

**P o w e r   B u s i n e s s**

## Promoting Sustainable Energy by Staying ahead of Trends to Consistently Offer Products and Services that Exceed Customer Expectations

The Power Business Group offers products and services aimed at the support and development of electricity infrastructure around the world.

Needs for large-capacity storage batteries that help stabilize power supply have increased with the expansion of renewable energy.

We have further strengthened our business structure for insulators from customer’s perspective in order to provide optimal products and services that meet customer demands in a prompt, accurate and flexible manner.

With the aim of becoming our customers’ brand of choice, the NGK Group will continue to promote businesses that will contribute to the development of power infrastructure as well as the spread and expansion of renewable energy.

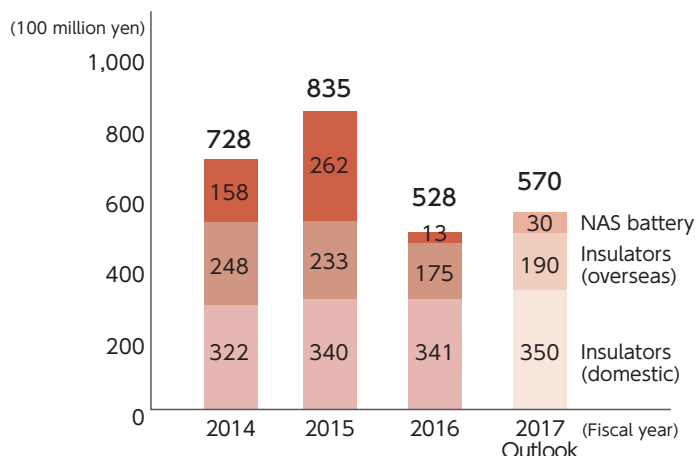


**Hideaki Saito**  
 Director and Senior Vice President  
 Group Executive,  
 Power Business Group

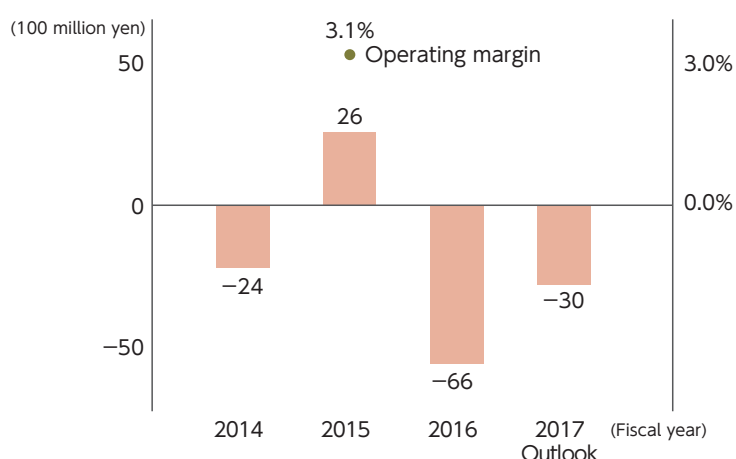
## Financial Data

### Financial results and outlook

#### Net Sales (After elimination of intersegment sales)



#### Operating Income (Loss)



# Products

## Main products

### Insulators

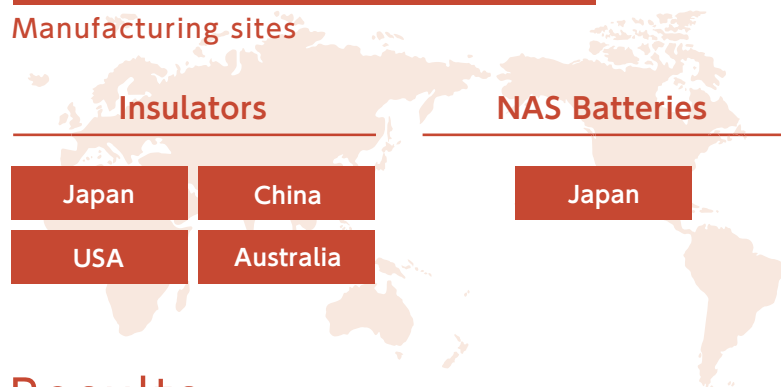
Insulators are the NGK Group's founding products made by ceramics. It helps maintaining staple power supply and ensures that transmission lines and steel towers are completely isolated. As a top insulator manufacturer, NGK manufactures and provides high-quality and highly reliable insulators and equipment for power transmission, substations and distribution.

### NAS Batteries

NAS® battery systems has strengths for Large-capacity, high-energy density and long-life which ensure a stable power supply over the long term. 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.

## Product Sites

### Manufacturing sites



## Results

### Business overview for fiscal 2016

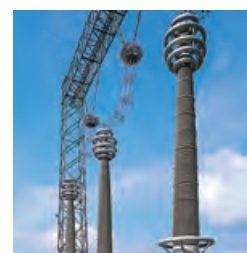
### Steady Progress in Promising Projects that will Lead to Future Growth

Net sales and operating income for both the insulators business and the NAS battery business fell below the forecasts made at the beginning of the fiscal year. In the insulators business, sales decreased due to sluggish replacement demand in North America. In the NAS battery business, sales declined mainly because there were no major shipments for both Japan and overseas.

Meanwhile, there has been steady progress in promising projects that will lead to future growth both for the insulators business and the NAS battery business. In Japan, replacement demand for insulators installed during the period of high economic growth has been strong, and such demand is expected to grow in the future. In overseas, while large-scale projects have been at a standstill due to the effects of economic slowdown and a decline in the price of crude oil, there is a demand of developing power grid system to solve the transmission networks against the backdrop of power shortages in emerging markets in the Middle East, China and Southeast Asia. As for NAS batteries, a large-scale hybrid battery system demonstration project was launched in Germany, which has been actively introducing renewable energy. Conditions for the widespread use of NAS battery systems are emerging since discussions on installing electric power storage batteries have commenced in Japan toward the expansion of renewable energy.



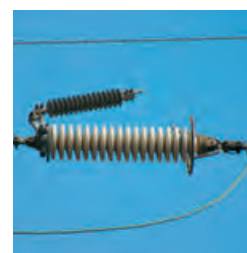
**Insulators for power transmission** which are indispensable for supplying power in a safe and stable manner



**Insulators and equipment for power substations**, the world's largest hollow insulators for substation system which resist up to 1,000kV-power transmission system (megavolt class)



**Polymer insulators for power transmission** which meet customer needs with a broad range of products including those made of porcelain



**Equipment for power transmission** such as line arresters that significantly contribute to reducing power outages



**Equipment for power distribution** that contributes to the maintenance and efficiency of power supply equipment



**NAS battery** which is the first megawatt-class electric energy storage system being utilized in the world

### Summary of Fiscal 2016

**Net sales** 52.8 billion yen  
(30.7 billion yen decrease from the previous year)

**Operating income (Loss)** (6.6) billion yen  
(9.2 billion yen decrease from the previous year)

#### Insulators

**Net sales** 51.6 billion yen  
(5.7 billion yen decrease from the previous year)

- Japan: Steady replacement demand
- Overseas: Decreased due to the postponement of large-scale projects, etc. (Asia, Middle East, etc.)

#### NAS batteries

**Net sales** 1.3 billion yen  
(24.9 billion yen decrease from the previous year)

- Decreased due to no major shipments for both Japan and overseas.

# Present Action

## Challenges and initiatives for fiscal 2017

### [Insulators]

### Enhancing Competitiveness and Establishing a Lean Business Structure

In the insulators business, we will continue to respond to strong replacement demand in Japan while strengthening the competitiveness of our products, approaching quality improvement and offering products and services that gain even higher levels of customer trust.

In order to respond to changes in the market conditions and demand swiftly, we will establish a lean business structure by streamlining production lines at plants, reorganizing and integrating business operations, thereby improving profits. Furthermore, we will promote the procurement and sales of OEM\* products and enhance our market presence, especially in the North American market, with the aim of responding to market calls for a broader product lineup.

### [NAS Batteries]

### Aggressively Developing Overseas Markets with the Aim of Generating Demand

While the environment surrounding the NAS battery business is likely to remain extremely challenging for the foreseeable future, the potential needs are high. For example, we aim to capture the orders in Hokkaido where the discussions are on-going about installing storage battery system to stabilize the power system to help the expansion of wind power generation. Looking at overseas, especially Europe where the expansion of renewable energy is particularly prominent, there is a movement to utilize storage batteries for demand management. Also in the Middle East, the plans have been coming up which introduce solar power systems to replace thermal power generation. Our extensive experience and track record in the installation of NAS batteries are significant advantages for approaching to such various needs above. As one another example, we have just announced that NGK will provide its NAS batteries for the large-scale hybrid battery system demonstration project to be conducted in Germany from April 2017. By actively leveraging these kinds of opportunities, we will endeavor to further enhance recognition of NAS battery systems and expand their applications.

## Outlook for Fiscal 2017

**Net sales** 57.0 billion yen  
(4.2 billion yen increase from the previous year)

**Operating income (Loss)** (3.0) billion yen  
(3.6 billion yen increase from the previous year)

### Insulators

**Net sales** 54.0 billion yen  
(2.4 billion yen increase from the previous year)

- Japan: Replacement demand remained steady
- China: Long-distance, large-scale power transmission projects increased
- North America, South Asia, Middle East: Large-scale projects remained stagnant due to the effects of economic downturn, decline in crude oil price, etc.

### NAS batteries

**Net sales** 3.0 billion yen  
(1.7 billion yen increase from the previous year)

- Japan: While detailed studies of storage batteries for power systems are underway in Hokkaido, full-fledged adoption will take time.
- Overseas: A large-scale hybrid battery system demonstration project was launched in Germany, which has been actively introducing renewable energy.

\* OEM is an abbreviation for "original equipment manufacturing," which refers to the manufacture of products to be sold under the brand of the entrusting firm (entrustment of manufacturing using the NGK brand).

## Topics1

### Contributing to Enhancing Safety and Reliability of Power Distribution Networks Expansion into Myanmar, Asia's Last Frontier

Myanmar has been maintaining a high rate of economic growth, the highest level in Asia, in fact. Following the 2011 shift in power away from military rule, the modernization of the country's infrastructure such as roads, railways, electricity, etc. has progressed.

While the Myanmar government has a national policy to improve its electrification rate from 30% in 2014 to 100% by 2030, the existing power distribution networks that cover the nation are made up of bare power cables and exposed cut-outs, which are susceptible to electric shock hazards and blackouts.

Given such situation, the NGK Group established a local entity in August 2016 by initiating the standardization of sealed cut-outs without exposure in the charger. We have since been providing instructions on manufacturing technologies and quality management to local alliance partners. It is our aim to enhance the safety and reliability of power distribution networks through the isolation of power cables, thus contributing to realizing a better standard of living and economic growth for people in Myanmar.



### Cut-outs

There is a fuse inside the cut-out, which stops the flow of current when an overcurrent is detected safely and promptly due to an accident involving the power distribution line, etc., thereby protecting power distribution equipment. Cut-outs manufactured by Energy Support Corporation being used by all electric companies and boast significant market share across Japan for their high reliability.



Conclusion of business alliance between Energy Support Corporation and a local company

# Next Vision

## Future outlook and initiatives

### [[Insulators]

#### Establishing Sustainable Business Structure and Enhancing Brand Value

In the insulators business, we will endeavor to establish a business structure that can deliver high profitability. Replacement demand is expected to expand in the future since the aging of power equipment both in Japan and the U.S. NGK's products have been highly recognized for their track records and quality and what we must focus on now is establishing a lean production system and a sustainable business structure. In addition, we will aim to further strengthen our systems from the customers' perspective in order to provide even more optimal products and services in a prompt, accurate and flexible manner.

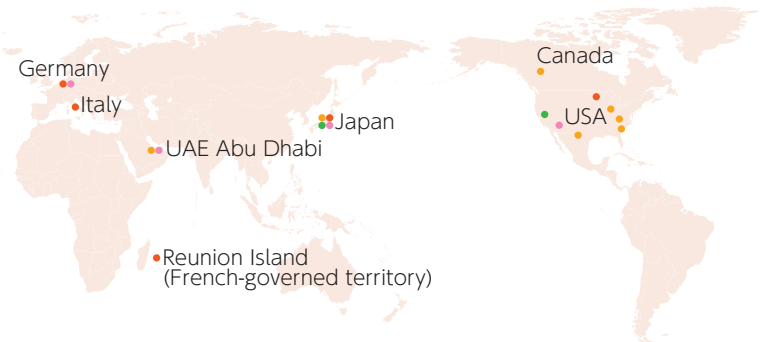
### [NAS Batteries]

#### Capturing Demand by Taking Advantage of Global Expansion of Renewable Energy

In the NAS battery business, we will strive to grow business in line with the global expansion of renewable energy by leveraging our strengths in large capacity, compact size and superior cost performance as the large capacity storage battery. It is expected that renewable energy will be fully introduced as energy infrastructure around the period between 2020 and 2025. Since NAS® battery systems have high demand potential, we will actively engage in demonstration experiments in various countries and regions in the next few years and prepare for an increase in demand in the future. By doing so, we will be possible to offer more practical solutions by accumulating insights and building up a track record as

## Track record of NAS battery installation

Approximately 200 locations worldwide, with power output amounting to approximately 530,000 kWh and storage capacity of 3,700,000 kWh



| Applications of NAS batteries |  |
|-------------------------------|--|
| ●                             | Peak reduction shift                               |
| ●                             | Power system measures, built with renewable energy |
| ●                             | Frequency adjustment                               |
| ●                             | Smart grid   |

there are significant background differences in reasons for introduction and use environment for storage batteries, depending on the customers. In addition, we are striving to establish operations related to remote monitoring systems after installing and also the after-sales services expected to cause as customers' needs. As a leading company of large-capacity storage batteries, NGK has been preceding its competitors in terms of both track record and performance. Looking ahead to the large-capacity storage battery market to emerge in three to four years' time, we will promote our sales activities and demonstration projects in overseas markets which leads us to be a top brand that is chosen by customers.

## Topics2

### Demonstration Project Commenced in Germany, Environmentally Advanced Country

#### NGK Offers NAS Battery Systems for Three Years from April 2017

The NGK Group has been endeavoring to be a highly proven and known brand for NAS batteries in the European market especially in Germany. Germany is an advanced country actively introducing renewable energy and in the meanwhile, they are facing imbalances and grid voltage instability due to the vulnerable power transmission network while a large amount of power generated in the northern region is sent to south, the consumption area.

To address these problems, Japan's New Energy and Industrial Technology Development Organization (NEDO\*) has worked for the commencement of the "Large-Scale Hybrid Battery System Demonstration Project" with the Ministry for Economics, Labour and Transport of Niedersachsen, where is the region in

Signing ceremony held in March 2017. Germany aims to shift more than 80% of its domestic electric power demand to renewable energy by 2050.



Germany that produces wind power the most. They signed a memorandum of understanding in March 2017. At the same time, one Japanese power company, NGK Insulators, Ltd a company commissioned by NEDO, and the energy provider in Germany have agreed to collaborate the project and concluded an implementation document. Our aim by introducing NAS batteries is to stabilize the distribution grid, and thereby control the electric power supply and demand balance. Another aim is to establish a new business model for electricity trading using the battery system.

# Ceramic Products Business

## Developing Products and Technologies that Contribute to Solving Environmental Issues, Including Automobile Exhaust Gases, and Responding to Energy-saving Needs

The Ceramic Products Business Group offers a line-up of ceramic products, led by ceramic substrates for automotive exhaust gas purifiers, that serves a broad range of industries and provides smart solutions for modern requirements such as environment protection and energy conservation.

It is one of our social responsibilities to ensure a stable supply of high-quality products and to continue to offer products that correspond to new environmental regulations in a timely manner.

We will deliver products that will meet social needs to international markets through our global production system comprising 18 plants located in nine countries.



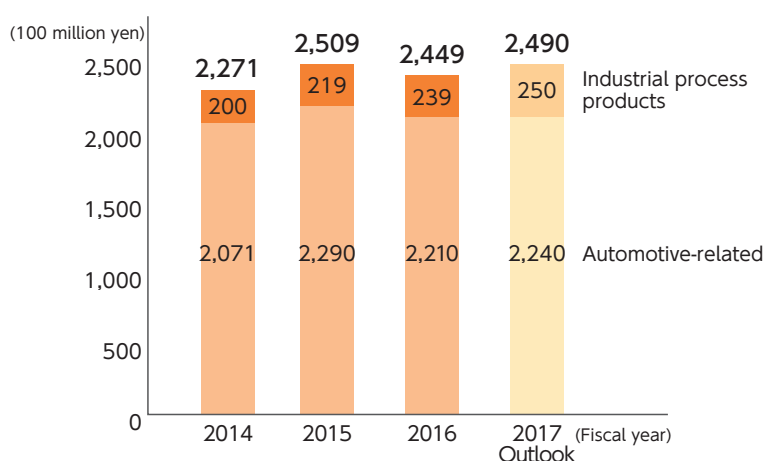
**Hiroshi Kanie**

Director and Senior Vice President  
Group Executive, Ceramic Products Business Group

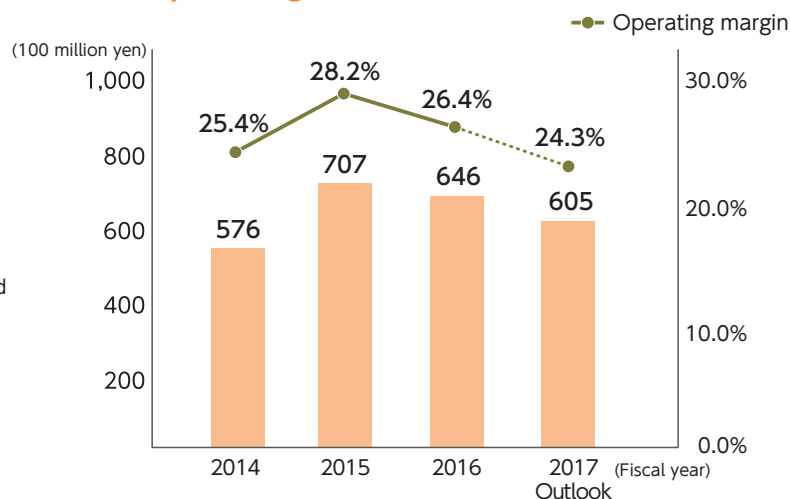
## Financial Data

### Financial results and outlook

#### Net Sales (After elimination of intersegment sales)



#### Operating Income

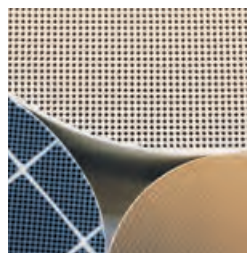


# Products

## Main products

### Automotive-related

Our business is focused on HONEYCERAM® ceramic substrates for automotive catalytic converters used to purify exhaust gases, diesel particulate filters (DPF) and gasoline particulate filters (GPFs) that eliminate particulate matter (PM), and NOx sensors used to measure concentrations of nitrogen oxides (NOx).



**HONEYCERAM**, which holds the world's top share DPFs that eliminate up to 99% of PM



The world's first **in-vehicle high-accuracy NOx sensors** that can measure NOx concentrations in real time with high precision

### Industrial Process Products

We offer a line-up 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 modern requirements such as environment protection and energy conservation.



C1 Home-use water purifier



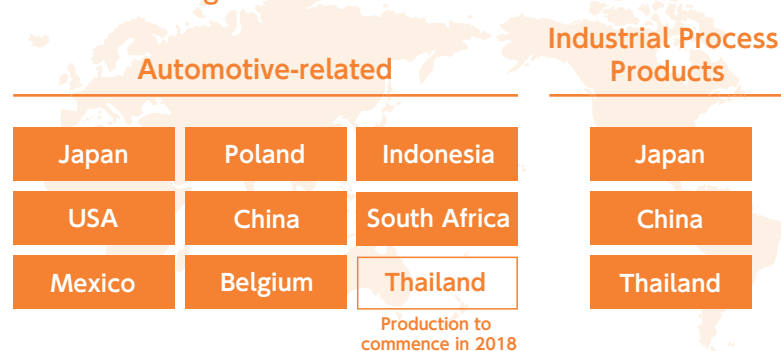
**Heating devices and refractories** using firing technologies gained through manufacturing of ceramic products



**Low-level radioactive waste treatment systems** that have been adopted by nuclear power facilities around Japan and contribute to reducing waste

## Product Sites

### Manufacturing sites



**Corrosion-resistant equipment and systems** including pumps, valves and glass linings with strong corrosion resistance



**Ceramic membranes and separators** used for purification and filtration of pharmaceutical products and food and treatment of wastewater and exhaust gas in chemical and electronics plants

## Results

### Business overview for fiscal 2016

### Profits Improved Backed by Demand Growth and Business Restructuring

While sales and profits decreased from the previous year due to the effect of yen appreciation, production output saw an increase on a year-on-year basis as demand in the automobile market remained brisk globally. The automotive-related business posted net sales and profits exceeding our initial forecasts as the needs for NGK products continued to rise due to favorable factors including tighter automobile exhaust gas regulations around the world and an increase in sales of small-sized passenger vehicles and trucks in China. In the industrial process products business, we saw an increase in demand, mainly in China, for heating devices for cathode materials used in lithium-ion batteries of electric vehicles. In addition, new projects and maintenance demand related to nuclear power facilities have been increasing gradually. Moreover, as a result of our ongoing efforts for business restructuring of kiln and refractory products, profitability continued to improve.

### Summary of Fiscal 2016

**Net sales** 244.9 billion yen  
(6.0 billion yen decrease from the previous year)

**Operating income** 64.6 billion yen  
(6.1 billion yen decrease from the previous year)

#### Automotive-related

**Net sales** 221.0 billion yen  
(8.0 billion yen decrease from the previous year)

- Volume of automotive ceramics increased due to strong sales of passenger vehicles in the Chinese and European markets as well trucks in the Chinese market.
- Net sales decreased as a result of yen appreciation while profits decreased reflecting increases in development costs and capital investment.

#### Industrial process products

**Net sales** 23.9 billion yen  
(2.0 billion yen increase from the previous year)

- Sales of heating devices for cathode materials used in lithium-ion batteries remained strong in Japan and China.
- Increase in new projects and repairs of nuclear power facilities, and the market conditions remained strong in key industries including the electronics, steel and chemical industries.

# Present Action

## Challenges and initiatives for fiscal 2017

Profits are expected to continue to decrease as in fiscal 2016 against the backdrop of prolonged yen appreciation, capital investment toward boosting supply capacity and active investment in new product development and human resources development, among other efforts. We have been pushing forward with the establishment of additional production lines and the launch of new plants around the world in an effort to further strengthen supply capability, which is one of strengths of the NGK Group.

### [Automotive-related]

## Strengthening Steady Supply of Uniform Quality around the World

In the automotive-related business, we will aim to improve productivity and strengthen the provision of consistent quality globally by adding new lines in Poland, establishing a new plant in Thailand (see page 15) and renewing equipment at other existing plants. As a global company, it is critical to ensure the steady supply of products with consistent quality. For that purpose, we regularly conduct GOMs (Global Operation Meetings), where plant managers get together to solve issues and share information, and PEMs (Process Expert Meetings), where persons in charge of manufacturing technology divisions gather to exchange opinions. We also tackle the standardization of quality from the equipment perspective.

We have been making constant efforts for technological innovation by placing state-of-the-art production lines to multiple plants. For example, such new production technology for HONEYCERAM® ceramic substrates was initially installed to the Ishikawa Plant then being done to Thailand, and, as same way, for silicon carbide diesel particulate filters (SiC DPFs) initially was to the Komaki Plant then was to Poland. Furthermore, we steadily respond to market and customer needs in the automotive-related business by launching new products and developing mass production systems to coincide with the introduction of new regulations and the establishment of new markets.

### [Industrial Process Products]

## Enhancing Business Base

In the industrial process products business, equipment demand for automotive materials such as cathode materials used in lithium-ion batteries has remained at a high level. In addition, we are expected to win a project related to a new low-level radioactive waste treatment system. We believe that we will be able to secure steady net sales and profits by making continuous efforts to enhance the business base such as by exploiting our manufacturing and engineering capabilities.

## Outlook for Fiscal 2017

### Net sales 249.0 billion yen

(4.1 billion yen increase from the previous year)

### Operating income 60.5 billion yen

(4.1 billion yen decrease from the previous year)

### Automotive-related

### Net sales 224.0 billion yen

(3.0 billion yen increase from the previous year)

- Volume of automotive ceramics is likely to increase due to an increase in sales of trucks in the Chinese market and tighter automobile exhaust gas regulations in Europe.
- Profits are expected to decrease as a result of increases in development cost and depreciation cost.

### Industrial process products

### Net sales 25.0 billion yen

(1.1 billion yen increase from the previous year)

- Active capital investment for automotive-related materials centering on cathode materials used in lithium-ion batteries.
- Conditions of key industries including the electronics, steel and chemical industries are expected to remain robust.

## Topics1

## Drying through "Light" Wavelength Control Drying System

The Industrial Process Division focuses on the development of wavelength control drying systems that enable low-temperature drying, which was impossible with traditional drying methods utilizing hot air. By using infrared light with specific wavelengths, it becomes possible to dry objects quickly without the need to raise the temperature of the objects. As it produces no heat-related deformation or deterioration, the technology is expected to be utilized for the manufacturing process of various high-functional films in the electronics industry. In addition, selective irradiation of infrared light that is effective to evaporate solvent will help curb unnecessary energy use and significantly reduce power consumption. We are currently working on evaluation testing with a focus on electronics at a heating test laboratory at our Chita Site, with a plan to expand the target to the pharmaceutical and food sectors.



Wavelength control drying systems providing innovative solutions for the drying process in manufacturing

Conserving heat energy and reducing power consumption by

**30-50%** compared with traditional methods

### Applications

|                                |  |   |
|--------------------------------|--|---|
| Automotive- and lighting       | <ul style="list-style-type: none"> <li>● Lithium-ion batteries</li> <li>● LEDs (light-emitting diodes)</li> <li>● Organic EL (electroluminescent)</li> </ul> | <ul style="list-style-type: none"> <li>● Fuel cells</li> <li>● Circuit boards</li> </ul>        |
| Information appliances-related | <ul style="list-style-type: none"> <li>● Ceramic capacitors</li> <li>● Ceramic sheets</li> </ul>   | <ul style="list-style-type: none"> <li>● Magnetic sheets</li> <li>● Polarizing films</li> </ul> |
| Medical                        | <ul style="list-style-type: none"> <li>● Pharmaceuticals</li> </ul>  | <ul style="list-style-type: none"> <li>● Cosmetics</li> </ul>                                   |
| Food                           | <ul style="list-style-type: none"> <li>● Packaging materials</li> </ul>  | <ul style="list-style-type: none"> <li>● Barrier films</li> </ul>                               |

# Next Vision

## Future outlook and initiatives

### [Automotive-related]

## Responding to Market Growth with Extensive Product Line-up

The market environment surrounding the Ceramic Products Business Group is anticipated to significantly grow in and after fiscal 2018, especially in the automotive-related business.

Substantial growth is expected for the gasoline particulate filter (GPF) market in line with the full-fledged introduction of regulations on the number of particulate matter (PM) emitted from gasoline-fueled vehicles. Under such circumstances, the NGK Group has commenced the mass production and shipment of GPFs, mainly in Europe.

Meanwhile, the NGK Group will also start the mass production of a new NOx sensor product. Given the serious air pollution that is plaguing China and India, it is a certainty that automobile exhaust gas regulations will be tightened in the future. As a result, demand for HONEYCERAM®, DPFs, GPFs and NOx sensors is expected to increase from a medium- to long-term perspective.

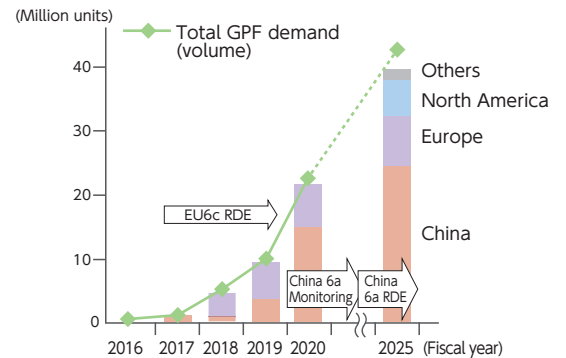
The NGK Group boasts a wide-ranging product line-up that can meet various needs of customers in different regions. Our aim is to establish a position as a top supplier by offering products for passenger vehicles, large-sized vehicles, diesel-fueled vehicles, gasoline-fueled vehicles and hybrid vehicles and attaining large market shares in every market. Through these efforts, we will strive to quickly identify technological trends of automobile manufacturers and push forward with technology and product development that looks ahead to future needs.

### [Industrial Process Products]

## Entering New Markets by Leveraging Broad Industry Channels

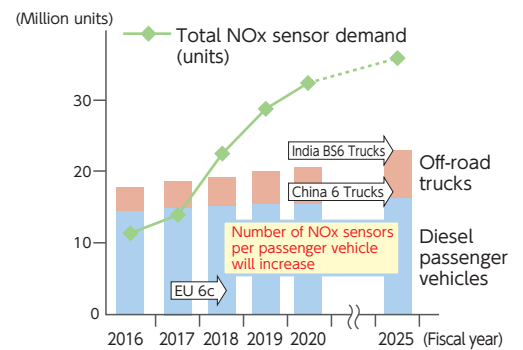
In the industrial process products business, we will promote selection and concentration in prospective markets by leveraging our broad industry channels covering a wide range of products, from various types of corrosion-resistant equipment to heating devices. Specifically, we have been endeavoring to develop new products and explore new applications for existing products in fields such as secondary battery materials, multilayer ceramic capacitors, biopharmaceuticals and medical equipment.

Number of passenger vehicles with GPFs and total GPF demand



GPF demand will dramatically increase as a result of the introduction of RDE (Real Driving Emissions) testing in Europe and tighter regulations in China (China 6a and China 6b).

Number of vehicles requiring diesel engine aftertreatment and NOx sensor demand



The number of NOx sensors installed for diesel passenger vehicles will increase as a result of tighter regulations in Europe (Euro 6c).

## Topics2

### Further Measures to Develop Global Human Resources

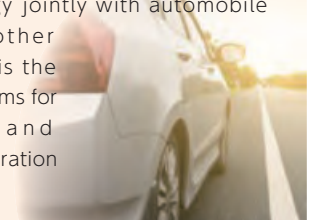
With the aim of promoting consistent quality globally, we have embarked on a project to establish the training center (provisional name) for developing global human resources. We will develop and inculcate the NGK Group's framework on quality and safety that must be observed in each country regardless of cultural and ideological differences while formulating optimal management and operational methods for each plant. It is our plan to promote discussions and preparations from fiscal 2017 and 2018 and to launch the training center within NGK's headquarters/Nagoya site by fiscal 2019.



## Topics3

### Developing Next-Generation Products

Motor-equipped vehicles that do not require constant engine operation such as hybrid vehicles and electric vehicles produce a shortfall in heat energy used for heating and other purposes compared with diesel-fueled vehicles and gasoline-fueled vehicles. Therefore, a system enabling the effective use of heat energy is crucial for such vehicles. The NGK Group has embarked on the development of heat energy management technology jointly with automobile manufacturers and other companies. Our focus is the development of key systems for the advancement and introduction of next-generation automobiles.





# E l e c t r o n i c s

## B u s i n e s s

### Contributing to the Development of Communications Infrastructure to Bring More Comfortable Living through Functional Enhancements and Miniaturization of Products

With the rise of AI (Artificial Intelligence) and the IoT (Internet of Things), the era of exchanging enormous amounts of information at high speed is upon us. Beryllium copper products widely used in ceramic components for semiconductor manufacturing equipment and electronics components that we develop and manufacture, as well as smartphones, home appliances, automobiles, industrial equipment, etc., are closely associated with such next-generation information infrastructure.

The NGK Group provides products that meet the constantly evolving needs of society by leveraging its unique differentiation technologies for materials and manufacturing processes.

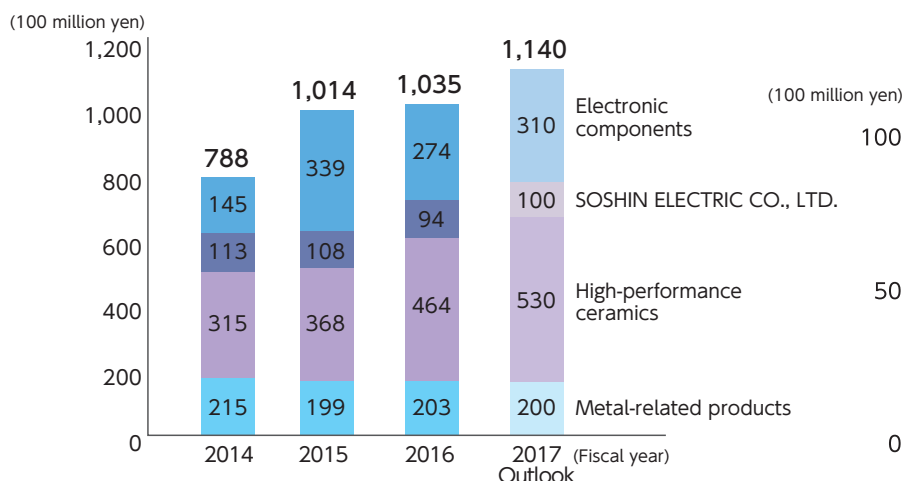


**Shuhei Ishikawa**  
 Director and Senior Vice President  
 Group Executive,  
 Electronics Business Group

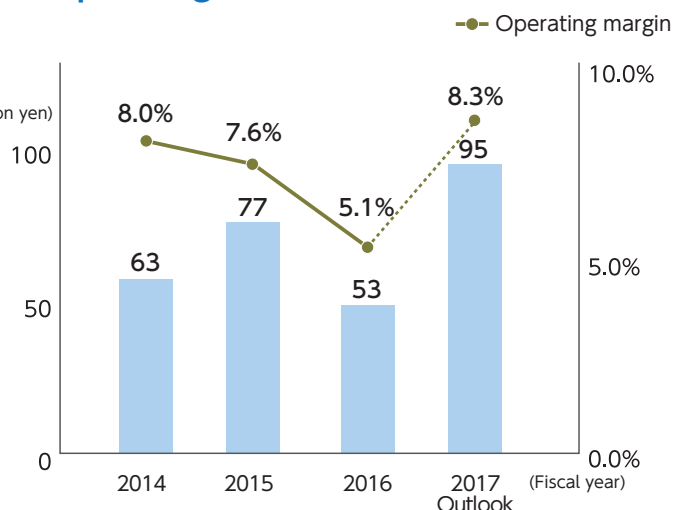
## Financial Data

### Financial results and outlook

#### Net Sales (After elimination of intersegment sales)



#### Operating Income



# Products

## Main products

### High-performance Ceramics (Ceramics for Semiconductor Manufacturing Equipment)

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

### Metal-related Products

Beryllium copper, which is made by adding a small percentage of beryllium to copper, has characteristics including excellent fatigue resistance and a long service life. It is widely utilized as a material for highly reliable conductive springs and contact points. The NGK Group has also been providing nickel-tin strips since 2016.

### Electronic Components

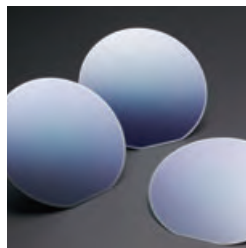
By fully exploiting our proprietary technologies cultivated over years in ceramics projects, we provide substrates for electronic devices and arc tubes for lighting purposes. In addition, electronic components for communication devices are manufactured and sold by Soshin Electric Co., Ltd. and ceramic packages by NGK Electronics Devices, Inc.



**Ceramics for semiconductor manufacturing equipment** that streamline the production process for semiconductors



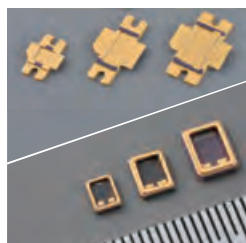
**Beryllium copper** that improves reliability of electronic devices and realizes miniaturization



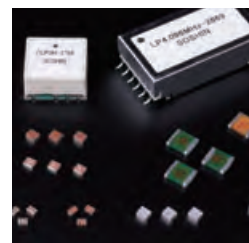
**Bonded wafers** delivering a level of performance and functionality that cannot be achieved with wafers made from a single material



Translucent **HICERAM®** alumina ceramics used as element substrates for LED devices



**Ceramic packages** for high-frequency devices that hold the world's top market share



**Electronic components for communication devices** such as multilayered dielectric filters and couplers

## Product Sites

### Manufacturing sites

| High-performance Ceramics | Metal-related Products | Electronic Components |
|---------------------------|------------------------|-----------------------|
| Japan                     | Japan                  | Japan                 |
| USA                       | USA                    | China                 |
|                           | France                 | Malaysia              |

## Results

### Business overview for fiscal 2016

### Accelerating Capital Investment in Response to Strong Demand

The Electronics Business Group on the whole posted increased sales and decreased profits compared to the previous year. This is attributable to the fact that sales remained strong backed by growth in the semiconductor market while there was a delay in recovery of demand for ceramic packages.

In the high-performance ceramics business, strong results were posted as capital investment by semiconductor manufacturers remained at a high level on the back of increasingly multilayered and miniaturized semiconductors. We also accelerated capital investments in response to strong demand.

In the metal-related products business, sales increased only slightly due to the appreciation of the yen despite an increase in shipment of beryllium copper products for industrial equipment in the Chinese market.

In the electronic components business, sales decreased as a result of the delay in investment in base stations for mobile phones in China, which negatively impacted the demand for ceramic packages.

### Summary of Fiscal 2016

**Net sales** 103.5 billion yen (2.1 billion yen increase from the previous year)

**Operating income** 5.3 billion yen (2.4 billion yen decrease from the previous year)

#### High-performance ceramics

**Net sales** 46.4 billion yen (9.6 billion yen increase from the previous year)

Sales increased from the previous year reflecting strong shipments of ceramic components for semiconductor manufacturing equipment as capital investment by semiconductor manufacturers and foundries (subcontracted semiconductor manufacturers) remained at a high level on the back of increasingly multilayered and miniaturized semiconductors.

#### Metal-related products

**Net sales** 20.3 billion yen (0.4 billion yen increase from the previous year)

Sales increased from the previous year reflecting strong shipments of beryllium copper products mainly for industrial equipment in the Chinese market.

#### Electronic components

**Net sales** 27.4 billion yen (6.5 billion yen decrease from the previous year)

Sales declined from the previous year due to sluggish demand for ceramic packages in the Chinese market despite increased volume of bonded wafers.

#### Soshin Electric Co., Ltd.

**Net sales** 9.4 billion yen (1.4 billion yen decrease from the previous year)

Sales in the fields of both industrial equipment and information communication devices remained sluggish due to a slowdown in the growth of the Chinese economy and a decline in investment in base stations

## Present Action

### Challenges and initiatives for fiscal 2017

#### Increased Sales and Profits Expected on the Back of Continued Booming of the Semiconductor Market

Increased sales and profits are expected for fiscal 2017 in the Electronics Business Group as a whole on the back of the continued booming of the semiconductor market.

In the high-performance ceramics business, capital investment by semiconductor manufacturers and foundries will remain at a high level. In order to respond to robust demand, we will expand production areas of existing plants and build new plants while focusing on the development of next-generation products in line with the increasing integration of semiconductors.

In the metal-related products business, growth has been slowing in the market for beryllium copper products and the prices of raw materials have been rising. We will redevelop our revenue structure of existing products and promote the expansion of sales of new materials and products for new applications with the aim of achieving the steady growth of profits.

In the electronic components business, we have been ramping up mass production of bonded wafers for SAW filters, looking ahead to the expansion of the high-performance filter market for mobile communication devices. As we anticipate that demand for ceramic packages will remain flat for existing products, we will accelerate the development of new products with the aim of contributing to earnings as soon as possible.

### Outlook for Fiscal 2017

**Net sales 114.0 billion yen**  
(10.5 billion yen increase from the previous year)

**Operating income 9.5 billion yen**  
(4.2 billion yen increase from the previous year)

#### High-performance ceramics

**Net sales 53.0 billion yen**  
(6.6 billion yen increase from the previous year)

■ Sales and profits are expected to increase year-on-year as capital investment by semiconductor manufacturers and foundries is likely to continue at a high level on the back of increasing integration and segmentation of semiconductors.

#### Metal-related products

**Net sales 20.0 billion yen**  
(0.3 billion yen decrease from the previous year)

■ Demand for beryllium copper products will remain flat. We will aim to expand the sales of new materials and products for new applications.

#### Electronic components

**Net sales 31.0 billion yen**  
(3.6 billion yen increase from the previous year)

■ Demand for bonded wafers will increase on the back of expansion of the high-performance filter market for mobile communication devices. As we anticipate that demand for ceramic packages will remain flat for existing products, we will launch and expand the sales of new products.

#### Soshin Electric Co., Ltd.

**Net sales 10.0 billion yen**  
(0.6 billion yen increase from the previous year)

■ Sales are expected to increase as a result of the expansion of sales of mainstay products in the businesses related to noise reduction, among others, by launching new products onto the market.

### Topics1

#### Boosting Production System in Response to Demand Increase

Boosting Production System in Response to Demand Increase

In the high-performance ceramics business, we have been boosting our production capacity through aggressive capital investment in light of the brisk semiconductor market. It is our aim to remain a top supplier by responding to customer demand for increased production through advanced capital investment during the phase in which makers of semiconductor manufacturing equipment are increasing production.

In Japan, we will expand production areas at our Komaki Site in order to boost production of functional components (susceptors) that support silicon wafers as a semiconductor material while establishing a new plant in Tajimi City in Gifu Prefecture. Overseas, we will open a new plant at FM Industries, Inc., our production site in the U.S., to boost production of chamber components. We will collaborate with customers in swiftly launching next-generation products onto the market, thus staying at the forefront of electronics with our advanced ceramic technologies.



Ceramics for semiconductor manufacturing equipment (susceptors)

Boosting production capacity by **25%**

#### Establishing new production site in Tajimi City, Gifu Prefecture

**Name:**

TAJIMI PLANT, NGK CERAMIC DEVICE CO. LTD. (provisional name)

**Investment amount:**

Approx. 20.0 billion yen

**Commencement of construction:**

March 2018 (scheduled)

**Commencement of production:**

April 2020 (scheduled)



### Topics2

#### Intelligent Plants

At this plant for beryllium copper strips, we engage in intelligent projects for production systems by utilizing big data. By accumulating all sorts of production data in real time during the strip manufacturing process and analyzing the interactions of production criteria and quality information using big data, we can produce findings that will contribute to quality management and the forecasting of abnormalities in production lines, among other purposes. These efforts will also result in the enhancement of yield and cost reduction. We will promote similar data gathering and analysis at other plants with the aim of further expanding such efforts to electronic components plants in the future.

# Next Vision

## Future outlook and initiatives

### Achieving Mass Production of High-Function Products

With the arrival of the era of IoT and AI, a wide range of technological innovations are expected to emerge in response to the increasing volume of information and communications as well as next-generation high-speed communications. There will be opportunities for the Electronics Business Group to expand and generate new products in line with such technological innovations.

For example, future growth is expected through business expansion by launching new models of bond wafers, ceramic packages and beryllium copper strips in the areas of infrastructure development for next-generation communications and enhancement of high-speed communications and by delivering high-functional ceramic components for semiconductor manufacturing equipment in response to increased demand for semiconductor memories for data centers. On the manufacturing and development front, we have been promoting the establishment of optimal production and development systems throughout the value chain.

In the high-performance ceramics business, we respond to customer demand for increased production by developing cooperative systems (capital investment, equipment lending, guidance on manufacturing, etc.) with subcontracted processing plants. We work on the development of next-generation manufacturing equipment in close coordination with the development programs of customers.

In the metal-related products business, we promote the

integration and standardization of specifications in collaboration with material manufacturers and customers, thereby addressing the inefficiency of low-volume high-mix manufacturing.

In the electronic components business, we share key factors for quality control with material manufacturers in order to differentiate ourselves in terms of product characteristics, thus achieving mass production of high-function products. Based on material and molding technologies, we carry out a broad range of joint development projects and prototype making with companies and research institutes in various fields with the aim of developing new products.

#### Bonded Wafers for SAW Filters

That Enhance Communication Quality for Smartphones and Other Devices

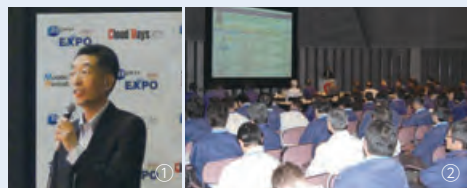


While conventional SAW (Surface Acoustic Wave) filters suffer from the disadvantage of being susceptible to a high degree of expansion and contraction based on temperature, NGK's bonded wafers realize a significant reduction in thermal expansion, thus offering solutions for next-generation LTE that require filtering functions with higher precision.

### that Utilize Big Data



The NGK Group commenced preparations for the introduction of big data analysis in 2013 and has been a leader in this field among material manufacturers.



As the NGK Group's efforts to realize cost reduction through the usage of big data received attention, Senior Vice President Ishikawa was invited to speak about the NGK Group's initiatives.

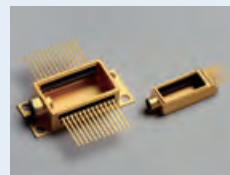
① June 2016: Special program at an IT-related exhibition  
② April 2017: Special lecture organized by a manufacturer

### Topics3

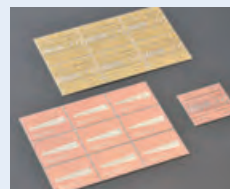
### Generating New Products Targeting New Markets and Next-Generation Products

The NGK Group has embarked on company-wide projects including the Ceramic Battery Project, which was formed last year, and the Optical component Project, which was kicked off this year (see pages 16-17). We aim to commercialize some of the products being developed in these projects within the Electronics Business Group, which will pave the way for us to enter new markets. By engaging in activities to solve problems concerning marketing, quality assurance and manufacturing from the development stage, we will strive to achieve smooth commercialization based on our business operation experience and insights.

We have been strengthening collaboration not only within NGK Insulators, Ltd. but also with Group companies. This includes our collaboration with Soshin Electric Co., Ltd. and NGK Electronics Devices, Inc. in exploring new products for the next-generation high-speed communications market. We will promote the development of new products for future growth by bringing together strengths of each company, including the material technologies of NGK Insulators, Ltd., broad network in the electronic components industry of Soshin Electric Co., Ltd., and mass production process of NGK Electronics Devices, Inc.



Optical communication packages that are used for the conversion parts of optical fiber communications. Demand is expected to increase on the back of the enhancement of high-speed communications.



Insulated circuit boards that maximize the performance of power semiconductors. Our focus has been the expansion of sales targeting the markets for industrial machinery and hybrid and electric vehicles, which offer promising growth prospects.