Promoting Streamlining to Improve Profits and Losses

Fiscal 2018 outlook

Net sales	Operating income (loss)	Net sales	Operating income (loss)
54.4 billion yen	(4.7) billion yen	56.0 billion yen	(4.0) billion yen

Fiscal 2017 results

Results for fiscal 2017 showed net sales of 54.4 billion yen while, with regard to profits and losses, various factors such as the continued streamlining of production systems contributed to a reduced deficit margin with operating losses of 4.7 billion yen.

Business in insulators was sluggish as a result of Japanese electric power companies reducing capital investment. With regard to NAS® battery business, 1.2-megawatt NAS batteries were delivered to Dubai to help in meeting the time-shift power consumption needs of large-scale solar power plants being constructed in the Middle East; however, due to a lull in construction activity, no other major shipments were made.

In fiscal 2018, net sales are projected to be 56.0 billion yen with operating losses of 4.0 billion yen, meaning a continuation of deficits despite a slight increase in revenues compared with the previous period.

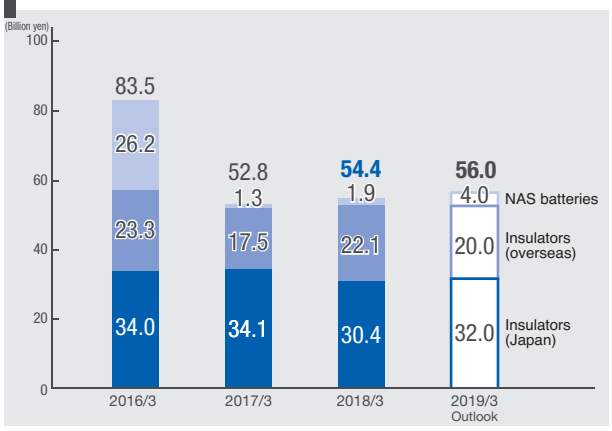
For insulator business, demand within Japan is expected to continue its sluggish trend, while overseas demand in the Middle East and North America is expected to be slow as well.

With regard to NAS battery business, while demand will increase mainly for users in Japan to meet the rapidly spreading adoption of renewable energy, the total number of shipments remains low and figures will remain in the red.

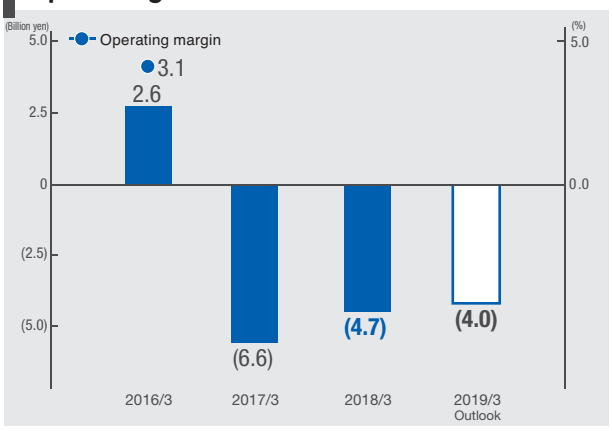
Senior Vice President; Group Executive, Power Business Group **Shigeru Kobayashi**

Financial results

Net sales (Billion yen)



Operating income (Billion yen/%)



Power business

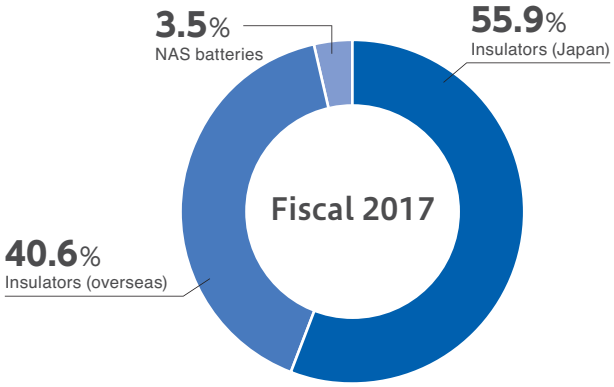
Insulators

Ceramic insulators play a role in insulating power transmission lines and steel towers. Ceramic insulators are an indispensable part in ensuring stable energy lifelines and were the NGK Group's founding products. As a top insulator manufacturer, NGK manufactures and provides high-quality and highly reliable insulators and equipment for power transmission, substations, and distribution, both in Japan and overseas.

NAS batteries

NGK manufactures and sells NAS batteries capable of ensuring power supply stability over the long term and with an array of superior features, including large capacity, high energy density, and long service life. NAS battery systems also contribute to peak power reduction by leveling out the power load, help stabilize renewable energy, act as countermeasures against surplus power, and facilitate power savings and cost cutting.

Sales ratio by business

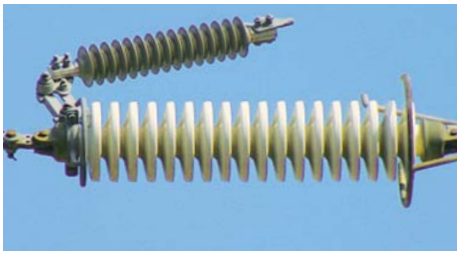


Insulators for power transmission

We constantly seek to innovate, and have succeeded in making our insulators more compact without compromising strength or isolation capacity. Thus, our suspension insulators for UHV power transmission are only 41 cm in diameter but can withstand a load of 84 tons.

Insulators and equipment for substations

These insulators are used to isolate power lines from equipment and the transformer building. In fact, our technological capabilities enabled us to make UHV gas bushings some 11.5 meters long—the largest porcelain products in the world.



Equipment for power transmission

TWe manufacture devices to prevent power outages when something happens to transmission lines. In particular, our line arresters, which have built-in functional ceramic (zinc oxide elements), make a huge contribution to blackout prevention by selectively discharging the large fluxes in current caused by lightning strikes.

Manufacturing sites

●Insulators: Japan, China, US, Australia ○NAS batteries: Japan

Aiming for Growth in NAS® Batteries amidst Business Restructuring

Future outlook

With regard to insulator business, due to the expansion of energy saving in Japan, electric demand is expected continuing decline, in addition, the continued constriction of capital investment among Japanese power companies, which will last until 2020 when legal separation of power generation, transmission and distribution starts, the demand of insulator for transmission and distribution will be sluggish for the time being.

For overseas markets, the continued stagnation in oil prices is prolonging austerity measures in the Middle East, while in North America investment is shifting towards IT measures and distribution area; thus, overall market conditions are expected to remain harsh.

Amidst all of this, in fiscal 2017 the NGK Group began restructuring North American business and scaling down the production system at the Komaki Plant, while in fiscal 2018 this scaling down will be extended to the Chita Plant, which will move to single-shift operation. Despite ongoing, positive results, such as securing OEM* status for some NGK products aimed at the North American market, the market conditions are more severe than were anticipated, and supplemental initiatives are being discussed.

In January 2018 we confirmed that, in some cases, insulators and related products did not undergo appropriate tests in accordance with agreements with customers. Upon taking steps to verify the quality of the concerned products, we have been working with customers to provide detailed explanations. We will work further to strengthen our quality control structures and make all members of the group aware of the importance of compliance in order to prevent reoccurrence.

Demand for insulators is not going to disappear. Our aim is to continue restructuring our business to put it in the black while also enhancing the quality of our products further to satisfy the trust that we have built up with our customers.

It will take time for full-scale demand for NAS batteries to be realized; however, we believe that latent need continues to rise.

In the Middle East, plans to introduce large-scale solar power plants are being implemented as part of efforts to meet the 2030 greenhouse gas reduction targets of the Paris Agreement. Also, in Europe there is a push to revise the 2030 renewable energy ratio targets upward. In Japan, as well, the push to avoid enhancing the transmission network and the push to use solar power generation for shifting peak power consumption times are fostering greater need for energy storage system offering long-term stability, which we foresee creating a surge in demand starting around 2020.

The power industry is entering an era of revolutionary change. Up until now, thermal and nuclear power were the base load power sources; however, as part of the fight against global warming we are increasingly moving away from coal-fired thermal power and shifting the base load more towards natural gas and renewable energy. One of the needs that is becoming more acute as a result of this transition is the need to shift the large amounts of solar power and other power generated during the day to the peak consumption periods during the night. Energy storage systems like NAS batteries are essential to achieving this.

Insulators have been the foundation of NGK business for 100 years, but NAS batteries will be what carries it through the next 100 years. Although the immediate future looks difficult, we are pushing ahead towards the flood in demand that is coming.

Another trend we are anticipating is the continued shift towards “local production for local consumption” for electricity as communities seek to reduce the distribution costs, which comprise so much of their power production and supply costs. With the ongoing decline in Japan’s population, it is unrealistic to expect underpopulated areas to be able to maintain large-scale power distribution networks. For such areas, the zinc secondary batteries that we are currently developing would be a more suitable option at the power distribution level.

Our work on NAS batteries has revealed a host of new opportunities in business areas where batteries are needed, such as in remote surveillance and maintenance. By such means as partnering with companies that already provide established services in these areas, we can create new business while also contributing to reduced environmental impact through more efficient energy usage.

NAS® battery systems
NGK developed the world’s first commercialized battery system capable of storing hours of electricity. These systems, which enable a high output of electric power for long periods of time, have been installed in around 200 locations worldwide.

*Outsourcing to another manufacturer the production of products and components sold under your company’s brand.

TOPICS 1

Delivering 1.2-megawatt (1,200 kilowatt) NAS batteries to Dubai

In March 2018, NGK delivered 1.2-megawatt NAS batteries to Dubai, one of the emirates of the United Arab Emirates (UAE), to be used in its energy storage technology demonstration project. The utility and long-term performance of NAS batteries in stabilizing output from solar power generation will be investigated.

The UAE is undertaking large-scale investment in solar power generation with the aim of increasing the percentage of renewable energy it utilizes from 1% currently to 25% (10 gigawatts or more) by 2030.

NGK has also provided the Emirate of Abu Dhabi in the UAE with NAS batteries totaling 108 megawatts of power, as well as a central control system offering integrated management of this stored power as a virtual power plant. Full operation of this system will begin this summer.

Our aim is to secure large-scale orders from Dubai as well, following success of the demonstration project there.

NAS batteries installed in Dubai

Order for large-scale, 1100kV direct current system in China

In January 2017, the State Grid Corporation of China tendered bids for a 1100kV direct current system, which would be the highest voltage system used anywhere in the world.

TThis project was incorporated into the Chinese government's 13th five-year plan (elimination of thermal power plants near major cities and construction of 17 long-distance power transmission systems). NGK Insulators Tangshan received an order for approximately 180,000 insulators, including around 50,000 insulators with the world's highest strength rating of 840 kN (full delivery of this order was completed in fiscal 2017). Excellent results from the specified vibration fatigue testing demonstrated the insulators' long-term reliability and helped secure the order.

Insulators offering the world's highest strength rating of 840 kN (shown at right)

TOPICS 2

Stronger Exhaust Regulations Create Strong Growth for Core Products

Fiscal 2018 outlook

Net sales	Operating income	Net sales	Operating income
240.7 billion yen	56.7 billion yen	267.0 billion yen	60.0 billion yen

Fiscal 2017 results

In fiscal 2017, increased truck sales on the Chinese market and the impact of the more stringent exhaust regulations in the EU contributed to strong growth in NOx sensors and other automotive products. On the other hand, however, increased amortization and development expenses, combined with temporary expense increases such as new plant startup costs, contributed to an anticipated increase in revenue but decrease in profits, with net sales of 240.7 billion yen and operating income of 56.7 billion yen. Please note that, from April 2018, industrial process business has been transferred to the newly established Process Technology Business Group, and the above results represent a new segment base.

Projections for this new segment base in fiscal 2018 anticipate increased revenues and profits compared to the previous period, with net sales of 267 billion yen and operating income of 60 billion yen.

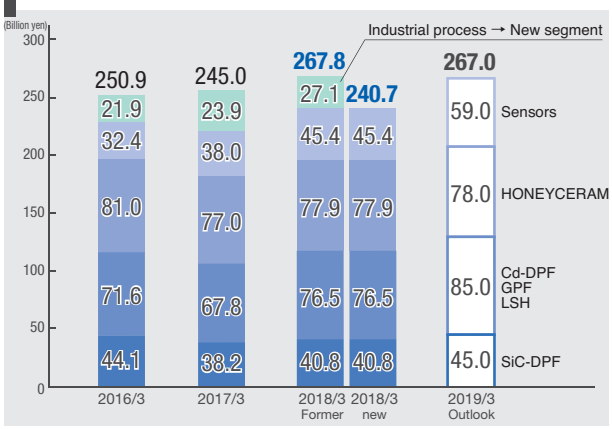
Sales of passenger vehicles in China and Asia's emerging markets and trucks in the US market are increasing, while exhaust regulations in Europe are getting more stringent. As a result of these trends, shipments of HONEYCERAM® to China and Asia's emerging markets are expected to increase, and demand for gasoline particulate filters (GPFs) for passenger vehicles in Europe is expected to ramp up significantly.

Because of further market share held by silicon carbide diesel particulate filters (SiC-DPFs), and because the number of NOx sensors per vehicle will increase, revenue is expected to increase for each.

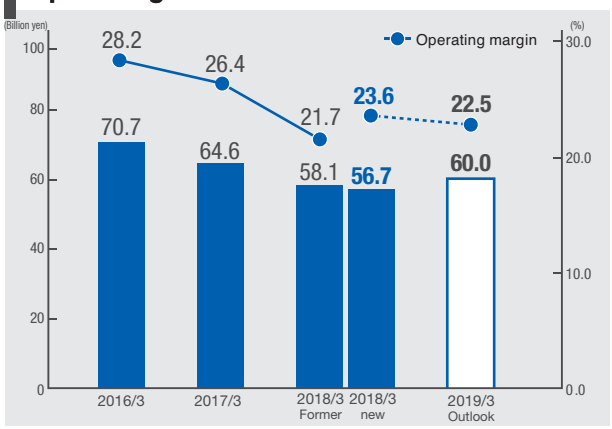
Director and Senior Vice President; Group Executive, Ceramic Products Business Group **Atushi Matsuda**

Financial results

Net sales (Billion yen)



Operating income (Billion yen/%)

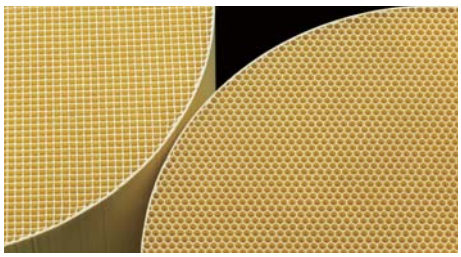


Ceramic products business

Automotive-related products

The HONEYCERAM® ceramic substrates for automotive catalytic converters are indispensable in cleaning vehicle exhaust. They have been adopted by automakers around the world and are manufactured by plants in Japan, Europe, America, Indonesia, Thailand, South Africa, and China.

NGK offers a range of other environmentally friendly and energy-efficient products, including diesel particulate filters (DPFs) and gasoline particulate filters (GPFs) which remove particulate material (PM), and NOx sensors which measure nitrogen oxide (NOx) concentration in automobile exhaust.

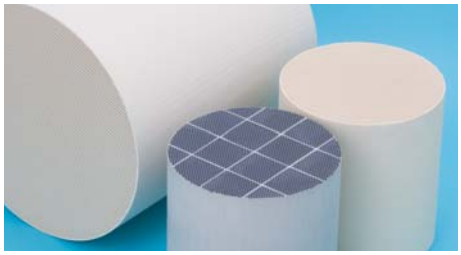


HONEYCERAM®

With a choice of square or hexagonal cell configurations (the latter being highly effective in conserving the volume of catalyst used), HONEYCERAM is used by auto manufacturers worldwide. Total production of HONEYCERAM recently exceeded 1.5 billion units.

In-vehicle high-precision NOx sensors

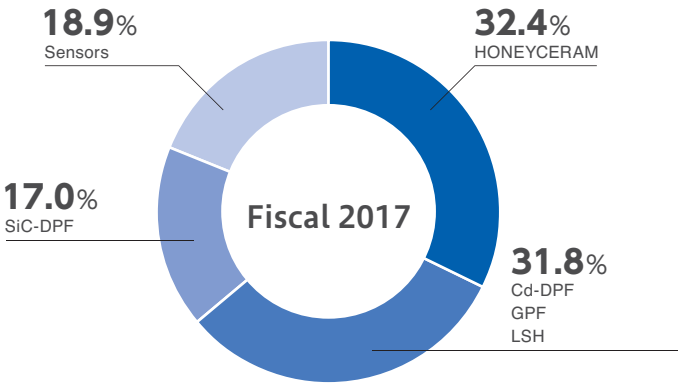
These sensors contain elements that utilize zirconia's oxygen pump function. They are now incorporated in clean diesel vehicles around the world because of their superior detection capabilities and greater durability.



Diesel particulate filters (DPFs)

These remove up to 99 % of particulate matter. Featuring superior heat resistance, silicon carbide filters (center of photo) are used in passenger cars, while lightweight cordierite filters are used mainly in heavy-duty vehicles.

Sales ratio by product



Manufacturing sites

● **Automotive-related products:** Japan, US, Mexico, Poland, China, Belgium, Indonesia, South Africa, Thailand

Steadily Investing in Production Facilities while Developing Products for a New Era

Future outlook

First, let us begin with an overview of NGK's core automotive-related products. For HONEYCERAM®, despite the fact that their total demand is generally tied with the sales volume for passenger vehicles (new automobiles) worldwide, the trend of replacing them with GPFs is causing their demand to somewhat fall below overall passenger vehicle sales.

Demand for DPFs for diesel vehicles is expected to grow as exhaust regulations for trucks and off-road vehicles become increasingly stringent in China, India, and other emerging markets and demand for trucks in China, in particular, looks to keep expanding. For large HONEYCERAM as well, the increasing sales volume for trucks in the Chinese market and stronger exhaust regulations in emerging markets are projected to increase the demand.

For GPFs, product shipments in the EU are expected to ramp up fully in fiscal 2018, while demand is expected to grow in China from next fiscal year onward.

Demand for NOx sensors is expected to increase significantly as a result of more stringent exhaust regulations in Europe, which necessitate the incorporation of more sensors per diesel passenger vehicle.

All of these are internal-combustion engine-related products; however, in recent years electric vehicles (EVs) are becoming the focus of more and more governments and automakers, and the media continues to report on the decline in diesel vehicles as a percentage of the European automotive market. Nevertheless, we project that the number of internal-combustion engine passenger vehicles will continue to increase until around 2025, and that the percentage of EVs and other non-internal-combustion engine passenger vehicles will hover between 6%–12% for the 2025–2030 period.

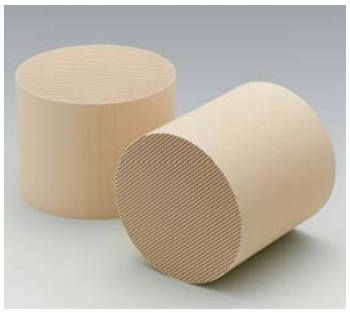
We expect diesel vehicles to be almost nonexistent among small motor vehicles by about 2025, but diesel vehicles will still be around for among large passenger vehicles and commercial vehicles that require torque.

Based on these assumptions, NGK is currently undertaking capital investment aimed at increasing SiC-DPF production at the No. 2 Plant in Poland. Our plan moving forward is to progressively decommission the aging No. 1 Plant and shift production to new lines in the highly cost-competitive No. 2 Plant in response to carefully monitored demand trends.

Observers are saying that the automotive industry is undergoing a once-in-a-century period of innovation. In such times, it is essential that we go back to basics. We will do what we are uniquely equipped to do, which is proactively pursue solutions to customer needs before they manifest themselves in the market, all while maintaining our commitment to the core aspects of our business: safety, the environment, quality, and CSR.

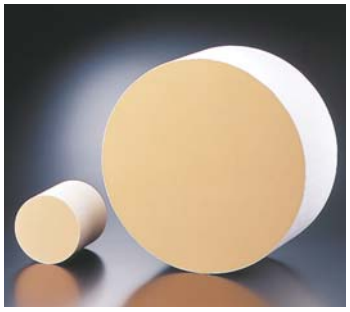
For example, the growth in hybrid automobiles on the market has seen a rise in the incidence of delayed catalyst activation due to insufficiently hot exhaust produced by engines that have been dormant for an extended period. To address this problem, we are currently developing a new product that will electrically heat catalysts to improve their purifying performance.

Such a product, however, is nowhere near ready to be added to our business group's product lineup. It will take at least five to six years, with 10 years even being possible. Instead of short-cuts and clever schemes, for our quest to discover and develop products that meet the needs of the new era, we prefer a straightforward approach that relies upon on the strengths that the NGK Group achieves through its fusion of unique material technologies and production technologies.



Gasoline particulate filters (GPFs)

These particulate filters for gasoline-powered vehicles are used in direct-injection gasoline engines that provide high horsepower and excellent fuel economy.



Large-size HONEYCERAM (LSH)

Designed for large vehicles, this model of HONEYCERAM catalyst carrier removes hydrocarbons (HC), carbon monoxide (CO), and nitrogen oxide (NOx) contained in diesel exhaust gas.

TOPICS 1

Large-scale capital investment for even greater revenue

For three years from fiscal 2017 to fiscal 2019, our business group is undertaking the largest capital investment in its history. By increasing spending on production across nearly all of our product areas, we aim to achieve even greater revenues over the following three years.

This investment is primarily aimed at the NGK Ceramic Device Ishikawa Plant, NGK Ceramics (Thailand), NGK Ceramics Polska (Poland), and NGK Ceramics Suzhou. The product areas targeted span everything from ceramic catalytic converter substrates for automobile exhaust purification to NOx sensors. All of the products our business group manufactures are connected with cleaning automobile exhaust; hence, as more and more countries adopt stronger environmental regulations, demand for our products increases.

This investment will not only allow our business group to ensure production can meet demand, it will also allow us to introduce cutting-edge production lines that will improve production efficiency to reduce costs and guarantee profitability.


Ishikawa Plant, NGK Ceramic Device


NGK Ceramics (Thailand)


NGK Ceramics Suzhou


NGK Ceramics Polska

Solidly executing the fundamentals of business; tenaciously pursuing the essence of business

The principle which our business group, as well as the President of NGK, advocates and seeks to implement is to make sure we solidly execute the fundamentals (safety, the environment, quality, and CSR) of our business while tenaciously pursuing the essence of what that business is.

As part of ensuring that we are thorough about the fundamentals of our business, we are working to cultivate workplace and organizational openness, where even bad news is reported straight away without hesitation, by reorganizing and streamlining our business meeting structure to create the business group capable of frank and earnest exchanges of opinion.

As part of tenaciously pursuing the essence of what our business is, we are working to improve the efficiency of our sales departments via systematization of the process for relaying product ordering information to our plants, moving it beyond mere information transcription to a fully standardized operation. We are also introducing system management for samples requested by customers. In addition, we are introducing automated aggregation systems into our budget formulation operations in order to reduce the number of man-hours spent on these tasks.

Moving forward, we will incorporate automation wherever we can so that we can concentrate our human resources in the communication-related and creative jobs that only humans can perform.

TOPICS 2

Meeting Robust Demand with Timely Enhancements to Production Capacity and Expansion of New Product Sales

Fiscal 2017 results

Net sales **61.3** billion yen

Operating income **0.9** billion yen

Fiscal 2018 outlook

Net sales **67.0** billion yen

Operating income **2.0** billion yen

Results for fiscal 2017 show net sales of 61.3 billion yen and operating income of 0.9 billion yen, which represents an increase in both revenues and profits compared to the previous period. The shipment of metals, such as beryllium copper products, rose primarily for industrial equipment in the Chinese market. With regard to electronic components, since their release on the market starting in fiscal 2014, the sales volume of electronic components such as bonded wafers for mobile communications and piezoelectric micro-actuators for hard disk drives (HDDs) increased; however, demand for ceramic packages declined. Also, income for NGK's consolidated subsidiary Soshin Electric increased thanks to solid growth in demand for products aimed at industrial equipment and devices.

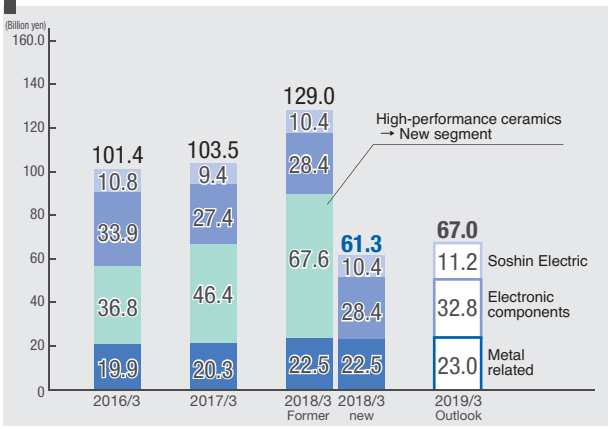
Please note that, from April 2018, semiconductor manufacturing equipment-related ceramics business has been transferred to the newly established Process Technology Business Group, and the above results represent a new segment base.

For fiscal 2018 we are aiming for 67 billion yen in net sales and 2 billion yen in operating income, which would represent a continued increase in revenues and profits from the previous period. For metal-related products, we expect a high level of demand to continue, primarily in the Chinese market. We will maintain our proactive marketing approach to expand sales of beryllium-copper products and new material copper-nickel-tin alloy products. For electronic components, we are expanding production capacity to meet the growing demand for HDD piezoelectric micro-actuators and bonded wafers, and for package products, we are concentrating on improving revenues for existing products while expanding our range of new products for next-generation telecommunications applications. Soshin Electric will stay focused on the steadily growing demand for industrial equipment and devices, working actively to develop markets for its core noise reduction-related products. It will also bring to market thick-film printed circuit boards for use in automobiles and multi-layered dielectric filters for use in wireless LANs conforming to new standards.

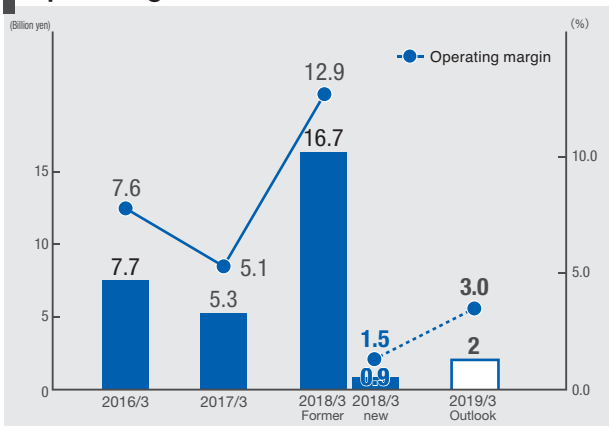
Director and Senior Vice President; Group Executive, Electronics Business Group **Shuhei Ishikawa**

Financial results

Net sales (Billion yen)



Operating income (Billion yen/%)



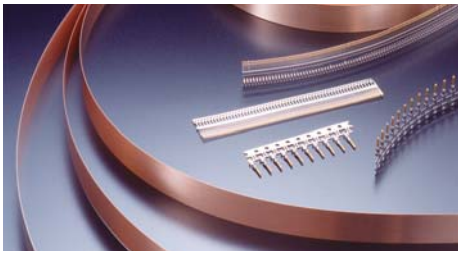
Electronics business

Metal-related products

Beryllium copper, which is made by adding a small percentage of beryllium to copper, is resistant to fatigue and has a long service life, making it the ideal material for reliable conductive springs and contact points in a broad range of applications. The manufacture and sale of beryllium copper is the primary business of NGK's metal-related product business. Since 2016, copper-nickel-tin alloy has been added to the product lineup as a non-beryllium copper product.

Electronic components

In addition to HDD piezoelectric micro-actuators, bonded wafers for electronic devices, and other products developed using the proprietary ceramics technology which NGK has cultivated over the years, our product lineup includes Soshin Electric's components for telecommunications devices and NGK Electronics Devices' ceramic packages for high-frequency devices.

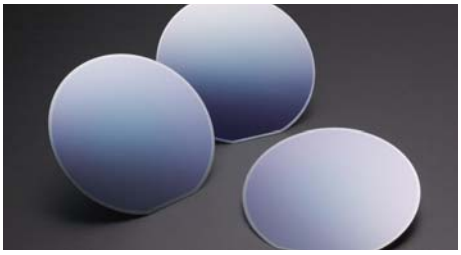


Beryllium copper alloy

We can provide the right alloy mix to suit your needs. Beryllium copper alloys offer high strength, high conductivity, fatigue resistance, high temperature properties, workability, and corrosion resistance.

Piezoelectric micro-actuators

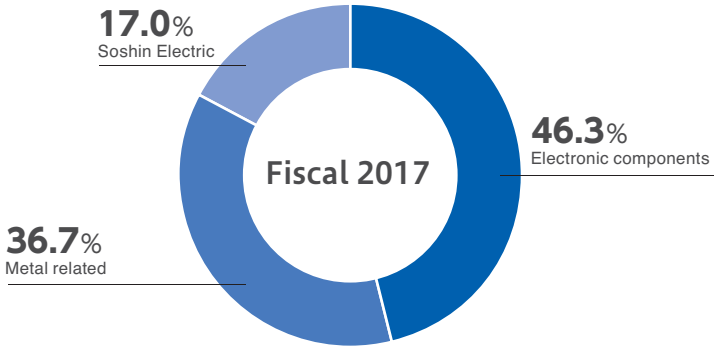
Micro-actuators are indispensable for performing precise control of magnetic heads in HDDs. Our ultra-compact micro-actuators are used in data centers throughout the world.



Bonded wafers

These wafers make the advanced communication transmission quality of smartphones and other devices possible. Combining different materials enables bonded wafers to deliver performance and functionality that cannot be achieved with wafers made from a single material.

Sales ratio by business



Manufacturing sites

- ● **Metal-related products:** Japan, US, France
- ○ **Electronic components:** Japan, Malaysia
- ◎ **Soshin Electric:** Japan, Malaysia

Anticipating Technological Innovation and Connecting It with New Product Creation

Future outlook

The arrival of the IoT and AI age will spur innovation in a range of technologies needed to address the explosion in next-generation data transmission volume and speed. The products of our business group are developed in anticipation of this innovation, thus allowing for new products or expansions of existing products to be developed at the right time.

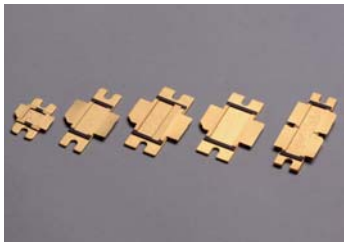
With regard to NGK's electronic components business, the strong growth in HDD piezoelectric micro-actuators is projected to continue. The rapid increase taking place in digital data volume is driving an expansion in demand for large-capacity, inexpensive HDDs aimed at data center backup servers. In order to capture this growing demand, we are working to bolster our production capacity and expand our lineup of customer program-compatible development products. Also, the proliferation of technologies which allow for ever faster mobile communication speeds is helping expand the market for advanced SAW filters, which utilize NGK bonded wafers. We are also developing technology to further enhance voice quality, which is receiving progressively better assessments from customers. Moving forward, we are prioritizing production capacity enhancements in preparation for a rapid growth in demand.

With regard to ceramic packages, the increase in infrastructure investment focused on the establishment of 5G next-generation high-speed communication standards is projected to foster an increase in demand for next-generation high-frequency packages for communication base station power semiconductors. With regard to metal-related products, apart from our beryllium copper, which is our core focus, we introduced a new copper-nickel-tin alloy material to the market in 2016. As a material used for high-performance conductive springs incorporated into smartphones, various automotive sensors, and many other devices, this product has a vast array of applications in the IT and electronics industries. For the future, we are working on enhancing its formability in order to expand its applications and marketability and, thus, sales.

In addition to IoT and AI, another global trend taking place is the adoption of electromotors in the automotive industry in response to environmental regulations. This trend is also helping drive more widespread adoption of hybrid automobiles. This increasing adoption of electromotors is fueling demand for automobile on-board power modules, which we are using to expand the scope of sales for our insulated circuit boards. We are also looking ahead to the widespread proliferation of power charging infrastructure and are working to expand sales channels for beryllium copper used in charging outlets.

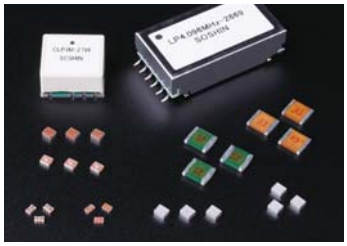
In April 2018, our business group took over the theretofore company-wide projects to develop micro-lenses for UV LEDs*1 and gallium nitride (GaN) wafers*2 and moved these into commercial production. Demand for these products is predicted to ramp up from 2020 onward as alternatives to ultra-high-pressure mercury lamps in response to the Minamata Convention on Mercury, which went into effect in August 2017. We are working to meet this demand by getting the products into mass production early.

Over the course of its history, NGK has been a company which produces long-lasting products and which cultivates business in areas with comparatively long-term, predictable demand; however, our business group is a bit different. Our focus is on figuring out how to address the shifting needs of the electronics industry, which can and do change significantly in only a short period of time. When some new need explodes onto the scene, we must be ready to meet it straight away or else risk missing the opportunity entirely; thus, as a matter of course we actively develop our business in directions that entail a certain amount of risk. As we move forward, we will continue creating new products that help ensure the ongoing growth of our business enterprise.



Ceramic packages

We offer a variety of ceramic electronic components, such as our high-frequency device packages which have earned the top share of the global market.



Electronic components for communication devices

By combining multilayer technology and high-frequency circuit design technology, we provide multilayer dielectric filters and couplers that are used in increasingly diversified base stations for mobile communications.

*1: Micro-lenses for UV LEDs: These lenses can be used to improve the sterilization efficiency of UV LEDs, which are seen as a replacement for mercury lamps as a sterilization light source, by narrowing their irradiation area. These lenses are made from quartz, which is known to be difficult to work but with which we are able to create complex shapes thanks to the use of our proprietary technology.
*2: GaN wafers: Used as a substrate for ultra-bright lasers and LEDs. Expected applications include projector and stadium light sources.

TOPICS 1

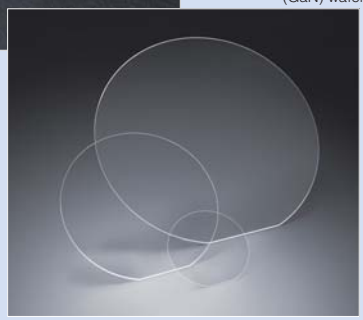
Launching new business promotion project

Fiscal 2018 saw the start of commercial production for micro-lenses for UV LEDs and for GaN wafers. Both of these new products were developed as, and had their commercial potential cultivated by, new product promotion projects within the Electronics Business Group.

Micro-lenses for UV LEDs are made from transparent quartz glass and are used to improve the sterilization efficiency of UV LEDs, which can be used in place of mercury lamps as a sterilization light source, by effectively narrowing their irradiation area. GaN wafers are used in light sources for lasers and LEDs, and offer low defect density across the entire wafer thanks to the use of proprietary NGK monocrystalline growth technology, giving them the ability to achieve unprecedented ultra-bright luminosity.

Marketing, pilot line creation, and performance/mass production testing is moving forward to ensure we are able to meet the full-scale market demand projected to appear around 2020.

Micro-lenses for ultraviolet LEDs



Gallium nitride (GaN) wafers

Expanding copper-nickel-tin alloy sales channels

The Electronics Business Group began mass production of copper-nickel-tin alloy in 2016 as a new, non-beryllium copper alloy.

This copper-nickel-tin alloy combines copper with 9%–21% nickel and 5%–6% tin. As a material used for high-performance conductive springs, this alloy has a wide range of potential applications, including connectors and switches. Unlike competitors' copper alloys, this alloy from NGK offers superior thermal resistance and abrasion resistance. This material is currently being used primarily with sliding brush-type contact points for timepiece gears and automobile on-board sensors. We are working to improve its formability as part of an active effort to expand its marketability to other applications, such as automobile on-board electronics and smartphone connector terminals.

Copper-nickel-tin alloy products

TOPICS 2

Driving Greater Growth with the First New Business Group in a Quarter Century

Fiscal 2017 results

Net sales	Operating income
94.7 billion yen	17.1 billion yen

Fiscal 2018 outlook

Net sales	Operating income
110.0 billion yen	19.0 billion yen

Newly established in April 2018, our business group features the combination of the HPC-related (ceramics for semiconductor manufacturing equipment) business previously handled by the Electronics Business Group and the industrial process business previously handled by the Ceramic Products Business Group. For the first time in a quarter century, NGK group started up a new business group.

Our aim is to realize further growth of the rapidly growing HPC-related business, which is becoming the second backbone after the automotive-business group, and the industrial process business, which has the high potential of business development in a wide range of fields.

From the strong growth of the HPC-related business, the results for fiscal 2017 based on new segment were promising, achieving net sales of 94.7 billion yen and operating income of 17.1 billion yen.

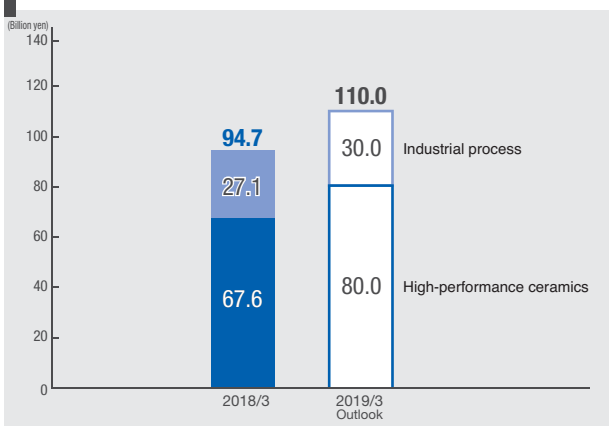
In fiscal 2018, we expect the increase in revenues and profits compared to the previous fiscal year, with net sales of 110 billion yen and operating income of 19 billion yen.

Revenues and profits for the HPC-related business are expected to increase as a result of increase in capital investment by semiconductor manufacturers. Industrial process business is also expected to see increase in revenues led by the continuous investment in lithium-ion batteries on Chinese automobiles and the installation of low-level radioactive waste treatment equipment used to process logging trees for the Fukushima Daiichi Nuclear Power Station.

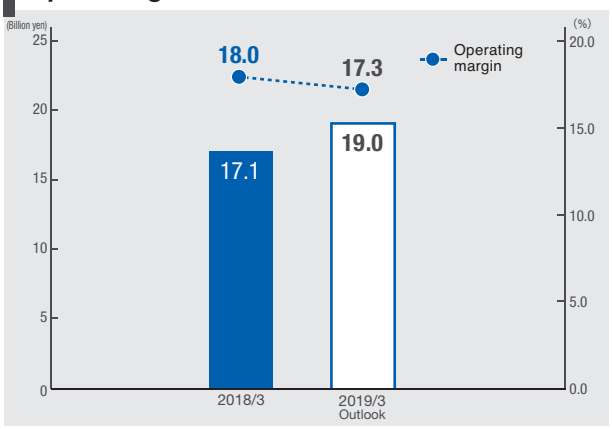
Director and Senior Vice President; Group Executive, Process Technology Business Group **Ryohei Iwasaki**

Financial results

Net sales (Billion yen)



Operating income (Billion yen/%)



Process technology business

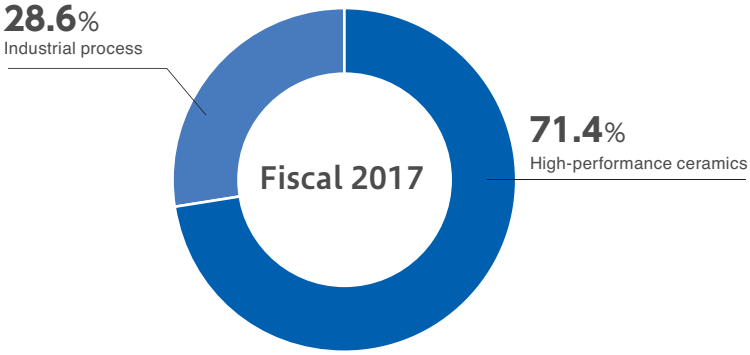
High-performance ceramics (ceramics for semiconductor manufacturing equipment)

We provide chamber components and ceramic functional components (susceptors) that support silicon wafers as a semiconductor material inside semiconductor manufacturing equipment. In the face of the increasing integration of semiconductors, our products respond to increasing demand for memory as well as miniaturization and energy conservation needs for electronic components.

Industrial process products

We offer a lineup of ceramic products—including heating devices, kilns, refractories, ceramic membranes, separators, corrosion-resistant equipment, and low-level radioactive waste treatment systems—that serves a broad range of industries and provides smart solutions for environmental protection and energy conservation.

Sales ratio by business



Ceramic heaters

These are used to keep the temperature of silicon wafers constant during the membrane formation process. Our unique heater structure sees a shaft attached to the underside of the heated stage on which wafers are placed. This way, we can protect terminals and conducting wires from halogen gas.

Low-level radioactive waste treatment systems

Our treatment systems are used at nuclear facilities throughout Japan, and are rated highly for their outstanding dust removal performance and steadfast safety. What's more, they make a real contribution to waste reduction.

Wavelength-control drying systems

By selectively irradiating light at specific wavelengths, the unit can dry at low temperatures (approximately 40°C) while limiting thermal damage to products, helping to enhance product quality, and improving productivity.

Manufacturing sites

● **High-performance ceramics:** Japan, US ○ **Industrial process products:** Japan, China, Thailand

Creating Synergy from the Fusion of Two Businesses

Future outlook

Capital investment in semiconductors is expected to increase further, driven by the demand for 3D-NAND flash*1 and DRAM*2 memory. Our HPC-related business sells heaters, electrostatic chucks, as well as aluminum chamber components. Susceptors are produced in Japan, while chamber components are produced in the US. Demand for both product groups is growing; therefore, we are conducting production investment and expanding domestic susceptor production on the Tajimi Plant, and chamber component production in the US.

In industrial process division, we are expanding sales of kilns for cathode materials used in lithium-ion batteries to meet the rapidly growing demand in China, refractories used for the manufacture of numerous electronic components in smartphones and other devices, and a new drying furnace that can selectively irradiate light at specific wavelength. In addition, we are also continuing to focus on engineering business such as waste treatment systems capable of processing low-level radioactive materials from nuclear power plants.

Our future goal is to create synergy between HPC-related and industrial process businesses. HPC-related business was originally generated from industrial process business. Although it has grown considerably on its own since then, we hope to maximize the synergies of the both by taking advantage of our compatibility now that we have the opportunity to work together again.

The value of our business group is to find solutions for customers by providing technologies that only NGK can offer. Therefore, we are not only promoting the fusion of highly specialized technology from HPC-related business and potentials of the product development in a wide range of fields from industrial process business, but also working on development themes from the New Business Planning Office and Corporate R&D. We believe that enhancing this value will contribute to stronger and more diverse business foundations.

The Process Technology Business Group is still young but is already an important driver for the future growth of NGK. We want to foster an open and voluntary mind respecting culture that regards maintaining the status quo as risks and challenging new things without being afraid of failures.

Electrostatic chucks

These are used in etching and other processes for the adsorptive immobilization of silicon wafers. We are able to adapt electrostatic chucks to suit their intended use to exponentially improve the semiconductor production process. For instance, we can integrate them with high-precision heaters and attach cooling plates.

Refractory products

Firing jigs are indispensable in firing electronic components and ceramic products. Our incredibly thin and lightweight refractories help to improve productivity and save energy.

*1: Memory cells are stacked vertically in multiple layers to create highly integrated NAND flash memory.
*2: A type of readable/writable semiconductor memory.

TOPICS 1

Enhancing production capacity for products used in semiconductor manufacturing equipment

Our business group is undertaking additional investment of 20 billion yen in three HPC (high-performance ceramics for semiconductor manufacturing equipment) business sites in Japan with the aim to increase the production capacity by 1.5 times compared to the original plan by 2020. Also, the new plant under construction in Tajimi, City, Gifu Prefecture will start production ahead of schedule in October 2019, which was originally planned in April 2020.

The semiconductor market is continuing to grow due to the increase in data volume and other factors led by the spread of IoT and AI. Each semiconductor manufacturer is expected to continue capital investment at a high level. From this reason, there is a strong demand for our susceptors (ceramic functional components that support silicon wafers); however, the production capacity is not catching up.

While implementing the production equipment up to the maximum capacity into the No.1 Building of the new plant in Tajimi, we will maintain manufacturing areas and add facilities in Chita and Komaki plants in Aichi Prefecture. By implementing these additional plans, we will respond to the expanding demand and aim for further growth of our business.

New Tajimi Plant, NCDK

Responding to the growth of the Chinese market for cathode materials used in lithium-ion batteries

In 2019, the Chinese government will enforce a law that mandates automobile manufacturers to manufacture and sell a certain percentage of new energy vehicles (NEV). In order to comply with the law, the demand for cathode materials used in lithium-ion batteries is rapidly expanding.

Our business group has been engaged in the business of kilns for cathode materials (roller hearth kiln), and our group company in China, NGK Technocera Suzhou, manufactures and sells these kilns, maintaining No.1 market share in China.

In order to respond to the demand expansion, we are working on developing and manufacturing a kiln offering greater productivity, as well as on securing external assembly plants and making the other necessary preparations to expand our production capacity.

Roller hearth kilns

TOPICS 2