ethylene-to-acetaldehyde plant with capacity for 15,000 m.t./year of acetaldehyde. The plant received ethylene from Esso's nearby refinery complex and it initially shipped its product by rail to Burghausen.

WACKER agreed with Hoechst and Marathon AG in 1965 to establish a refinery at Burghausen. The Marathon refinery started operating in 1968 and the site's steam cracker, today operated by Austria's OMV, supplies the WACKER Burghausen site with ethylene. The last carbide furnace at Burghausen closed down in 1969.

Meanwhile, WACKER had hired Dr. Siegfried Nitzsche, a chemist from LANDMARK: Huge carbide storage silo at WACKER's Burghausen plant in 1954.

FIRST STEPS: Oxygen production plant at WACKER's Burghausen site in 1916.

Jena, eastern Germany, in 1947 and he began research work in August that year on silanes and silicones. It was the first step toward WACKER becoming one of the world's top silicone providers and a technological leader in the field of silicon chemistry. Nitzsche's team synthesized silanes in 1949 using the already developed Mueller-Rochow process. The first silicone test plant started operating at Burghausen in 1950 and the first silicone products such as fluids and resins were marketed. WACKER established its first silicone department in early 1953, and output reached 2,800 m.t. by 1964. WACKER expanded silicones capacity rapidly during the 1960s in response to burgeoning demand, starting up an additional plant at Burghausen in 1969 with initial silane capacity of 24,000 m.t./year and that same year taking a 33.3% stake in Stauffer-Wacker Silicones Corp. at Adrian, USA. WACKER became sole owner of the operation in 1987. In 1965, the company established Wacker Chemicals Corp. in New York, which functioned initially as a distribution site for major silicone customers in North America.

Chief chemist Dr. Eduard Enk had, in 1953, launched studies on the manufacture of hyperpure silicon, making him the father of WACKER's semiconductor business. Production of monocrystalline silicon rods began at Burghausen in 1955. Rod diameter was originally 30 millimeters, and the purity was one foreign atom per 10 million silicon atoms. Today, purity is 99.99999999%.

Siemens—the first company in Germany to build transistors—transferred its licenses to WACKER in 1958 for depositing polysilicon and pulling silicon monocrystals. The Burghausen site began by year-end making hyperpure silicon using the Siemens process, establishing WACKER as DuPont's only rival in that field.

WACKER sold just 530 kg of polysilicon in 1959, but the business expanded rapidly with the computer industry and the company founded Wacker Chemitronic GmbH as a wholly owned subsidiary in 1968. The business, based in Burghausen, was the forerunner of today's Munich-based Siltronic AG semiconductor business.

WACKER constructed in 1969 the first two full-scale plants at Burghausen for distilling the trichlorosilane precursor and for producing polycrystalline silicon. This hyperpure polysilicon was used to pull monocrystalline silicon rods, which were processed into silicon wafers.

Chemitronic succeeded for the first time in 1973 in growing rods of hyperpure polycrystalline silicon with a diameter of more than 20 centimeters. By the end of the 1970s, every other silicon atom used in the world's semiconductor technology had been supplied by WACKER.

Meanwhile, Dr. Max Ivanovits had developed dispersible polymer powder, based on the extraction of the water from dispersions. Large-scale production began in 1957 in one of Burghausen's first powder towers with a capacity of 1,200 m.t./year.

WACKER expanded into Asian markets and established Wacker Chemicals East Asia Ltd. in Tokyo in 1983. This was followed in 1984 by the establishment of a subsidiary in Singapore.

WACKER announced a major restructuring in 1994 with wafer

operations at Chemitronic merging with Siltronic, and polysilicon the business becoming WACKER. part of Meanwhile, the company's hyperpure polysilicon

SQUEEZING

**OUT SILICONES:** Output soared in the 1960s.

became of interest to the photovoltaic industry and in 2000, the group sold its first 1,000 m.t. of solar silicon.

Demand for solar-grade polysilicon surged and WACKER launched the biggest investment plan in its history, spending about €500 million in 2010 to expand the main plant at Burghausen by 10,000 m.t./year. This was followed by an additional €900-million investment to begin polysilicon production at the Nünchritz site. WACKER had acquired the Nünchritz silicone plant in the state of Saxony, eastern Germany, in 1998, after German reunification, for its silicones division.

Dr. Peter-Alexander Wacker was appointed president and CEO of WACKER in 2001. He had been a management board member of the company since 1996. Blue Elephant Holding GmbH, a holding company established by Wacker family members, acquired the 44% stake in WACKER still held by Sanofi-Aventis—the successor of Hoechst—in 2005 and the Wacker family became 100% owner. Under the lead of Peter-Alexander Wacker, a 30% stake in the company was floated successfully on the stock exchange through an initial public offering in April 2006.

In May 2008, Peter-Alexander Wacker moved to the company's supervisory board and Dr. Rudolf Staudigl became CEO.

## Technical centers and WACKER ACADEMY An international network of expertise

roducts for local markets must be as diverse as the climates, environments, laws, and needs of the consumers using them throughout the world. This diversity is the key to finding lasting competitive products and services. It is why WACKER has a worldwide network of technical competence centers and the WACKER ACADEMY to support its customers.

WACKER is one of the chemical industry's most research-intensive companies. The 21 technical centers that WACKER operates across Europe, Asia/Pacific, and North and South America support the company's sales and marketing activities, liaising between sales offices and local production sites. They are staffed by specialists in the polymer and silicone fields who speak the language of WACKER's customers and understand their needs. These experts are familiar with regional raw materials and domestic markets, and they know which applications are in demand and which innovations are potentially interesting, so they can customize products to requirements. WACKER's regional state-of-the-art technical centers help customers to develop formulations for new products and optimize the recipes for their existing products.

The 12 WACKER ACADEMY locations serve as a collection of forums for industry-specific knowledge transfer between customers, distributors, and WACKER experts. They provide access to a large pool of data and knowledge. Almost all of the WACKER ACADEMY locations are adjacent to WACKER technical centers-this promotes the sharing of ideas and enables participants to conduct practical on-site tests. The group, through the WACKER ACADEMY, operates its own industryspecific training and competence facilities that offer classroom-based courses, online seminars, and individual training sessions about WACKER's products and their application fields for customers, development partners, and distributors. Under the WACKER

ACADEMY brand name, the company disseminates its wealth of knowledge and expertise which, as market leader, it has accumulated over many years in product R&D and practical applications. The courses cover silicone applications as well as polymer chemistry. The WACKER ACADEMY works with the company's research facilities, as well as with universities and institutes, to ensure that its seminars remain state of the art.

Thanks to these advanced training facilities around the world, WACKER offers an ideal platform for sector-specific networking, and it promotes local know-how transfer with customers and partners. Experienced instructors are from WACKER's industrial and R&D operations.

With its network of 25 production sites in Europe, Asia, and the Americas-including major plants in Germany, the United States, China, and South Korea-WACKER has an established presence in all of the world's major economic regions. At present, the company operates 21 technical centers on four continents: in North and South America (Adrian, Allentown, Dalton, Portland, Mexico City, and São Paulo); Europe (Burghausen, Freiberg, Nünchritz, and Moscow); Australia (Melbourne); and Asia, including China (Shanghai and Shunde), India (Mumbai and Kolkata), Japan (Tokyo and Tsukuba), Singapore, South Korea (Seoul), Taiwan (Hsinchu), and the United Arab Emirates (Dubai). Most of these centers offer a broad range of expertise, but some are highly specialized. For example, the company's technical center at Dalton, known as the world's "carpet capital," is the company's global mainstay for carpet applications. WACKER's Center of Excellence Electronics (CoEE), located at Pangyo, South Korea, is another example. The facility, which opened in 2012 and includes a cleanroom plant for silicones at nearby Jincheon, offers exclusive silicone expertise and R&D services to the local electronics and semiconductor industries.





**PURSUIT OF EXCELLENCE:** WACKER's technical center at Seoul specializes in the development of silicones for electronics applications.

WACKER provides professional training at a total of five WACKER ACADEMIES in the Americas, including facilities in the United States, Mexico, and Brazil. In Europe, seminars are held at the Burghausen site in Germany as well as at the company's training center in Moscow. Customers located in the Middle East and Africa are attended to by the WACKER ACADEMY in Dubai. Training centers in Mumbai, Shanghai, and Singapore, as well as Suwon (South Korea) complete WACKER's offering in Asia.

As part of a strategy to strengthen the company's presence in South and Southeast Asia, WACKER recently upgraded its technical centers at Kolkata and Singapore. The service and R&D center in Singapore can now also provide technical support to customers in the cosmetics, polishes, paper coating, and plastics processing sectors. The regional center of excellence Amtala, near Kolkata-operated at by the Wacker Metroark Chemicals joint venture-has been enlarged. It now provides cutting-edge application technology and test equipment for silicones used in the textile, personal care, and construction industries.



# Products and innovation The WACKER business model

ACKER is а global manufacturer of state-of-theart specialty chemicals and materials. Its portfolio includes more than 3,200 products found in everyday items ranging from cosmetic powders to solar cells, which are supplied to over 3,500 customers in more than 100 countries. Silicon is WACKER's main raw material. Siliconbased products account for 80% of sales. while the remaining 20% of its range is based primarily on ethylene. Customers range from consumer goods, food, pharmaceuticals, textiles and the solar, electrical/electronics and base-chemical industries, to medical technology, biotech and mechanical engineering firms. The company is among the three largest global players in its most important segments.

It all started more than 100 years ago when Alexander Wacker, a businessman rather than a chemist, spotted the potential of electrochemistry, notably the electrothermal route to producing calcium carbide and acetylene. In March 1903, Alexander Wacker founded the Consortium für elektrochemische Industrie GmbH, the nucleus of WACKER's future corporate research arm, which is still known as the Consortium. In the same year, the Consortium developed an economically competitive method of reacting acetylene and chlorine to produce tetrachloroethane. Consortium scientists followed this up in 1913 with an industrial-scale process to make acetaldehyde from acetylene, which was used at Burghausen until 1968. It was known as the '1st WACKER Process' and was licensed throughout the world. A year later, the Consortium's researchers applied for a patent on a 'Method of producing acetic acid from acetaldehyde.' Acetic acid is the starting material in the production of polyvinyl acetate, the basis for all WACKER VINNAPAS® products.

Carbide production is highly energyintensive, so Alexander Wacker scoured Bavaria for a site that could generate its own hydroelectricity. He selected Burghausen because of the height difference between the Alz and Salzach rivers. On 26 June 1913 the Kingdom of Bavaria granted him permission to harness the water power of the Alz. The rest is history.

WACKER has reinvented itself several times over the past 100 years but has always remained loyal to its main raw materials: acetylene, later ethylene, and silicon metal, supplemented today by acetic acid and methanol.

WACKER's large-volume products include siloxanes, fumed silica, polysilicon and vinyl acetate monomer (VAM). From





EARLY DAYS: One of WACKER's first plants.

these, it makes silicones, silicon wafers for semiconductors, and binders and additives based on polyvinyl acetate (PVAc) and vinyl acetate ethylene (VAE) copolymers. In addition, it processes starch and/or dextrose to make therapeutic proteins and food ingredients. Most of WACKER's products are aligned with global megatrends and the company commands leading positions and high market shares in most of its products.

As a manufacturer of silicones and polymers, WACKER is particularly well represented in key industries, such as the automotive and construction sectors. It is also a major supplier of silicon wafers to the semiconductor industry. In recent years, the company has greatly expanded its growing polysilicon business, which supplies hyperpure polycrystalline silicon to the solar and semiconductor industries.

### Competitive advantage

The WACKER Group's key competitive advantage is the highly integrated nature of its main sites at Burghausen and Nünchritz in Germany and Zhangjiagang in China. Byproducts from one process are used as starting materials in others in a total integration or Verbund process. Auxiliaries required in these processes, such as silanes, are recycled in a closed loop, and waste heat from one process is captured and used in other production lines. This results in lower costs compared with open production processes, as well as reduced energy and resource consumption.

WACKER SILICONES supplies over 2,800 products, ranging from silicone fluids and emulsions, resins, elastomers and sealants, to silanes and fumed silica. The division manufactures both specialty products tailored to customers' specific needs, and standard products. In 2013 WACKER had a 17% share of the  $\notin$ 10-billion global silicones market, in second place behind Dow Corning, the market leader, and neck-and-neck with Momentive Performance Materials. Silicones have traditionally grown at a 3% premium to GDP. The company operates two fully integrated world-scale sili-

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cones sites at Burghausen and Nünchritz, Germany, and a third fully integrated facility at Zhangjiagang, China, in a joint venture with Dow Corning. WACKER SILICONES has the highest level of integration in the industry, with its own fumed silica production. Its largest customers are the construction, processing additives and consumer care industries.

WACKER POLYSILICON is one of the world's two largest producers of polysilicon, accounting for 23% of global output in 2013. Global polysilicon demand was worth an estimated €4 billion last year, with 75% of production going to the solar market and 25% to the semiconductor industry. The solar polysilicon market is expected to grow at an annual rate of 10-20%; semiconductors at about 5% a year. WACKER is positioning itself to meet this expanding demand, with polysilicon shipments growing from 49,000 m.t./vear in 2013 to an estimated capacity of 52,000 m.t./year this year. The ramp-up of capacity at its greenfield Poly 11 plant in Tennessee in the second half of next year will account for a major part of the capacity hike to 72,000 m.t./year in 2015. The company has the potential to raise capacity to 150,000 m.t./year by debottlenecking and expanding all its facilities. WACKER has more than 50 years of experience in polysilicon production, with a first-in-class dedicated poly grade for solar and semiconductor applications, including float zone. It has switchable reactor technology for polysilicon chunks for both applications. In addition, it boasts low specific energy consumption and a broad customer portfolio based on long-term contracts. Its unique production setup includes fully integrated processes for polysilicon and byproducts.

WACKER POLYMERS manufactures state-of-the-art binders and polymeric additives, including dispersible polymer powders based on VAE, and dispersions used in diverse industrial applications or as base chemicals. Customers include the paints, coatings, paper and adhesives industries. Construction is the main outlet for polymeric binders, which are used in tile adhesives, dry-mix mortars, self-leveling flooring compounds, and exterior thermal insulation and finishing systems. WACKER POLYMERS is a market leader in dispersible polymer powders and dispersions, with more than 75 years of experience in VINNAPAS® dispersions. It is the only manufacturer to have a complete supply chain for dispersions and powders in Europe, Asia and the Americas. The company has a

strong service back-up through its numerous technical centers and also conducts joint product development with customers.

supplies SILTRONIC leading semiconductor manufacturers with silicon wafers. These are the essential basic materials for virtually all semiconductor products, including transistors and rectifiers, microprocessors and memory chips. SILTRONIC is the third largest supplier of semiconductor silicon wafers after Sumco and Shin-Etsu, with a 14% share of the global market last year. The company makes 300 mm wafers at Burghausen and Freiberg, Germany, and in Singapore. It has been consolidating smaller diameter wafers production and now makes 200 mm wafers at Portland, OR, and in Singapore.

WACKER BIOSOLUTIONS is the smallest division, supplying customized biotech and catalog products to the fine chemicals and life science industries. Products include pharmaceutical proteins, cyclodextrins, cysteine, polyvinyl acetate

solid resins for gumbase, organic intermediates and acetylacetone. The division focuses on customerspecific solutions for applications such as food additives, pharmaceutical actives and agrochemicals. Nutrition and gums represented 61% of BIOSOLUTIONS' 2013 sales of €158 million, and were comprised of cyclodextrin and cysteine food ingredients and gumbase resins for chewing gum. The pharma and agro industries accounted for 34% of sales, including building blocks for phar-

maceuticals and agricultural chemicals, and auxiliaries and excipients for the pharma industry. Biopharmaceuticals, including custom manufacturing of biologics, contributed only 5% of BIOSOLUTIONS' sales, but WACKER's strong technology and intellectual property position should enable this business to expand significantly.

### **R&D** and innovation

WACKER is driven by innovation. In 2013 it spent €174 million on R&D, equivalent to 4% of its €4.48 billion (\$6.1 billion) turnover that year. Process and product optimization accounted for 38% of total R&D spending, product development 29%, technology development 23%, and basic research 10%. The group employs nearly 1,000 people in R&D and boasts a portfolio of 260 projects within more than



EVERYTHING STARTS FROM SILICON: 80% of WACKER's business is based on silicon metal.

40 technology platforms. It owns 5,500 patents and collaborates externally with more than 40 academic institutions. New products launched within the last five years account for more than 20% of its sales.

WACKER'S R&D pipeline covers a diverse range of applications and end-markets. In household and personal-care products, it includes silicone-based antifoams for detergents and silicone-based materials to improve the performance of shampoos, conditioners, creams and cosmetics. In lithium-ion batteries, the company is working on active anode materials and



electrolytes. In the automotive sector, it is focusing on high-temperatureresistant silicones, high-performance coatings for airbags, and wafers for automotive electronics. In building and renovation, WACKER is developing improved VAE dispersions and siliconebased building-preservation products, new binders and sealants, and new building insulation materials. As a major supplier of polysilicon to the photovoltaic industry, the company is working on high-quality polysilicon for efficiency-leveraged cells and process optimization. And in food and pharma, the focus is on cyclodextrin complexes for the production of purely vegetarian low-fat and low-cholesterol food, and on segregation systems for the production of antibody fragments.







Specialist group celebrates 100th anniversary



ACKER'S history spans a century of evolution starting in Bavaria, southern Germany, where founder Dr. Alexander Wacker commissioned the world's first acetone plant at Burghausen. During its lifetime, WACKER has lived through economic upheaval, political turmoil, two world wars, and the German economic miracle, up to the present age of digitization and globalization. Alexander Wacker's original legacy has been carried on by the company's scientists, engineers, salespeople and employees, who made WACKER first a leading European pioneer in industrial acetylene chemistry, then a trailblazer in plastics and finally an innovator in silicon chemistry. During these 100 years, WACKER has evolved from a broad-based, family-owned chemicals company into today's publicly quoted

global specialist employing more than 16,000 people whose products are targeted at high-growth, niche technology markets such as photovoltaics, electronics, construction and pharmaceuticals.

For most of its life – 80 years – WACKER was owned in equal parts by the Wacker family and Hoechst, then the world's largest chemical company. The connection was severed after 1999 when Hoechst merged with France's Rhône-Poulenc to create Aventis. The Wacker family acquired a controlling stake in WACKER in 2000 and bought the remaining shares from Aventis's successor, Sanofi-Aventis, in 2005. Peter-Alexander Wacker, the founder's great-grandson, was CEO from 2001 to 2008. Under his leadership, WACKER went public in 2006. But the family connection is still strong. The Wacker family owns almost 70% of WACKER shares, the remaining 30% being listed on the Frankfurt Stock Exchange.

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Rudolf Staudigl, WACKER's president and CEO since May 2008, is one of the company's longest-serving executives. He is passionate about the company he joined more than 30 years ago. This year sees WACKER celebrating its centennial. Over the last one hundred years, the group has constantly reinvented itself, yet still remained true to its roots. From our Bavarian origins in Burghausen and Munich, we have become a global player. Today, we operate major plants in Germany, the United States, China, South Korea, and Singapore, and are among the top three suppliers and technology leaders in all our key business areas on the world market.

Researchers at our R&D facility, historically called Consortium, among many products invented methods to produce acetic acid, polyvinyl chloride, and polyvinyl acetate. Today, dispersions and dispersible powders based on polyvinyl acetate and ethylene form the basis of our WACKER POLYMERS division. They are used around the globe in a wide range of applications, from tile and carpet adhesives to dry-mix mortars and paper coatings.

In the 1950s, WACKER gained unique expertise in silicon chemistry, starting with silicones. At that time, we were the first company in Europe to produce them. Now, our WACKER SILICONES division offers a diverse portfolio of close to 3,000 silicone products, which, thanks to their almost unlimited application potential, are used in a great many industrial sectors. WACKER POLYSILICON, too, emerged from the synthesis of silanes, the precursors of silicones. This division supplies hyperpure silicon to the chip and photovoltaic industries. In our own semiconductor division, Siltronic, we process the silicon into wafers.

Tradition and innovation are not contradictory at WACKER; rather, they are interdependent aspects that enrich one another. This interplay of constancy and flexibility is reflected in our organizational structures, too. For example, alongside its large-scale production sites, WACKER runs a global network of 21 technical service centers where polymer and silicone experts provide customers with local support by modifying and enhancing our products. What's more, the importance we attach to these promising markets of the future is shown by the fact that WACKER now generates over 85% of its sales outside Germany. Asia, accounting for over 40% of sales, is our key region. The Group has spent a century, in the words of its slogan, 'Creating tomorrow's solutions,' a path that would not have been possible without our tradition and culture of innovation, a legacy that our founder, Alexander Wacker, handed down to Wacker Chemie."