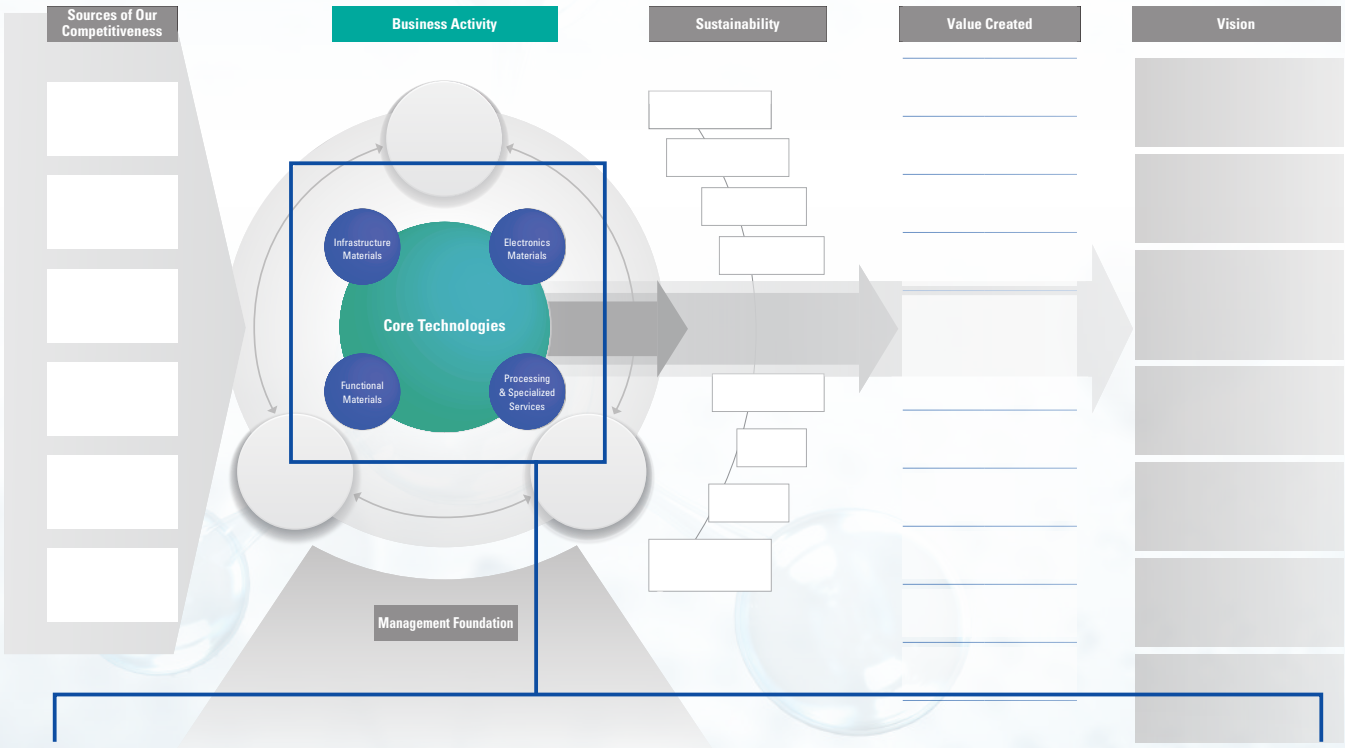
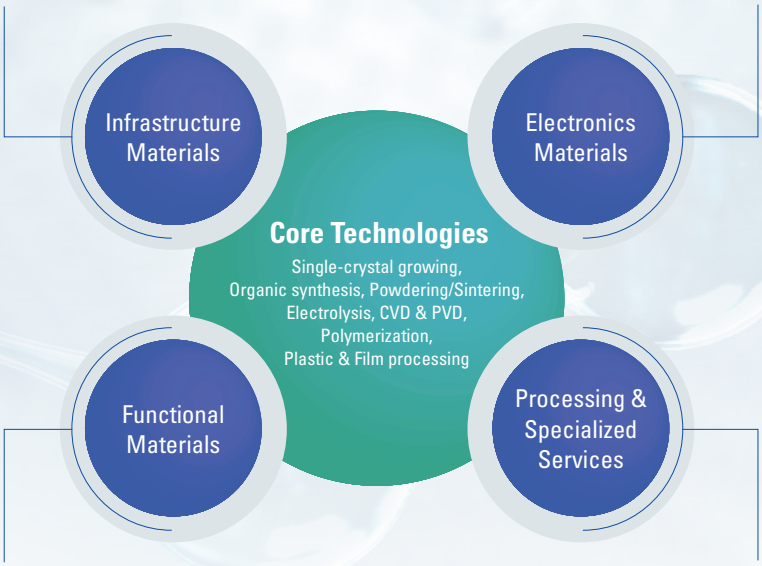
Leveraging our core technologies in four business fields to manufacture materials and products that underpin industries and livelihoods



PVC is indispensable to our lives mainly in the areas of infrastructure, housing, and agriculture. As the largest manufacturer of PVC, we provide a stable supply to customers around the world.

In addition to our world-leading share in silicon wafers, we provide various materials that are essential for semiconductor manufacturing. We contribute to the digital transformation and green transformation of industry.



Along with more than 5,000 different types of silicones that support people's lives and industries, we provide a stable supply of high value-added products. We also help alleviate environmental impacts and food shortages.

Meeting the diverse needs of customers by leveraging the advanced technological capabilities developed by the Shin-Etsu Group.

Technologies, Materials and Products of the Shin-Etsu Group

The Shin-Etsu Group makes a wide array of products for use in a broad range of industrial fields by drawing on the production technologies accumulated in the process of continuously diversifying and improving its product offerings. By reciprocally maintaining close relationships, our business mix extends across many different fields and we have built a robust business structure impervious to economic conditions.

Business Segment

- Infrastructure Materials
- Functional Materials
- Electronics Materials
- Processing & Specialized Services

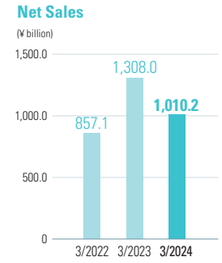
*1 Chemical vapor deposition (CVD)
A method for depositing thin film by chemical reaction on the substrate of precursors produced by applying energy such as heat, plasma, or light to raw material gases.

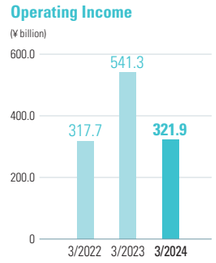
*2 Physical vapor deposition (PVD)
A method for adhering and depositing on the substrate surface by evaporating and scattering solid raw materials as atomic/molecular particles by heating, sputtering, ion beam irradiation, etc.

Business Overview

Infrastructure Materials

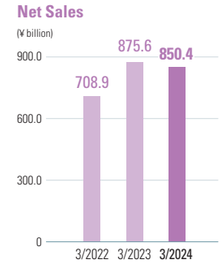
With regard to polyvinyl chloride, in addition to the stagnation of residential construction in the core US market against the backdrop of rising mortgage interest rates, weak construction and residential investment in China resulted in continued export pressure from Chinese manufacturers. The situation for caustic soda was similarly challenging. Against this backdrop, we strived to maintain price level through painstaking negotiations. In addition, we carried out extensive regular maintenance work in the US during the October-December period.

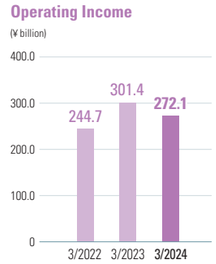




Electronics Materials

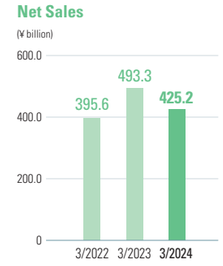
The semiconductor market continued to be in an adjustment phase since the fall of 2022 into the period under review, but we also saw signs that the market had bottomed out. Under these circumstances, we focused on fulfilling shipments of semiconductor materials such as silicon wafers, photoresists, and photomask blanks as planned. With regard to rare earth magnets, although adjustments continued for industrial equipment applications, we strived to expand sales in automotive and other markets.

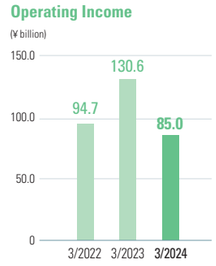




Functional Materials

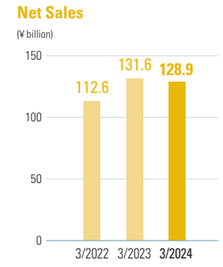
For silicone general-purpose products, we continued to experience inventory adjustments and softening market conditions stemming from the sluggish Chinese economy, the impact of which intensified in the second half of the fiscal year. To address this, we worked to supplement earnings by expanding sales of high-performance products.

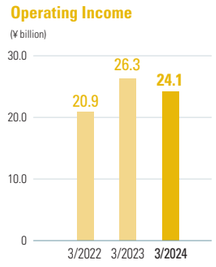




Processing & Specialized Services

Demand for semiconductor wafer-related containers remained in an adjustment phase, mainly for in-process applications, but sales of input devices for automobiles remained steady thanks to a recovery in the automotive industry. Sales of PVC wrapping films for food packaging to the restaurant and lodging industry grew on the back of higher inbound tourism demand.





Reference **Supplemental information by business (Fiscal year ended March 31, 2024/as of the year-end)**

	Infrastructure Materials	Electronics Materials	Functional Materials	Processing & Specialized Services
Assets (Note)	¥2,361.0 bn	¥1,487.9 bn	¥674.7 bn	¥247.7 bn
Capital Expenditures	¥128.4 bn	¥211.3 bn	¥52.5 bn	¥18.2 bn
Depreciation and Amortization	¥78.2 bn	¥105.6 bn	¥39.2 bn	¥5.7 bn
Number of Employees	1,862	12,451	4,334	7,357

Note: These amounts were prepared on an informal basis.

Infrastructure Materials

PVC is indispensable to our lives mainly in the areas of infrastructure, housing, and agriculture. As the largest manufacturer of PVC, we provide a stable supply to customers around the world.

Using Our Products to Solve Societal Issues (PVC)

Protecting the planet by reducing greenhouse gas emissions and expanding social infrastructure to cope with population growth

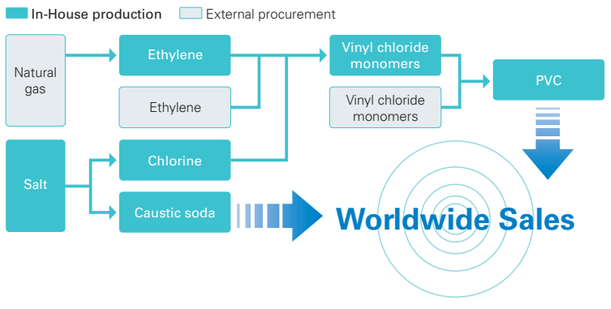
- Salt accounts for roughly 60% of the raw materials used to make PVC and is a commodity that still exists in abundance throughout the world. As the production of PVC does not rely heavily on petroleum resources, it makes effective use of the planet's limited resources. As such, CO_2 emissions during the PVC production process are lower than other plastics.
- The main applications of PVC are pipes and construction materials. Products made with PVC help conserve resources because they have a longer service life compared to other plastic products (PVC pipes last around 50 years*).
- PVC-framed windows boast superior thermal insulation and therefore help lower energy consumption and curb CO_2 emissions.
- PVC construction materials are much lighter than materials made from steel, for example, which leads to reductions in the amount of fuel required to transport them and move them into place during construction.
- In Japan, the material recycling rate for PVC is about 33%*, higher than that for other types of plastic.

*Source: Ministry of Land, Infrastructure, Transport and Tourism, Vinyl Environmental Council

Competitive Advantages (PVC)

- Efficient production with the world's largest production capacity
- Stable quality and stable supply to customers
- Favorable raw material situation and stable energy procurement in the U.S.
- Integrated production system starting from raw materials (ethylene)
- Three global bases, and production at multiple sites in three locations in the U.S.
- Global sales network

Integrated production system starting from raw materials (Shintech)



Major Products and Applications

PVC

PVC is extremely durable and easy to work with. It can also be easily recycled. For these reasons, it is used widely in items related to our daily existence. For example, PVC pipes in water supply and sewerage systems help extend the useful life of such infrastructure because they do not need to be replaced for at least 50 years.

PVC Pipes

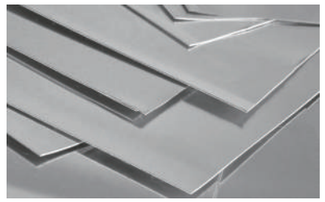
PVC-Framed Windows

Plastic Greenhouses for Agriculture

Caustic Soda

Caustic soda is a base chemical produced from the electrolysis of salt and is indispensable to various industries for the purpose of alumina extraction, as a raw material in lithium-ion batteries and super-absorbent polymers, and for water treatment.

Alumina



Cathode Materials for Lithium-Ion Batteries

Polyvinyl Alcohol (POVAL)

Polyvinyl alcohol (POVAL) has many applications, including adhesives, various types of film, textile treating agents, interlayers of laminated glass, and pharmaceutical additives.

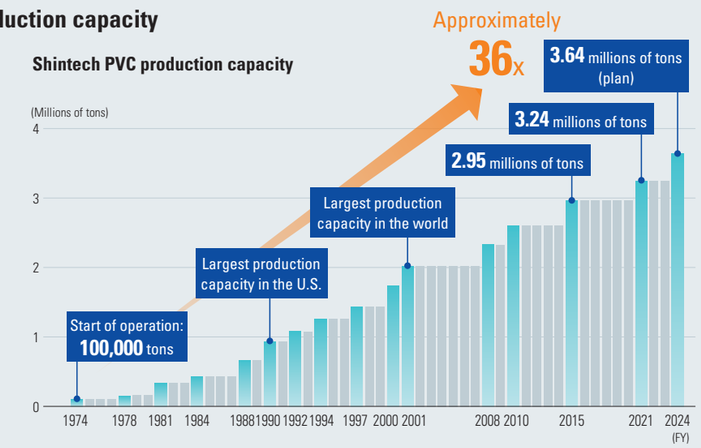
Car Windshields

Topic

Shintech: Augmenting PVC production capacity

Shintech, one of the Group's subsidiaries in the US and the world's largest manufacturer of PVC, has continuously expanded its capacity to meet the ever-increasing global demand for PVC. Today, Shintech proceeds to increase its capacity while taking advantage of the favorable raw material conditions in the US, and will start up a PVC facility with an annual capacity of 400,000 ton in mid-2024, which equates to about 10% of existing capacity. This will bring Shintech's annual production capacity to 3.64 million tons, enabling it to capture growing demand and provide a stable supply of PVC to customers around the world, while also achieving economies of scale.

Shintech PVC production capacity



Electronics Materials

In addition to our world-leading share in silicon wafers, we provide various materials that are essential for semiconductor manufacturing. We contribute to the digital transformation and green transformation of industry.

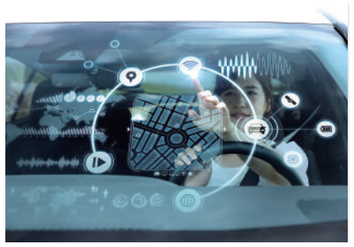
Using Our Products to Solve Societal Issues

Development of AI, 5G, automated driving, IoT

To achieve fully automated driving and telemedicine, 5G-compatible communication devices and infrastructure are necessary, and many high-performance, energy-efficient semiconductors are used in these devices. Silicon wafers, the substrate material for semiconductors, and various other semiconductor materials provided by the Shin-Etsu Group not only help to enhance performance and reduce the size and weight of electronic devices, but also contribute to improving electric power conservation and efficiency, thereby supporting the expansion and continuous growth of semiconductors on multiple fronts.

Providing technologies and materials essential for carbon neutrality

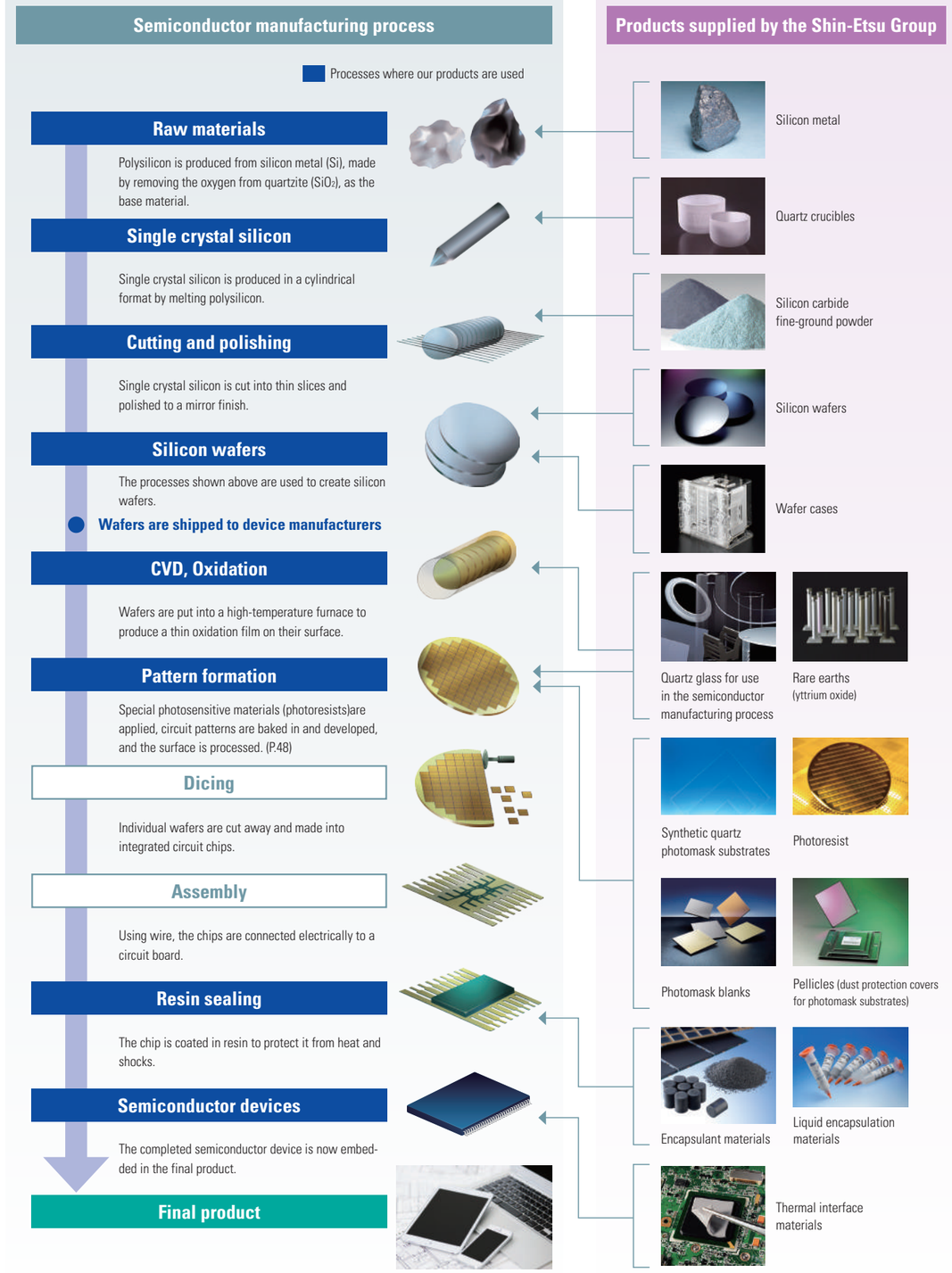
Rare earth magnets, which have about 10 times more magnetic force than conventional ferrite magnets, help enhance motor efficiency and power consumption, contributing to improved energy efficiency and reduced greenhouse gas emissions.



Competitive Advantages

Overall business	• Stable quality and stable supply to customers • Responding to increasingly sophisticated technological requirements
Semiconductor-related products	• Synergies gained from an extensive lineup of semiconductor-related products (competitive edge in development and proposal capabilities)
Rare earth magnets	• Stable supply supported by operating multiple production bases and an established integrated production system starting from raw materials • Development of products that substantially reduce the use of heavy rare earth materials and promotion of recycling

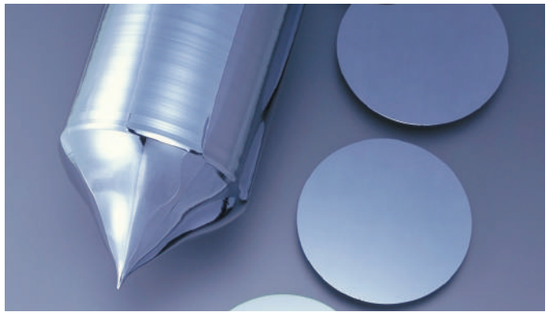
Shin-Etsu Group Products Associated with the Overall Semiconductor Manufacturing Process



Major Products and Applications

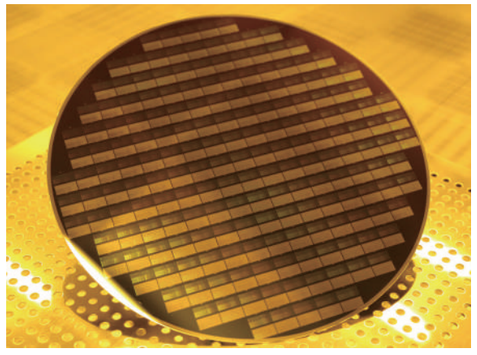
Silicon Wafers

Silicon wafers are the substrate material for semiconductors and are used in all kinds of devices, from smartphones, home appliances, automobiles and other devices that we see in our daily lives, to cutting-edge fields such as AI and IoT. Shin-Etsu Group's silicon wafers, including our quality control and evaluation analysis, have earned high praise from customers around the world, along with our high-precision single crystal technologies, high-end processing technologies, and high-quality epitaxial growth technologies for advanced logic and imaging devices.



Photoresists

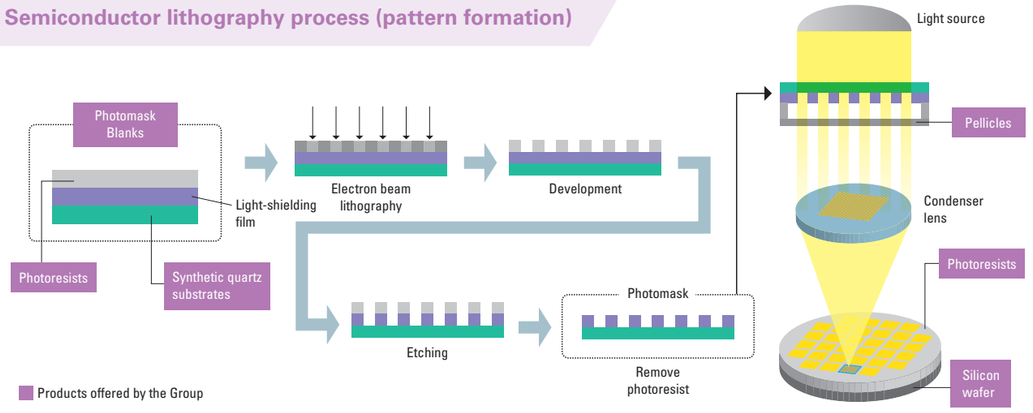
A circuit pattern is formed by applying photoresists to the surface of a silicon wafer and then passing light through a photomask to expose the surface in that pattern. In addition to photoresists for excimer lasers (KrF, ArF) and EUV, we also supply spin-on middle/under-layer hardmasks used in the nanofabrication process.



Photomask Blanks

Photomask blanks are the material that forms a thin metallic film on the surface of a synthetic quartz substrate and serve as patterning templates when drawing circuits on silicon wafers. In addition to providing photomask blanks for use with krypton fluoride (KrF) and argon fluoride (ArF) lasers, we have established state-of-the-art photomask blank mass production technologies, including multilayer film structures, permeable membrane structures with excellent light resistance properties, EUV blank and others.

Semiconductor lithography process (pattern formation)



Rare Earth Magnets

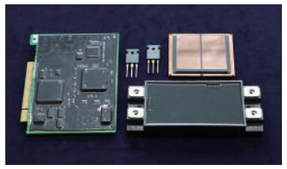
Rare earth magnets are used in products such as automobile motors, power generators, industrial robots, compressor motors for air conditioners, motors for hard disk drives utilized in data centers and other facilities and wind power generator. We are engaged in the manufacture of these magnets from the separation and refinement of rare earths as raw materials to the magnet product. Furthermore, it is reliably supplying high-quality rare earth magnets with advanced features by means of the development of its own grain boundary diffusion method, which reduces the amount of heavy rare earth used, while maintaining high performance.

Electric vehicle

Data center

Encapsulant Materials for Semiconductor Devices

These materials are notable for their superior heat and crack resistance and are used in general semiconductors, automotive power modules and devices for home appliances. Furthermore, the encapsulant materials we have developed for large-scale packaging improve the rate at which materials are effectively utilized, contributing to the reduction of device manufacturing costs.



epoxy molding compounds

LED Packaging Materials

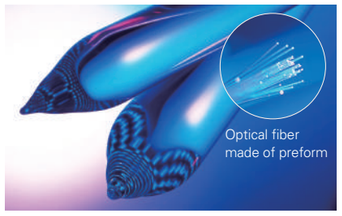
These materials offer high transparency, heat resistance, and other excellent properties, and help prevent the degradation of LED brightness over a long period of time.

Wavelength Conversion Silicone Film

Synthetic Quartz

Synthetic quartz, the key material of optical fiber, provides superior light transmission. In an ordinary glass plate, light attenuates in about two meters. However, synthetic quartz allows light to reach a distance of about 100 km. The Group was the first in the world to mass produce synthetic quartz, which is higher in purity than natural quartz. Due to these attributes, it is used as an optical fiber, a photomask substrate for semiconductor lithography and a stepper lens for semiconductor lithography. In addition, it is used as a large-scale photomask substrate for flat panel display (FPD) lithography, including liquid crystal and OLED displays.

Large-size photomask substrate for FPD



Preform for optical fiber

Topic

Established the fourth production base in the semiconductor lithography materials business

With the aim of expanding the semiconductor lithography materials business, we have acquired approximately 150,000 m^2 business site in Isesaki City, Gunma Prefecture, to build a plant that will become the fourth base of this business. We will invest in the new plant in phases, and the first phase will cost approximately ¥83 billion including the acquisition of the land, and construction is scheduled to be completed by 2026.

Demand for semiconductor lithography materials is growing as an essential material for the manufacturing of advanced semiconductors, and quality requirements are increasingly becoming more sophisticated. We will establish this new production base to meet the rising demand from customers and to diversify risks in terms of business continuity. Going forward, we plan to expand the facility as an advanced base for semiconductor lithography materials, including for research and development.

Illustration of the new base

Functional Materials

Along with more than 5,000 different types of silicones that support people's lives and industries, we provide a stable supply of high value-added products. We also help alleviate environmental impacts and food shortages.

Using Our Products to Solve Societal Issues

Low environmental impact of silicone

Silicone primarily consists of silicon (Si), which is the second-most abundant element found in the outer layer of the earth's crust, behind oxygen. As a raw material, it is associated with a low dependence on petroleum resources and a low environmental footprint. Silicones' outstanding properties are used in environmentally friendly products such as electric vehicles, fuel-efficient tires, solar power generation, and LED lighting.

Addressing food shortages and environmental issues (cellulose derivatives)

Cellulose derivatives are an environmentally friendly material made from natural polymer cellulose. They help address the food shortage and environmental problems caused by population growth, with one of their uses being a binding agent for plant-based meat substitutes.

Improving food safety (synthetic pheromones)

Synthetic pheromones are an environmentally friendly agricultural pest control agent that has no impact on beneficial insects or other organisms, and helps improve food safety by reducing the amount of insecticides and pesticides sprayed on fields.

Competitive Advantages

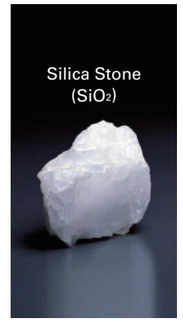
Overall business	• Ability to develop a variety of high value-added products by leveraging our technological capabilities • High quality products and stable supply system
Silicones	• Thorough response to customer needs through tripartite teamwork manufacturing that integrates the sales, research, and production divisions • Use of advanced technological capabilities and know-how cultivated over 70 years (ability to develop new products and technologies, expansion of high-performance product lineup) • Global production bases and a sales network in 13 countries • Continuous expansion of production capacity
Cellulose derivatives	• World top-class production • Active capital investment for pharmaceutical applications • Global stable supply structure secured by three manufacturing sites

Major Products and Applications

Silicones

Silicone is a man-made compound created from silica stone, which is abundantly available on our planet. It is a highly functional material with unlimited possibilities, as it features both inorganic and organic properties and has numerous excellent characteristics, as well as a high degree of freedom in product design. Silicone is used in a wide range of fields, including electricals and electronics, automobiles, construction, cosmetics, healthcare, and foods.

Core raw material used in silicone



Silicone representative configurations

Major characteristics of silicone

- Heat resistance
- Cold resistance
- Adhesion properties
- Defoaming properties
- Electrical insulation properties
- Water repellency
- Release properties
- Weather resistance

Cosmetics

Electric Vehicles

Contact Lenses

Buildings

Plastic Products

Textile Treatments

Cellulose Derivatives

Cellulose derivatives are made from pulp, a natural material derived from plants. In the pharmaceutical field, they provide function of controlling dissolving part in the body, controlled time release of drugs and are used as a tablet coating agent. In industrial applications, cellulose derivatives are used as a molding aid for automotive exhaust gas filters to prevent air pollution. In the food industry, it is used as an additive to thicken, gelatinize, and prevent deformation during cooking, as well as to improve the texture of plant-based meat, which has been attracting attention in recent years.

Pharmaceutical

Industrial

Food

Silicon Metal

Silicon metal is the main raw material for silicone, semiconductor silicon, and synthetic quartz, and is produced by SIMCOA Operations Pty Ltd in Australia.

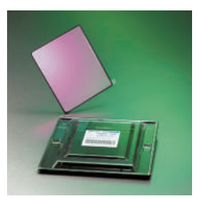
Synthetic Pheromones

Synthetic pheromones are artificially synthesized from pheromones emitted by insects, and are used as environmentally friendly pest control agents as they obstruct the mating process between male and female pests, thereby suppressing reproduction.

Liquid Fluoroelastomers SHIN-ETSU SIFEL®

We were the first company in the world to succeed in developing the SHIN-ETSU SIFEL® liquid fluoroelastomers, which by using silicone addition-reaction technology can be made into a form that hardens into a flexible, solid synthetic rubber upon heating. It possesses excellent process ability and such superior properties as resistance to oils, solvents and chemicals together with good durability against heat and stability at cold temperatures, and is used for essential applications in automotive, aircraft, electronics, and optical products.

Pellicles



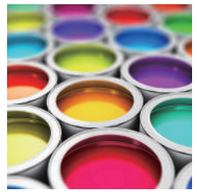
We provide high quality pellicles for use as dust protection covers for photomasks used in both ArF and KrF excimer lasers. In addition to having excellent light resistance properties and uniform rates of light transmittance, our pellicles have been thoroughly treated to ensure low outgassing. With these attributes, our pellicles support the increasingly intricate production of semiconductor devices. Furthermore, we also mass produce ultra-large pellicles used in flat panel display (FPD) manufacturing.

Anode Material of Lithium Ion Batteries

SiO is a greatly promising material as an anode material of next-generation lithium-ion batteries that have high capacity and excellent power properties. We have successfully improved battery characteristics by controlling the structure and surface of SiO particles and by developing our own lithium pre-doping technology.

SOLBIN®

SOLBIN is a copolymer resin from Nissin Chemical Industry Co., Ltd. that is prepared primarily from vinyl chloride and vinyl acetate, which are notable for their superior adhesiveness and solubility. It is mainly utilized in coatings, paints, inks and adhesives.



Topic

Plan to double production capacity of pharmaceutical cellulose

To bolster the pharmaceutical cellulose business, we will invest approximately ¥10 billion in facilities and equipment at our Naoetsu Plant. We plan to double the production capacity of Shin-Etsu AQOAT® (hypromellose acetate succinate), a pharmaceutical excipient, with completion scheduled for the spring of 2026.

Shin-Etsu AQOAT®, which we developed in-house, is made mainly from plant-derived pulp, and is widely used such as a coating agent for tablets that are safe for the human body. It is designed to dissolve in the intestine and not in the stomach, enabling control of where the drug dissolves. In addition, it also maintains drug effectiveness for a longer time. In recent years, its ability to improve poorly soluble (hard-dissolving) actives, enhancing drug solubility for better body absorbance, has been attracting attention. Accordingly, we expect demand to continue growing going forward, and we intend to capture this demand by expanding our facilities.

Processing & Specialized Services

Meeting the diverse needs of customers by leveraging the advanced technological capabilities developed by the Shin-Etsu Group.

Using Our Products to Solve Societal Issues

- Creating a next generation mobile society by facilitating technological innovations in automobiles, such as the spread of automated driving and environmentally friendly vehicles
- Advancing IoT in society by developing communications infrastructure and improving the performance of facilities and equipment

Competitive Advantages

Shin-Etsu Polymer Co., Ltd.

- Comprehensive capabilities to handle everything from material development to processing as a member of the Shin-Etsu Group
- Technological capabilities to create high-valued-added products with core technologies in processing various resins

Shin-Etsu Engineering Co., Ltd.

- Technological capabilities to handle design, construction, and maintenance of domestic and overseas plants in-house

Mainstay Products and Applications

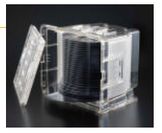
Shin-Etsu Polymer Co., Ltd.

Input Devices

Providing input devices for automobile steering, power windows, etc.

Wafer Cases

Providing cases for shipping silicon wafers and for inprocess wafer conveyance at device manufacturers.



Wrapping Films

Providing PVC wrapping films for food packaging with superior stretchiness and excellent adhesive properties.

Topic

Launched biomass wrapping film

KitcheNista, a consolidated subsidiary of Shin-Etsu Polymer, launched KitcheNista Wrap Antibacterial Blue, a PVC wrapping film for food packaging made from 10% biomass raw materials, in January 2024. By using plant-derived additives, this film helps reduce greenhouse gas emissions. Its suitability for food ingredient management makes it popular with restaurants and nursing care facilities, and if a piece of wrap accidentally gets mixed in with food, its blue color makes it easy to find and remove.

Shin-Etsu Engineering Co., Ltd.

Engineering

Shin-Etsu Engineering conducts plant design and construction and equipment maintenance for the Shin-Etsu Group.

Vacuum Assembling Equipment

Shin-Etsu Engineering also designs and manufacturers vacuum assembling equipment for LCD panels, enabling large-scale liquid crystal panel production.

Micro LED Chip Transfer Equipment

This equipment transfers micro-LED chips quickly and accurately, thereby promoting the widespread use of micro-LED displays.

Minoru Igarashi
General Manager, Department 2, Silicone-Electronics Materials Research Center Shin-Etsu Chemical Co., Ltd.

Shin-ichiro Yoshida
Group Manager
Sales and Marketing Department III, Silicone Division
Shin-Etsu Chemical Co., Ltd.

Takashi Kondo
General Manager,
Matsuida Plant, Silicone Production Department 4,
Shin-Etsu Chemical Co., Ltd.

Special Feature

Tripartite Teamwork Manufacturing

Shin-Etsu Chemical develops products tailored to customer needs by integrating sales, development, and production activities in a tripartite teamwork, enabling rapid-delivery manufacturing. One of the characteristics of the Company is that, instead of establishing a central research facility, the R&D centers for each product are located adjacent to the respective plants. For example, the Gunma Complex, which is the main production base for silicone products, has four plants consisting of the Isobe Plant, Matsuida Plant, Gobara Plant, and Yokonodaira Plant, along with the Silicone-Electronics Materials Research Center, putting tripartite teamwork manufacturing into practice.

What are the features of Shin-Etsu Chemical's tripartite teamwork manufacturing?

Igarashi As a comprehensive R&D center for silicones and organic electronic materials, the Silicone-Electronics Materials Research Center conducts customer-oriented R&D in a wide range of technologies, including synthesis, composites, formulation, processing, and production processing. In our silicones business, there are cases where the sales team listens to customer needs and communicates them to the development team, but there are also cases where the development team accompanies the sales team to listen directly to customers and use that information to promote product development before transferring developed products to the production team for mass production. I think we are different from other companies in that, unlike technical sales, our development team develops products by listening directly to our customers. We are in a position to understand many issues and underlying needs that customers are unaware of, because we are actually involved in the development process.

Kondo In the production department, which I am in charge of, products developed by Mr. Igarashi are transferred to us for production, and in some cases, we accompany the sales team to talk to the customers. Although the sales team is the point of contact, the pace of development is probably completely different compared to a process where the sales team stands in between and communicates with the customer on all matters.

In addition, and this goes without saying, but we must deliver our products in line with our customers' pace of development. In this respect, since the production department and the research center are located in the same area, we have a significant advantage in that products can be brought to the production department as soon as they are developed, and we can proceed with production while checking on each other's work. Even though we live in an age where it is easy to hold online meetings, it is still easier to communicate with each other and to feel each other's passion when we talk face-to-face, which I think is extremely important.

Yoshida Being in charge of sales, I often make business trips to the Gunma Complex from the Head Office in Tokyo, but since both the development and production departments are located in the same area, it is a great advantage to have our three teams work closely together under our tripartite teamwork manufacturing system. Sales is always in contact with customers, but I would like the development and production departments to experience firsthand the atmosphere between us in order to better understand customers' true needs and to boost their satisfaction. In this sense, I am grateful for the opportunities to have the development and production departments accompany us.

Once a month, the development, production, and sales departments meet to share information on the status of each department, and the sales department attends both the research center and production department meetings so that we can determine whether or not we can handle a certain project now, or whether it is worth tackling. We engage in our work while constantly thinking about things like, "we are working on this type of cutting-edge research, so maybe we can solve that issue our customer is facing," or "we have been able to run a production cycle on this schedule in the past, so we can probably ask the research team to conduct development with this delivery deadline," or "with our current capacity utilization, we should ask production to mass produce custom products around these dates." I also get ideas for new proposals through casual communication with the development and production teams.

Igarashi At the research center, we are always on the look-

out for the latest technological trends. At the same time, we get information on market trends from the sales department, anticipate when they might make certain requests, and make sure that we can respond to them quickly.

What advantages do you feel the Company has?

Kondo Many of our silicone products are custom products, and unlike the fully automated production lines used to make general-purpose products, we engage in batch production, producing a large number of different products using the same equipment. Silicone comes in many forms, including fluids, resins, rubbers, and powders, and we actually manufacture nearly 3,000 types of products, only counting the customized solid and liquid silicone rubber products. In order for the on-site operators to efficiently set up and make detailed production arrangements, it is important to coordinate with the development and sales departments. The fact that we are able to manufacture such a wide variety of products rapidly in response to customer needs is precisely because we have established our tripartite teamwork manufacturing system.

Yoshida One major point is that our ability to develop 3,000 different products is largely underpinned by our ability to secure enough manpower for development.

Silicone-Electronics Materials Research Center

Igarashi In addition to having the manpower to handle small-lot production of a wide variety of products, silicones are compounds, so one of our advantages is that we have built a systematic database to determine what properties can be achieved using which combinations, and can develop products efficiently according to customer needs. This is one of the advantages we have over our competitors. However, development personnel tend to be driven by the desire to develop innovative products rather than by concerns over cost, delivery schedules, or production, so we must work closely with production and sales to ensure that our developed products are launched as quickly as possible. No matter how good a product we develop, it is meaningless if it does not address commercial needs. I believe that the benefits of the tripartite teamwork system are great in terms of being able to develop products quickly while maintaining a marketing mindset.

Yoshida In the silicones business, we have a wide range of customers, each with different needs, so we inevitably end up producing a wide variety of products, and our ability to respond to these needs is highly valued by our customers. In addition, customers appreciate the value of highly functional custom products even more, which leads to a long and stable business relationship. I believe the tripartite teamwork is especially crucial for us to be able to quickly run through the development cycle of specialized materials.

How do you put tripartite teamwork manufacturing into practice?

Yoshida Let me use the silicone rubber for molding that does not require post cure, which has received great positive feedback from our customers in recent years, as an example. Silicone rubber is used in a wide range of applications, including automobiles, electrical and electronic equipment, office automation equipment, home appliances, and daily necessities, because it combines a number of excellent properties not found in general organic rubbers, such as heat resistance, cold resistance, weather resistance, and electrical properties. This silicone rubber for molding is available in two types: a millable type that is molded in a mixing machine called a roll mill, and a liquid type for injection molding. When customers mold silicone rubber, they previously had to go through a process called cure twice, just as they do with ordinary synthetic rubber.

Cure (primary cure) is a process in which a curing catalyst is added and heat treated to give the rubber elasticity. Post cure is mainly performed to stabilize the physical properties of silicone rubber, remove low molecular weight siloxane from the polymer, and remove the decomposition residue from the curing agent used. In particular, when used in a sealed environment inside electrical components, the low-molecular-weight siloxane contained in the material volatilizes and causes electrical contact failures. This creates the need to remove the low-molecular-weight siloxane as much as possible, which makes the post cure process necessary. In addition to the lengthy processing time stemming from the long heat treatment in a high-temperature oven (dryer), the post cure process involves heavy electricity use, generating exhaust gases that significantly burden the environment, and we had received numerous customer requests to find a way around this problem.

Igarashi To address this, we became the first in the industry to introduce materials for a liquid silicone rubber injection molding system that eliminates the need for post cure. This molding system, called the Liquid Injection Molding System (LIMS), eliminates the need for post cure by using a pump to transfer the two separate liquids to the injection molding machine, where they cure in the mold. Since most of the processes can be automated, it is widely used mainly for automotive parts.

In addition to this, in 2020, we developed a millable-type silicone rubber for molding that does not require post cure. This revolutionary product is expected to improve productivity and reduce energy consumption during molding, while also preventing defects such as contamination, and has received even greater positive feedback than the liquid-type product. The newly developed millable-type silicone high consistency rubber (HCR) employs an addition curing method that does not generate by-products, and uses a polymer with much lower low molecular siloxane content than conventional products, thereby eliminating the need for post cure.

Kondo The reason this case fits the tripartite teamwork pattern is that there was a long-standing need for a millable-type product, following the release of the liquid-type product, which our sales team has been telling us about for some time. This was a need that would have been challenging to fulfill without close cooperation between the development and production departments.

First, the research center had to create a curing agent that leaves no cure residue and a manufacturing process for low-molecular-weight raw rubber so that what had previously been carried out as two cure steps could be carried out in one step. This was probably the most difficult part. On the other hand, the technology to remove the low-molecular-weight siloxane left in the raw rubber was also a tough hurdle that the engineers in the production department had to solve. However, we had accumulated considerable technical expertise in removing low-molecular-weight siloxane from raw rubber at various plants, so we were able to make good use of this expertise.

Ultimately, the development and production departments worked hand-in-hand and side-by-side, and as a result of repeated trial-and-error technical development efforts on both sides, we were able to successfully mass-produce HCR that does not require post cure.

Yoshida As Mr. Kondo mentioned, HCR not requiring post cure calls for sophisticated manufacturing methods as well as advanced mass production technology, and we still maintain a considerable competitive advantage today. For customers, the use of HCR eliminates the need for the many ovens previously lined up for post cure, which translates into nothing but good outcomes, such as shorter processing times, lower costs, energy savings, reduced CO_2 emissions, and additional free space, making it an easy product to market. Customer feedback was extremely positive even after we reflected this added value into our price.

Please tell us about the direction of your initiatives going forward

Yoshida In October 2023, we established the Sustainable Silicone Business Development Department, which conducts market research and sales promotion for the development of environmentally friendly products. As part of the sales team, we will work to quickly identify robust demand for environmentally friendly products to follow HCR not requiring post cure, and provide feedback to the development department. In addition, there is growing interest in recycling, and we believe there is a significant amount of silicone that can be recovered from, for example, automobile air bags and construction sealing materials.

Kondo When it comes to recycling, we have to consider everything starting from the manufacturing equipment, so the tripartite teamwork cooperation becomes even more important. At the Gunma Complex, we are already promoting recycling by collecting defective products and injection molding burrs* generated by customers and using them again as raw materials for polymers.

Igarashi Environmentally friendly products and the use of recycled raw materials are surely major themes in development for silicone product as well.

Matsuida Plant

How do you pass down the tradition of tripartite teamwork manufacturing to the next generation?

Yoshida At Shin-Etsu Chemical, it is a matter of course for the development department to visit customers together with the sales department to listen to their concerns. In addition, the production department also has production engineers, and if a problem arises, they work together with the sales and development departments to solve it as part of their daily work. So, as long as young employees follow in the footsteps of their seniors without being particularly conscious of it, they will eventually develop a sense that the development, production, and sales departments are in tune with one another; this was the case for me and my colleagues. Tripartite teamwork manufacturing creates a sense of unity and a virtuous cycle within the Company, and I believe that this will continue to evolve as our business style going forward.

*A rough edge or area that extends beyond the perimeter or edge of a manufactured product.