

# C e r a m i c P r o d u c t s

## B u s i n e s s

### 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.

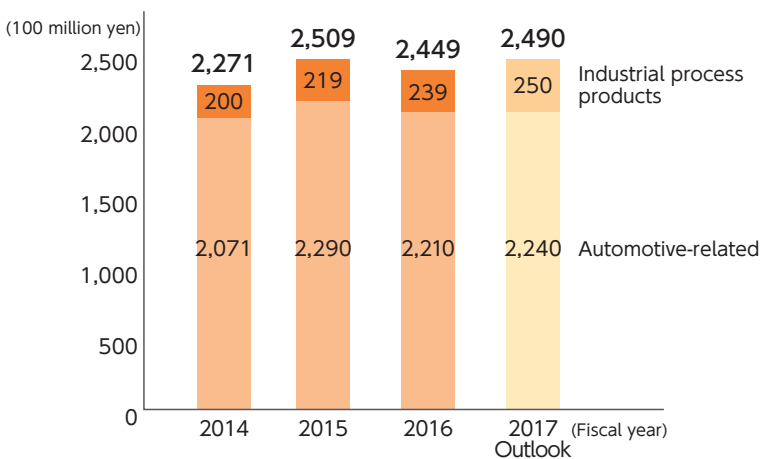


**Hiroshi Kanie**  
 Director and Senior Vice President  
 Group Executive, Ceramic Products Business Group

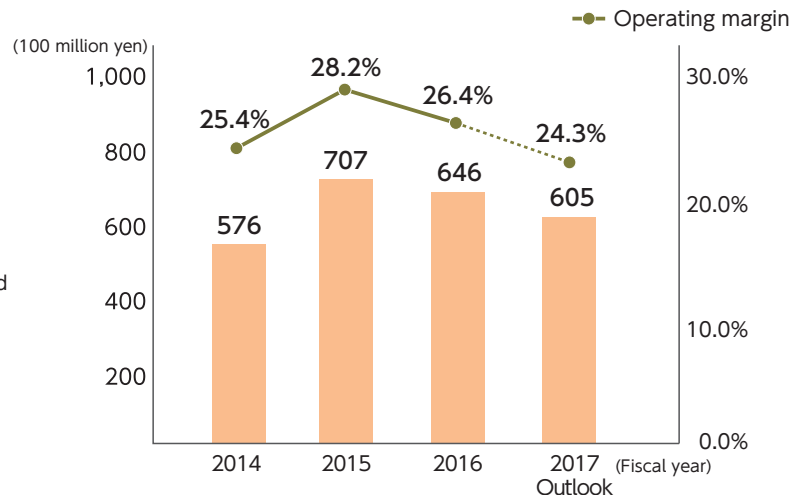
## Financial Data

### Financial results and outlook

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



#### Operating Income

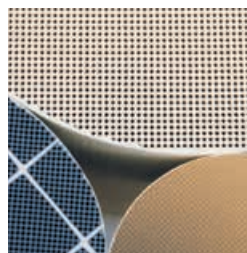


# Products

## 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



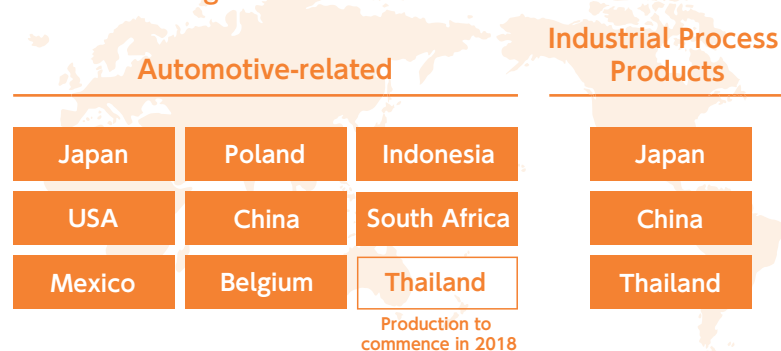
**Heating devices and refractories** using firing technologies gained through manufacturing of ceramic products



**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<sup>®</sup> 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



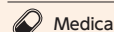
Automotive- and lighting

- Lithium-ion batteries
- LEDs (light-emitting diodes)
- Organic EL (electroluminescent)
- Fuel cells
- Circuit boards



Information appliances-related

- Ceramic capacitors
- Ceramic sheets
- Magnetic sheets
- Polarizing films



Medical

- Pharmaceuticals
- Cosmetics



Food

- Packaging materials
- Barrier films

# 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.

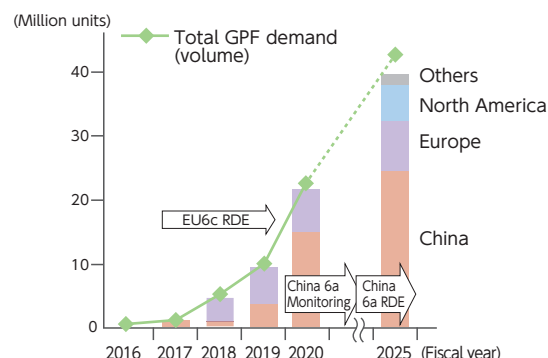
The NGK Group boasts a wide-ranging product line-up that can meet various needs of customers in different regions. Our aim is to establish a position as a top supplier by offering products for passenger vehicles, large-sized vehicles, diesel-fueled vehicles, gasoline-fueled vehicles and hybrid vehicles 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

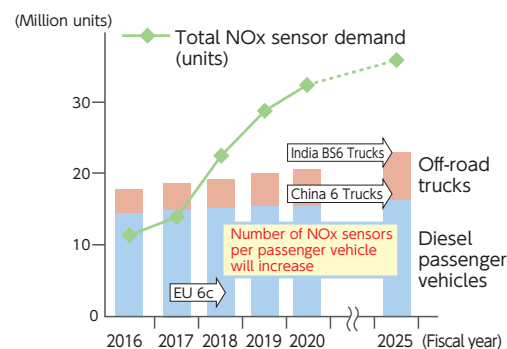
In the industrial process products business, we will promote selection and concentration in prospective markets by leveraging our broad industry channels covering a wide range of products, from various types of corrosion-resistant equipment to heating devices. Specifically, we have been endeavoring to 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.