Gunbai Column No. 14

Denka Chloroprene rubber chips

The Product of the Challenges and Efforts of our Predecessors

Denka Chloroprene

Denka chloroprene was the first special synthesized rubber to be commercialized in Japan. It has excellent elasticity and is resistant to heat, oil, and weather. It is used in an array of products, such as car parts, electric cables, wet suits, and medical gloves.

Shortly after World War II, Denka, under its new diverse policies, made its way into the synthetic organic chemistry industry. Denka then started to research the development of chloroprene rubber. As commercialization was said to be difficult, Denka twice reached out to DuPont in the US, the creators of chloroprene, to negotiate implementing their technology; however, they were unsuccessful.

"Then why don't we produce it ourselves?" suggested Yosoichi Nomura, the Company President at the time, leading to the company's attempt to create their own chloroprene rubber. They were confident the results of their ongoing research on acrylonitrile* would help them in mass-producing chloroprene rubber. After investing in the facilities and researchers, research began at the Omi Plant in 1959. It was only three years later, in 1962, that they established the manufacturing technology and successfully mass-produced chloroprene rubber. Reaching their goal with such speed showed the world just how advanced Denka's technology was.

The product would be called "Denka Chloroprene" and would grow alongside the automobile industry. At the beginning of the year 2000, Denka aimed to improve their productivity by enhancing their facilities. Denka is now the world's biggest producer of chloroprene rubber. In recent years, it is being used in electric vehicles and the demand for it is anticipated to continue growing. Denka hopes to keep supporting its customers' needs with its world-class facilities and the technology developed by the hard work of its predecessors.

*Acrylonitrile: An organic compound used in producing synthetic fiber. Denka has been using it since 1951, but due to a shortage in material, they have ceased production.

VOC FREE

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Denka

The DenkaWay

Winter

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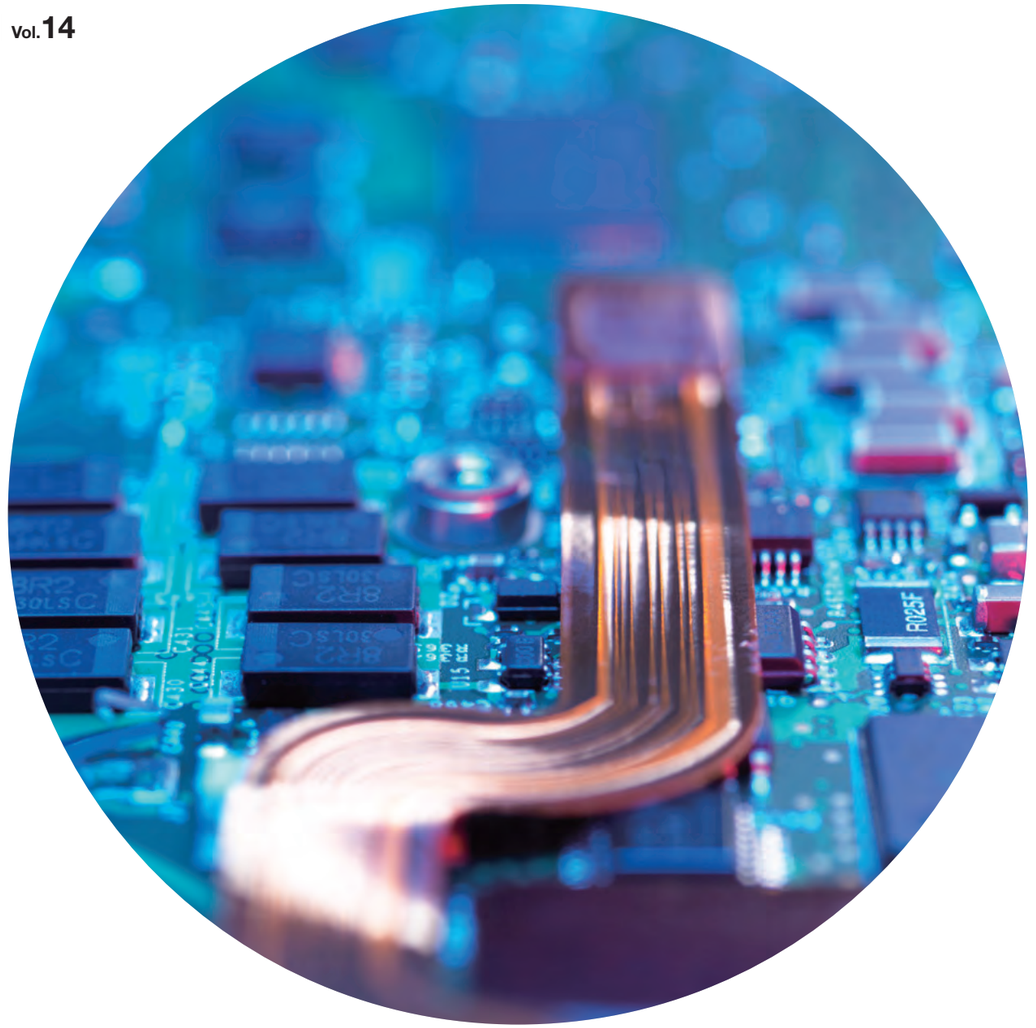


Semiconductors Shape the Future

Contents

Semiconductors Shape the Future

Semiconductors were once said to be an industrial staple.
As they are now used in practically everything, they are almost as abundant as air.
However, there are likely to be some people who don't yet know about them.
In this article, we provide a detailed overview of semiconductors and the outlook for the industry.

Amazing the World with Innovation

Firstly, what are semiconductors?

Flying drones delivering shipments. Robotic waiters serving in coffee shops. Going for a walk with an avatar robot. Driving with EVs. Thanks to automatic driving, it is now easy to enjoy the view out the window while driving. In the not-so-distant future, where we live may well be like this. What shapes such a society, is the power of semiconductors.

Semiconductors are substances with properties that are somewhere between conductors that conduct electricity and insulators that do not. Electronic parts that have a long history, such as diodes that transmit currents in one direction and transistors that control the currents of electricity, are also semiconductors. In recent years, semiconductors are mainly ICs (Integrated Circuits). Individual semiconductors that have a single function, such as diodes and transistors, are referred to as discrete semiconductors. On the other hand, ICs package discrete semiconductors and other electronic devices on a single board.

ICs can mainly be categorized into two types. One is memory ICs. These assume information storage roles. The other is logic ICs, whose roles are in calculation. For example, as the basic operation of a computer is to store and calculate, they are configured with a combination of memory ICs and logic ICs.

In the 1980s when Japan was known as a semiconductor superpower, the country was mainly manufacturing memory ICs. In recent years, logic ICs have become a hot topic due to global shortages. Logic ICs started to be used in electronic home appliances in the 1980s and are currently used in most products driven by electricity. It is anticipated that the applications in which semiconductors play active roles will continue to increase, as exemplified by the electrification of automobiles, the development of AI, and increases in sensor demand due to the expansion of IoT (Internet of Things). Semiconductors are extremely critical for the development of society and, ultimately, the future of humans. Denka's technologies and products are making a significant contribution to the evolution of semiconductors.

Interview with a specialist

Aiming for the Top with Your Best Work in the Ever-Increasing Demand for Semiconductors

Mr. Atsushi Osanai
Professor at Waseda Business School (Graduate School of Business and Finance)
Visiting Professor at BBT University

Profile

He was engaged in product planning, technological planning, etc. at SONY for ten years. After being named general manager of the Product Strategy Division, he studied at Kyoto University's Graduate School on a business assignment. After earning a doctorate degree, he served as associate professor at Kobe University, an external advisor to SONY Corporation, etc. before becoming an associate professor at Waseda University in 2011. He was assigned to his current position in 2016. He also serves as a researcher at Harvard University and as an advisor to both Japanese and overseas companies.

Increased use in automobiles continues

These days, the shortage of semiconductors often comes up in conversations. There are several reasons for this. One reason is the hoarding of parts and components by the US and China due to their trade conflict. Another reason is transport congestion caused by the recent pandemic is making it difficult to supply materials and is affecting production.
One of the biggest reasons for the shortage is the expanding applications of semiconductors, particularly the drastic increase of semiconductors used in automobiles. Years ago, semiconductors were not employed in automobiles. With a wider and more popular application of ECUs (Electronic Control Units) to control engines, transmissions, power steering, etc. in automobiles, the number of semiconductors used has also increased. Now, it is not all that rare to use more than 100 semiconductors in a single car.

To tell the truth, the semiconductors used in automobiles are not necessarily cutting-edge types. The interior of an automobile is a harsh environment with high temperatures and humidity in addition to severe vibrations. As a result, parts and components that have long been used and are already known to be stable are employed. They are manufactured in a process that is about ten years old. As the production system was built based on demand forecasts at that time, it wasn't predicted that the semiconductor business would peak as it has now. Due to the unanticipated high demand, semiconductor manufacturers cannot actively make investments in technologies from a decade ago. Demand is increasing, yet production is not. The supply-demand balance is deteriorated, and therefore semiconductors are in short supply. This situation will likely continue for a while, but in Japan, as a new semiconductor factory in Kumamoto Prefecture is planned to start operations in late 2023, the situation is expected to gradually improve.

Concerns about economic bloc formations

Looking forward, it is unlikely that semiconductor demand will decrease. Demand from the automobile industry continues to be strong. Thanks to the development of automatic driving technology and electric cars, the number of semiconductors employed will increase even more.

In addition to automobiles, the range of applications for semiconductors will surely increase. Things that use engines, such as aircrafts and ships, and factory boilers have been mechanically controlled until now. However, a trend in reducing CO_2 emissions will likely lead to the use of motors and other electrical controls. For this, semiconductors will be needed.

A potential cause for the slowdown of the growth of the industry can likely be attributed to the formation of economic blocs. A movement to prevent cutting-edge technologies from becoming available to China is accelerating in the US and Europe, and this may put brakes on the growth of the entire semiconductor industry. In addition, if the formation of economic blocs makes progress, such as the bloc involving the US, Europe and Japan and the bloc of China and Russia, distribution will only occur within each bloc, making the until recent stable global supply difficult.

Conventionally, cutting-edge semiconductor technologies were clearly divided for military and civilian applications. However, as commercial drones are being utilized as weapons in the Russian invasion of Ukraine, such barriers have been removed. Given this situation and looking from the perspective of security, it is possible that semiconductors might not be distributed as before. Having said that, even if the formation of economic blocs progresses, semiconductor demand will likely continue to grow within each bloc.

Only the best can survive

Japan was once known as a semiconductor superpower. Now, however, it is far behind other countries such as Taiwan, South Korea, and China. Japan is said to be good at value creation but not at value acquisition. Even if something new is created in Japan, it's left at the creation stage. Japan is often unable to reach a point to make profits out of what it created. Even when something new is created, if it does not immediately sell, they immediately move on to the next new thing in an attempt to recover.

The semiconductor industry is a process industry. Through mass production, it can reduce costs, and give a competitive edge. It is an industry that cannot succeed without pursuing quantity.

One of the internationally competitive products being created in Japan is SONY's image sensor. Why are they competitive? The reason is that SONY has a leading share. Becoming a second or third-rate player would put them at risk of becoming trapped in a vicious circle where it is not possible to reduce costs because they cannot mass produce, causing their products to sell poorly and further reducing their market share.

One example is the lithium-ion battery materials Denka manufactures. Dr. Akira Yoshino of Asahi Kasei won a Novel Prize for this technology that was invented in Japan. Looking at current market shares, the leader is a Chinese company. Panasonic, who enjoyed the number-one share, is now in second place. Most of the top ten companies are either Chinese or Korean. The same can be said of solar panels and large LCD panels. Despite being developed in Japan, Japan does not get to reap the benefits of these technologies. Those enjoying the benefits are Chinese, Korean, and Taiwanese companies. We must change this structure. The determination to not only just invent things but also establish a system to earn profits and maintain a leading position is required for both Japan and Japanese companies.

Be the flag waver for Japanese companies

Denka is a company that has produced excellent materials, whether they are organic or inorganic. Taking advantage of its background as a general chemical manufacturer, it has enhanced its technological strengths while maintaining a production system to respond to demand, which has led to its sense of presence in the industry.

Mr. Imai, President of Denka, often mentions "the work we are the best at." When considering economic performance, it is important to keep in mind the words "the best." Individual Japanese companies need to discover their "best" and create new values. They can't just stop at creation though. It is important that they actually profit from these values.

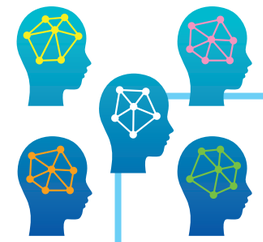
Denka must also earn value out of the technologies it has created. The company is also required to work with customers and other manufacturers and build strategies to assure that final products lead to actual business.

We now live in a world where, due to confrontations in international society and the accompanying formation of economic blocs, the free trade system is unstable in a way which has never been seen before. Japanese companies must have the corporate strength to overcome any type of business condition. The power of business needs to be enhanced across Japan, and I expect Denka to set the trend of the times for this.

Keywords of semiconductor technology

AI

Semiconductor chips play a major role in the AI process of learning from information and making decisions from learned data. The range of applications for AI is anticipated to expand further to, for example, handling inquiries from consumers and the automatic operations of automobiles and machines.

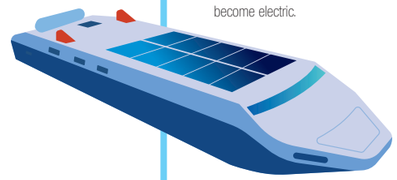


Communication

5G technology has spread widely and development of 6G is making progress. It is necessary to process and transfer larger data at a higher speed than ever before, but radio-waves and optical fibers have physical limitations. It is therefore expected that needs for semiconductors with higher performance capabilities will increase.

CO_2 reductions

Engines and other processes that generate CO_2 will be replaced with processes using electricity, such as motors. Semiconductors will be used to control them. In addition to automobiles, many more things such as ships, aircrafts, and boilers at factories will become electric.



Amazing the World with Innovation

Denka's Semiconductor Production Support ing Technologies

Semiconductor manufacturing processes are evolving daily with cutting-edge technologies being introduced in succession.
Denka's technologies and products play pivotal roles leading up to the completed semiconductors.

Monosilane gas
(dichlorosilane, hexachlorodisilane)

Providing function by forming a film on wafers

A gas that forms conductive and insulating films on wafers when a circuit pattern is formed. This gas is difficult to handle due to its self-ignition properties, but Denal Silane, a joint venture of Denka and Air Liquide Japan, has the technologies to safely mass produce it.

Emitter

Creating circuit patterns with electronic wires only a few micrometers thick

World share No.1

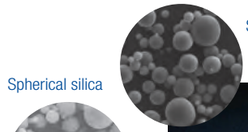
An emitter is a small part that is constituted of metals and ceramics and emits electrons. With miniaturization and microminiaturization of semiconductors in progress, situations where electron beams are required have been increasing, thereby increasing the employment of emitters in a wide variety of equipment, especially in wafer and mask inspection equipment and other equipment used in inspection processes. In the lithography process, by irradiating electron beams, circuit patterns are printed on glass sheets. At one time the optical lithography combining optical lenses and ultraviolet rays was the mainstream, but electron beam lithography can print finer and more complicated patterns.

Spherical silica / Spherical alumina / Spherical magnesia

World share No.1

Heat and shock protection

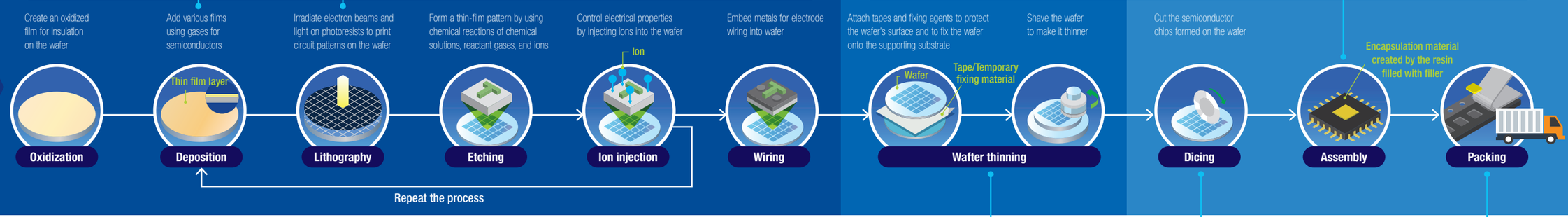
A filler is a substance that is mixed in order to give functionality to resins. Their functionality is diverse, and it includes the improvement of thermal conductivity, controls of electrical and mechanical properties, and the improvement of workability. Semiconductor chips emit heat when operated. To enable them to operate stably, it is necessary to reduce thermal expansion differences between semiconductors and encapsulation resins or to release the heat, and spherical fillers that have thermal conductivity are used as sealing materials for semiconductor chips. In 1971, Denka started to manufacture Denka Spherical Silica, a semiconductor encapsulation material. Thanks to the technology used to produce spheres from molten material at high temperatures, we can produce nearly perfect spheres with different diameters, ranging from large to small, and combine them in an optimum manner. We have developed many types of fillers from spherical silica, such as spherical alumina and spherical magnesia.



Manufacturing semiconductors

Front-end process Create an LSI (Large Scale Integration) by aligning several hundred semiconductors on a wafer made from silicone

Post-process Cut out LSIs on the wafer for packaging



Continue to test the limits of our material development technologies

Takuya Okada
Deputy General Manager
Electronics & Innovative Products

The manufacturing process of semiconductors is evolving day by day, with new methods being developed in quick succession. At the same time, we are receiving many requests from customers. Thanks to the material development technologies it has cultivated up to the present day, Denka has created materials to meet the customers' needs. Their requests are not necessarily simple. We need to satisfy complicated conditions, such as semiconductors that have both heat resistant and adhesive properties, but they want the adhesive properties to disappear after being exposed to light. We need to take full advantage of the technologies we have, continue to make customer proposals, and work to improve our current technologies.

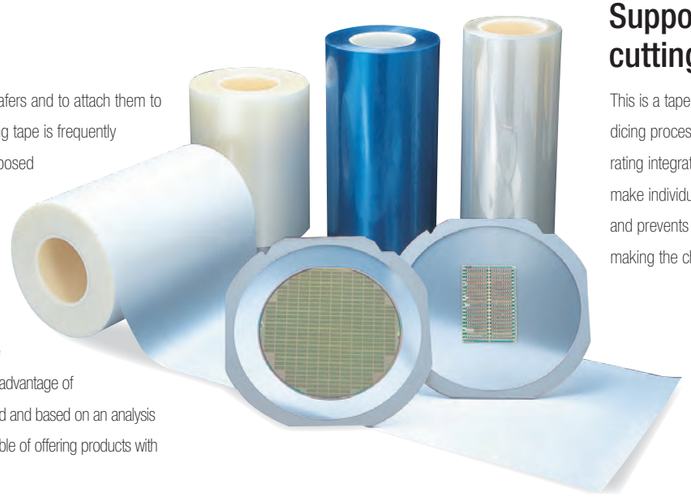
We want to be the company that semiconductor manufacturers and manufacturers of semiconductor manufacturing equipment want to contact when in need. To become such a company, we will continue to tackle new challenges and offer products that meet the needs of our customers and society.

Back grinding tapes

Effective even under harsh conditions

This tape is used to protect the surface of wafers and to attach them to equipment while being grinded. Back grinding tape is frequently used independently, but when wafers are exposed to severe conditions like gas, heat, and chemical solutions in the front process, a temporary fixing agent may also be used to fix the wafers to supporting substrates.

New semiconductor manufacturing processes are created every day, and therefore require suitable tapes and fixing agents. Taking advantage of the material design technologies it has cultivated and based on an analysis on the molecular structure level, Denka is capable of offering products with the required properties.



Dicing tapes

Supporting the smooth cutting of chips

This is a tape used to stabilize wafers during the dicing process (the process of cutting and separating integrated circuits formed on the wafer to make individual chips). It has excellent adhesion and prevents the dispersion of chips while also making the chips easy to pull out.

Sheets for carrier tapes / Top cover tape

World share No.1

Preventing defects

A problem at the time of shipment is static electricity and the defects and the mix with or attachment to foreign articles that results from it. To prevent this, semiconductor parts are protected by carrier tapes or top cover tapes when shipped. Denka contributes to the stable supply of semiconductor parts with complete support from raw material combination to development and mass production of sheets and films.

Think INNOVATION

Introducing articles that provide hints for innovation

No. 14

Creating Music Starts with Creating Atmosphere

Composer/Arranger/Conductor

Miho Hazama

©Agnete Schlichtkrull

Miho Hazama has composed and arranged music for Yosuke Yamashita, Ryuichi Sakamoto, and the NHK Symphony Orchestra. In 2019, she was selected as one of Newsweek Japan's "Top 100 Respected Japanese People Around the World." Her third album, "Dancer in Nowhere," was chosen as one of New York Times' Best Jazz Albums of 2019 and was nominated for a Grammy Award. She has also worked as Siena Wind Orchestra's Composer in Residence since 2017 and as The Danish Radio Big Band's chief conductor since 2019. In 2020, she was appointed as the permanent guest conductor of the Netherlands' famous Metropole Orkest.

The path I discovered in New York

I was in the second grade. The NHK Taiga Drama's theme song moved me and instilled in me a dream to compose orchestral music. Before that, I had started learning to play the electric organ and piano and was studying composition. After entering college, I double majored in classical and commercial composition, but I was studying in a time when the popularity of visual music was on the rise. I had always dreamed of creating orchestral music, and when I wasn't able to do that, I was disappointed and felt like giving up on my dream.

During this time, I had also started playing piano for the Big Band Jazz Club and had come to think that maybe I should follow a path in the genre of music I was enjoying there. With my mind made up, I decided to pursue a Master of Music in jazz composition abroad at the Manhattan School of Music. After finally starting my studies, I realized I was the only one in my class without a bachelor's in jazz. I was off to a very slow start. There was also a language barrier and I often found myself questioning what I could do, but I soon found myself thinking, "What if I use my classical roots, knowledge, and sense to compose orchestral jazz music?" When people think of composing jazz, what often comes to mind is a big band with a horn section and a rhythm section. There isn't much jazz music written for orchestras. However, the things I had learned, the things I wanted to do, and the motivation in New York all led me to orchestral jazz music. I knew this would be my new identity.

Miho Hazama conducting her production of "Tokyo Jazz 2022 Neo-Symphonic! Cinema Jazz." (August 19, 2022, Tokyo Metropolitan Theatre Concert Hall)

©2/FaithCompany

Creating a motivating environment for all

I have been blessed with the opportunity to work in many countries, including the US, Denmark, the Netherlands, and Japan. I am always trying to interact with people of different countries by matching their tempo. For example, in New York people talk quickly and logically and they desire quick answers. In order to keep up, I need to kick my brain into high gear. If I was to talk to Europeans in the same manner, they would ask me what the hurry was. In Japan, they would take me for someone egocentric. I make a conscious effort to make sure, no matter what country I'm in, that I blend in.

In the same way, I think it's important to adjust to the atmosphere of the performers and interact with them in a way that suits them best. I get to work with many musicians, but we often only have a short prep time before the performance. It is required that I be able to assess their strengths and personalities in an instant. I prepare myself so that I can help the band or artist put on the best show they can. The performer's personality often shows in their music. An easygoing person's music will sound easygoing, and an angry person's music will sound angry. The best thing I can do for them is create a space in which everyone can feel motivated yet challenged. If I can manage that, I'm confident we can create great music.

On the Frontline of the Threefold *Value-Up*

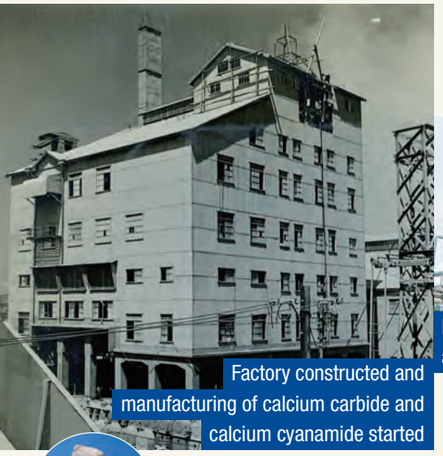
No. 05 Omuta Plant

In this segment, we focus on the worksites that are striving to realize the threefold growth vision "Denka Value-Up." In this fifth edition, we will introduce the Omuta Plant.

Denka Evolves with the Omuta Plant

In this section, we look back on the Omuta Plant's 106-year history, during which it has supported Japan's industries and continuously developed new technologies. Inheriting this history, the plant will move on to the next stage.

1916



Factory constructed and manufacturing of calcium carbide and calcium cyanamide started

Omuta Plant began manufacturing inorganic chemical products such as carbides and nitrogenous lime fertilizers. Through the cultivation of inorganic chemistry and nitriding technologies, the foundations were laid for Denka's development.

1943

Manufacturing of acetylene black started

Manufacturing of acetylene black began in 1943, and it has become one of Denka's main products, used in a variety of applications including battery materials, rubber fillers, and electronic components.

1956

Alumina cement is a refractory material developed with the Omuta Plant's electric furnace and cement manufacturing technologies. It is mainly used in blast furnaces at steel mills, and Denka boasts the largest market share in Japan.

Manufacturing of alumina cement started

Beckenbach type Lime kiln completed

1965

Manufacturing of calcium cyanamide drift less type started

1966

Manufacturing of boron carbide started

1967

Manufacturing of calcium cyanamide granular type and FIRELEN started

1970

Manufacturing of Sulfex and β silicon nitride started

1968

A new 40-meter high lime kiln that was completely novel at the time. It ceased operation in 2020 with the termination of the plant's carbide business and was dismantled and completely removed in April 2022. It contributed to stable supply and operations for a long time and was a symbol of the Omuta Plant.

1974

Manufacturing of boron nitride started

1975

Integrated drainage system completed

1977

Manufacturing of BN Composite EC started

1971

Manufacturing of spherical silica started

This is an amorphous silica with a remarkably low coefficient of thermal expansion and excellent electrical properties and stability. It is used as a semiconductor encapsulant and as a resin filler in 5G high speed communication substrates.

1985

Manufacturing of Flux Compound started

1989

Manufacturing of spherical fused silica filler started

1992

Manufacturing of special cement additives started
Manufacturing of AN Plate started

Denka began manufacturing AN Plate, a ceramic circuit board with high thermal conductivity. In the same year, the company also began manufacturing Flux Compound, which contributes to improving the functionality of concrete.

2002

Spherical alumina was developed with the high-temperature fusion technology cultivated in fused silica. It can provide high thermal conductivity and improve the surface hardness of resins and rubbers.

Manufacturing of spherical alumina filler started

2004

Manufacturing of ALSINK started

2009

Manufacturing of ALONBRIGHT started

Omuta Innovation Hub completed

2020

This is a general office that brings together the previously dispersed manufacturing, research, and production technology divisions. While achieving a sense of unity and functional operation as the core of the plant, it has adopted an innovative layout to facilitate communication.

The Omuta Plant continues to grow by linking the technologies of its predecessors to future growth

The Omuta Plant began operations in 1916 as Denka's first manufacturing site. After receiving the land from Mitsui Mining Co., Ltd., Denka chose to construct a plant there as it was possible to procure important raw materials such as coke, sulfuric acid, and electric power at competitive prices. As part of the Mitsui Mining's coal complex, Denka started manufacturing inorganic chemical products such as carbides and nitrogenous lime fertilizers. After World War II, the plant grew due to an expansion of the acetylene black business. Despite concerns about the hollowing-out of the industry due to production being discontinued or transferred overseas, it steadily improved upon its high temperature processing and nitriding reaction technologies. Currently, it offers a number of specialty products, including those essential for semiconductors, xEVs. And 5G. In 2020, a new general office called the Omuta Innovation Hub was completed. The plant continues to invest in new facilities for future growth and aims to realize a decarbonized society.

Heading into the future with our inherited DNA

Yoshimi Ishizuka
Omuta Plant Manager/ Managing Director

Omuta Plant has a long history of establishing proprietary equipment and technologies, including electric furnace and nitriding technologies, some of which are found nowhere else in the world. This history has been built up by "people." This plant has inherited the DNA of people who think outside the box and strive for improvement. Currently, we are taking on new challenges, such as implementation of AI and automation of operations. In addition, in order to contribute to the company's goal of achieving carbon neutrality by 2050, we are considering initiatives such as converting to carbon neutral fuel sources and purchasing electricity with non-fossil certificates. We are also responsible for the stable supply of environmentally friendly products, including those for xEVs.

In 2020, the plant ended its carbide production, which had continued for more than 100 years. It is now upgrading its equipment to meet the needs of new technologies such as 5G and xEV. It can be said that we are truly in the period of change. Cherishing our history and DNA, we will continue to move forward into the future.

Ultrafine Powder
Experimental Building

Business *Value-Up*

Spherification Facility

Winning “Semiconductor of the Year 2021” Award by responding to market needs

Upgrading Facilities for Manufacturing of High Performance Spherical Fillers

The Omuta Plant is undergoing construction at a rapid pace to expand its next-generation high-performance spherical filler production line. This upgrade is based on the strategic investment of 5 billion yen announced in October 2021. Spherical silica has a low coefficient of thermal expansion, making it ideal for semiconductor encapsulation materials and package substrates, while spherical alumina has high thermal conductivity and is widely used as a heat-dissipating material in automobiles and telecommunications. The construction is scheduled for completion in FY2024, with the aim of meeting the increasing demand for high-speed large-capacity data communications (5G) and electric vehicles (xEVs). Because spherical fillers require a complex manufacturing process, the plant previously relied on manual labor and the expertise of veteran employees. However, this facility expansion marks a shift to mechanization and automation, which will improve efficiency and stabilize quality.

Among Denka’s spherical fillers, spherical magnesia offers particularly high performance. Its thermal conductivity is 1.5 times higher than that of spherical alumina, enabling it to meet the growing need for heat-dissipating materials. The main characteristics of Denka’s products are perfectly spherical shapes and consistent particle sizes, which is something that no other company can imitate. In combination with resin, these two characteristics allow for more spherical magnesia filler to be added, making it easier to achieve the desired functionality. Although other manufacturers also provide spherical magnesia for the market, none are as high performing and reliable as Denka’s products.

In 2021, our spherical magnesia won an excellence award at the Semiconductor of the Year 2021 awards held by Electronic Device Industry News. (Sangyo Times, Inc.) Mr. Kunitomo commented, “We have reaffirmed that our materials technology can create new value. Encouraged by this award, we will continue to provide products that can meet the needs of society.”

VOICE

Imagining the future of manufacturing

As semiconductors in the marketplace continue to achieve higher performance, technologies for improving thermal conductivity and heat dissipation have become essential. Our products can meet such needs. Dissipating heat and increasing the functional efficiency of devices leads to lower power consumption and reduced environmental impact. Therefore, to contribute to society through high performance products, we are carrying out upgrades to realize a next-generation plant. We will make this plant our flagship and then deploy these upgrades at other locations throughout the company.

Shuji Sasaki
Manager
Production Dept. 4
Omuta Plant

Osamu Kunitomo
General Manager
Production Dept. 4
Omuta Plant

Naoto Hayashi
Manager
Production Dept. 4
Omuta Plant

Business *Value-Up*

Supporting the evolution of industry
by increasing production capacity and developing new products

Toward Expansion of Heat-Dissipating Substrate Manufacturing Facilities and Launch of New Products

Denka SN Plate and Denka AN Plate are ceramic circuit boards with excellent thermal conductivity. They are used as heat-dissipating substrates for power modules in automobiles (mainly xEVs), electric trains, machine tools, and wind power generation. Along with the evolution of semiconductor chip capabilities, dissipating chip heat is becoming increasingly important, and the need for both products is growing. To meet this need, the Omuta Plant is in the process of expanding and upgrading its manufacturing facilities. Since existing manufacturing methods require too many employees, the plant is undergoing major process reforms, including automation. These facility expansions will be done in phases, with future demand in mind. “We want to make the plant capable of meeting customer needs in every aspect, including quality, production capacity, and cost,” General Manager Iwamoto emphasizes.

In addition to these two products, the Omuta Plant is developing a new heat-dissipating substrate: BNR (BN resin complex). This product combines the boron nitride sintering technology developed at the Omuta Plant with the resin mixing and composition technology of the Denka Innovation Center and the Shibukawa Plant. It is characterized by high thermal conductivity, three to four times higher than that of resin substrates with fillers. Also, unlike ceramic circuit boards, it can be attached directly to metal, eliminating the need for greasing and soldering. This allows for more compact modules with better heat dissipation while reducing processes and costs. “We are currently conducting performance evaluations in anticipation of customer adoption,” explains General Manager Taniguchi. “We are working on development to achieve performance that satisfies our customers and aiming to establish the technology to start mass-production as soon as possible.”

VOICE

Staying ahead of fast-changing industry trends

By offering BNR in addition to SN Plate and AN Plate, Denka will become able to meet customer needs as an all-rounder in heat-dissipating substrates. We aim to be the first company our customers rely on by developing technologies that anticipate module trends and changing demands. We hope to contribute to the development of the semiconductor industry, which is realizing higher and higher performance.

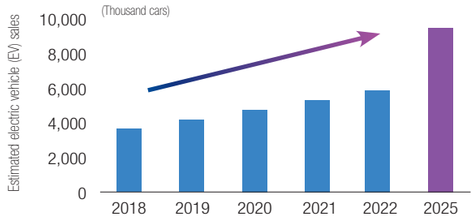
Yoshitaka Taniguchi
General Manager
Ceramics Research Dept.
Omuta Plant

Go Iwamoto
General Manager
Production Dept. 3
Omuta Plant

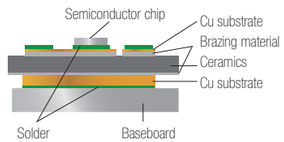
Denka AN Plate

Developing BNR

Market trend of automotive power modules

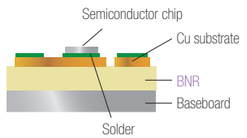


General power module



- Attaching Cu substrates on both sides of ceramics using brazing material
- A ceramic circuit board and baseboard are soldered together

An example of modules using BNR



- A BNR and baseboard are attached directly

Bare Substrate Plant No.3

Environment *Value-Up*

Aiming to achieve carbon neutrality by 2050

Fuel Conversion from LPG to LNG

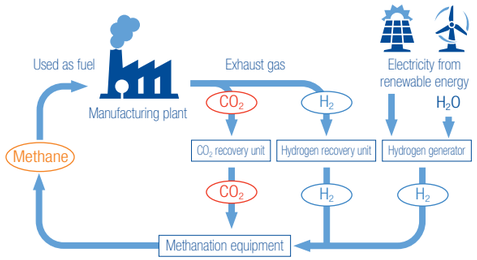
Liquefied Natural Gas (LNG) is an energy source that emits less CO_2 than Liquefied Petroleum Gas (LPG) and can be supplied stably. At the Omuta Plant, a project is underway to convert the fuel for the fusion process of spherical silica and spherical alumina from LPG to LNG.

The production of these two products requires the raw materials to be fused with a burner, in which LPG is used. About 70 to 80% of the CO_2 emitted from the plant comes from this process. On the other hand, LNG emits less CO_2 than petroleum, so replacing LPG with LNG can effectively reduce CO_2 emissions. However, this is not an easy task. Burners vary in shape, heating time, and temperature depending on the customer's requirements. Since LNG generates less heat than LPG, simply replacing the two will not produce the same product. The Omuta Plant is looking into ways of establishing this technology by 2030 using simulation technology and learning from the Tuas Plant in Singapore, which produces the same products. Once the technology is established, it will be possible to recycle CO_2 within the plant through methanation, which recovers CO_2 from exhaust gas and synthesizes it into a natural gas raw materials.

In addition, the plant is also working to recycle various wastes generated in the manufacturing process into resources. In fact, waste in the spherical silica manufacturing process is used in the production of special cement additives.

Denka's spherical silica and spherical alumina have been recognized for their high performance and maintain the number-one share in the global market. "We will focus not only on the performance of our products, but also on reducing environmental impact. We want to move ahead of the curve," says Deputy Manager Kawai. All members of the Omuta Plant are working together to pursue high-quality products with low environmental impact, with the goal of achieving carbon neutrality by 2050.

Methanation process to convert exhaust gas into fuel



VOICE

Employees suggest ideas more and more proactively

Since Denka's Environment Value-Up was established in 2021, the plant manager and I have been communicating its importance to our employees. They are now more environmentally conscious and proactively suggest things like, "Wouldn't this be effective in reducing our environmental impact?" Reducing environmental impact is essential for our customers to choose us and for the future of society. We will continue to work on this while actively incorporating cutting-edge technologies.

Masahiro Kawai
Deputy Manager
Omuta Plant

An open workplace where diverse members shine

Mid-Career Hires Enjoy Their Jobs

The Omuta Plant is currently focusing on mid-career hiring, and personnel with a variety of career backgrounds are actively working at the plant. One such person is Mr. Asayama, who joined the company in 2010. He decided to change jobs after becoming interested in Denka's manufacturing and products. He was working in a completely different industry before, but now he is involved in the manufacturing of spherical silica.

The Omuta Plant provides a worker-friendly environment for employees with no specialized knowledge. Mr. Asayama attributes this in part to the standardization of work: Internal rules and work procedures are clearly defined down to the smallest detail. "At first, I didn't even know how to use the tools. But there were detailed manuals for each task, and my senior colleagues were kind enough to teach me, so it was easy to learn new things," he recalls.

In particular, he praises the open atmosphere. In the Manufacturing Dept.4, to which he belongs, meetings are held regularly to share insights and discuss ways to improve operations together with staff from partner companies. Regardless of company and career, everyone shares their opinions, and if they have a good idea, they actively implement it. Diversity in human resources also has a positive impact on the workplace. Mr. Asayama says, "Many of them are highly motivated and have their own opinions, so every meeting is very active. Having people from different backgrounds voice their opinions helps improve product quality and reduce workplace accidents." He also enjoys chatting with his supervisors and openly discusses any problems he has. A work environment that facilitates communication allows mid-career hires to shine.

VOICE

Aiming to manufacture higher quality products

The spherical silica I am involved in manufacturing is used in semiconductors, the shortage of which is attracting worldwide attention. We receive various requests from customers and continue pursuing quality. I feel a sense of accomplishment when customers are satisfied with our products as a result. To ensure a stable supply of high-quality products, I would like us to continue working to improve quality and optimize operations throughout the department.

Yuichi Asayama
Silica Manufacturing Sec.
Manufacturing Dept.4
Omuta Plant

Human Resources *Value-Up*

A Specialist's Perspective

Denka is striving to become a Specialty-Fusion Company. What do Denka's specialists foresee for the future?

I Want to Play a Supporting Role in Society and in the Workplace.

Denka's spherical silica, which accounts for about 30% of the global market share, is used as a semiconductor encapsulating material. Although it is not a product that we usually see, it is an indispensable material for semiconductors, and thus supports our daily lives.
Mr. Uno, who is in charge of the spherical silica production process, also handles the training of on-site staff. That is because skills improvement and multi-skill development is essential for stable production. Mr. Uno actively communicates with everyone on site, from experienced staff to new hires and temporary workers. He explains, "The quality level demanded by our customers is increasing, especially for semiconductor materials used in automobiles. Our goal is to provide products of the highest quality by making maximum use of our workplace experience and knowledge." He is committed to further raising the quality level to meet the increasing standards. "I would like to take full advantage of our technological capabilities and pay sufficient attention to quality control, so that our customers will say, 'We couldn't have done it without Denka's spherical silica.'"

Nobuyuki Uno
Manager
Fine Section, Silica Production Section,
Manufacturing Dept. 4
Omuta Plant

Joined the company in 1992. He is responsible for the production process of silica products of less than one micrometer and special products that are highly customized to meet customer requirements.

DENKA TOPICS

Introducing Denka Group news topics from October to November 2022.

Nov. Announcement of New Vision and Next Management Plan "Mission 2030"

The new vision and Mission 2030 can be viewed on a special webpage.

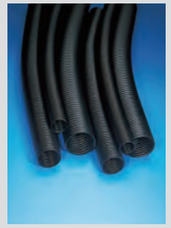
On November 8, Denka announced its new vision and next management plan "Mission 2030," which will cover the period from FY2023 to FY2030 (eight years). This plan seeks to increase the value of our human resources and management and create business value that combines the three elements of specialty, megatrends, and sustainability, with a focus on both financial and non-financial aspects of the business.

When formulating Mission 2030, Denka analyzed future indicators to clarify its raison d'etre from a long-term perspective and identified three megatrends that will create business opportunities: ICT & Energy, Healthcare, and Sustainable Living. The new vision is based on this discussion, the candid opinions of younger employees, and the thoughts of the management team. To achieve the mission set forth in the vision, Mission 2030 promotes value creation in the three areas of business, human resources, and management to increase corporate value.

Oct. Silicon nitride production capacity for xEVs to be increased by 1.5 Times

Aiming for further growth in the environmental and energy fields, Denka has decided to make a new capital investment in silicon nitride at its Omuta Plant, an additional 1.5-fold increase in production starting in 2023. This product has been well-received in automotive applications, where performance requirements are severe, and with the expansion of the xEV market, demand is rapidly increasing for use in heat-dissipating substrates for inverters.

Oct. Strategic investment of approx. 2.3 billion yen in Toyo Drain polyethylene drainpipes

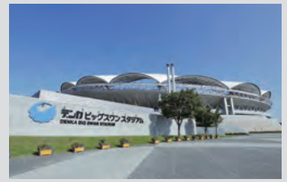


Denka has decided to make a strategic investment of approximately 2.3 billion yen in Toyo Drain polyethylene drainpipes manufactured by Kyusyu Plastic Industry Co., Ltd., one of Denka's subsidiaries, to acquire land, relocate manufacturing facilities, and install new equipment. This investment will increase our supply capacity for this product, which is increasingly being used for collecting and draining groundwater in infrastructure development.

Oct. Denka and SCGC agree to establish a joint venture for the production and sale of acetylene black

Denka has entered into an agreement with SCG Chemicals, a leading Asian conglomerate, to establish a joint venture company to manufacture and sell acetylene black. Denka was planning to establish a new manufacturing facility as a measure to meet the rapidly increasing demand. Following the establishment of the joint venture, a new facility with an annual production capacity of approximately 11,000 tons will be established.

Oct. Naming rights sponsorship contract with Denka Big Swan renewed



Denka, Niigata Prefecture, and Albirex Niigata have decided to renew the naming rights agreement for Denka Big Swan Stadium. A joint press conference was held at the stadium on October 23. The stadium is the home ground of Albirex Niigata, which has returned to the J1 League after a six-year absence.

Oct. Portfolio reforms through withdrawal from cement business and restructuring of carbide chain

Denka has agreed to transfer all shares of its cement business to a new wholly owned subsidiary by the end of March 2023 through an absorption-type company split, and then transfer all shares of the subsidiary to Taiheiyo Cement Corporation. Denka has resolved to terminate cement production by around the first half of 2025 and to withdraw completely from in-house limestone mining and cement manufacturing operations.

With You, With Denka. With Society.

From left: Toshio Imai, President of Denka, Hideyo Hanazumi, Governor of Niigata Prefecture, and Yukio Nakano, President of Albirex Niigata

©ALBIREX NIIGATA

We interviewed three people who were in involved in renewing the contract.

We want to liven up Niigata Prefecture through the power of sports!

Tamagawa: First of all, I am very happy that we were able to successfully renew the contract. We have two sites in Niigata Prefecture, and about 2,000 people, or one third of our employees, work there. We hope that this agreement will help the people of Niigata Prefecture become even more familiar with our company.

Inazuki: When we announced the renewal of the naming rights agreement, we received comments of gratitude from prefectural residents. I think this is because the name “Denka Big Swan Stadium” is already well established in the prefecture.

Kurashina: This stadium is a symbol of Niigata Prefecture, and as our home stadium, it is a special place for Albirex Niigata. Denka is also a uniform partner for our team, and we are honored to continue working with you. Albirex Niigata won the J2 League championship and was promoted to J1 last season, so I think that the day of the contract signing came at the perfect time.

Tamagawa: I’m really looking forward to seeing Albirex Niigata playing in the J1 League at Denka Big Swan Stadium this year. I am sure the supporters will be very excited as well.

Inazuki: Niigata Prefecture hopes that the Niigata Sports Park, which includes this stadium, will attract people of all ages as a mecca for sports. As we consider new ways of using this system, we would like to draw on the insights of Denka, which is involved in a variety of activities that contribute to the community.

Kurashina: Albirex Niigata hopes to provide inspiration and courage to spectators through soccer. Denka is involved in various activities to contribute to the community through the stadium, and we hope it will continue its efforts to promote sports while keeping an eye on the COVID-19 situation.

Tamagawa: I am looking forward to working with Niigata Prefecture and Albirex Niigata to further enhance our community contribution activities.

Minako Inazuki
Policy Planning Officer
Urban Development Section,
Urban Affairs Bureau, Public
Works Department
Niigata Prefecture

Hiroyuki Kurashina
Sales Division
Albirex Niigata

Eri Tamagawa
Corporate Communication
Dept.
Denka

Renewal of naming rights agreement for Denka Swan Stadium

Contributing to the Community and Promoting Health and Welfare with Niigata Prefecture and Albirex Niigata

Denka decided to renew the naming rights partnership agreement for Denka Big Swan Stadium, which it has sponsored since 2014, and has signed a new agreement through December 31, 2025. A joint press conference was held on October 23, with Hideyo Hanazumi, Governor of Niigata Prefecture, Yukio Nakano, President of Albirex Niigata, and Toshio Imai, President of Denka, in attendance.

Denka Big Swan Stadium is the home ground of Albirex Niigata, which last season returned to the J1 League after a six-year absence. It is a World Athletics Class 2 and Japan Association of Athletics Federations (JAAF) Class 1 certified stadium and was the venue for the opening match of the 2002 FIFA World Cup held in Japan and Korea. It has a seating capacity of approximately 42,300. In terms of attendance, it ranks 10th in the entire J-League and 1st in the J2 League (average number of visitors from 2018 to 2022).

Niigata Prefecture is home to Denka’s Omi Plant in Itoigawa City and Gosen Site in Gosen City. The latter is the development and manufacturing base for test reagents for influenza vaccines and rapid diagnostic kits for COVID-19. Approximately 2,000 of the Group’s 6,000 employees work in Niigata Prefecture. By renewing the contract, Denka aims to engage more deeply with Niigata Prefecture and its residents, and to support regional revitalization and sports promotion.