

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

Net sales **61.3** billion yen
Operating income **0.9** billion yen

Fiscal 2017 results

Net sales **67.0** billion yen
Operating income **2.0** billion yen

Fiscal 2018 outlook

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.

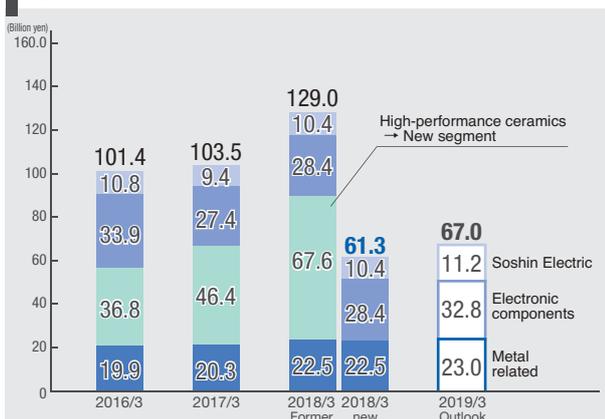
For fiscal 2018 we are aiming for 67 billion yen in net sales and 2 billion yen in operating income, which would represent a continued increase in revenues and profits from the previous period. For metal-related products, we expect a high level of demand to continue, primarily in the Chinese market. 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.



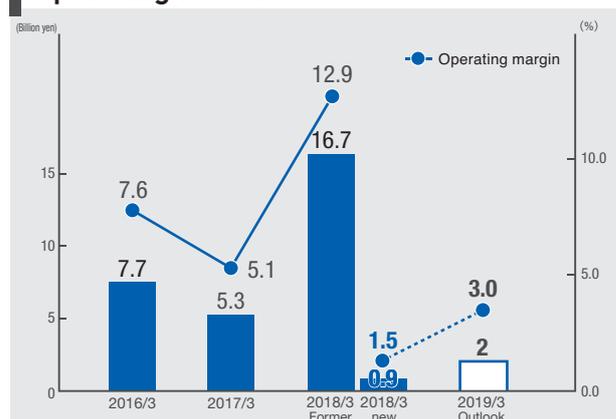
Director and Senior Vice President; Group Executive, Electronics Business Group **Shuhei Ishikawa**

Financial results

Net sales (Billion yen)



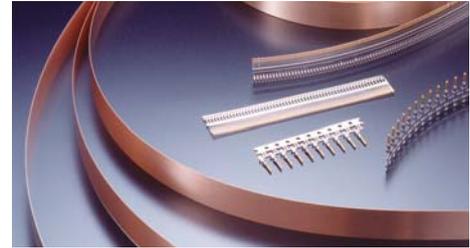
Operating income (Billion yen/%)



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.



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.

Electronic components

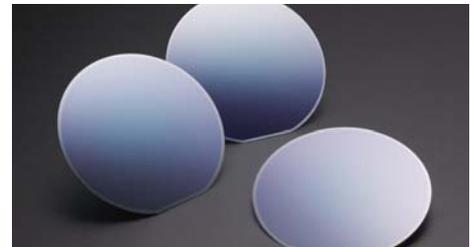
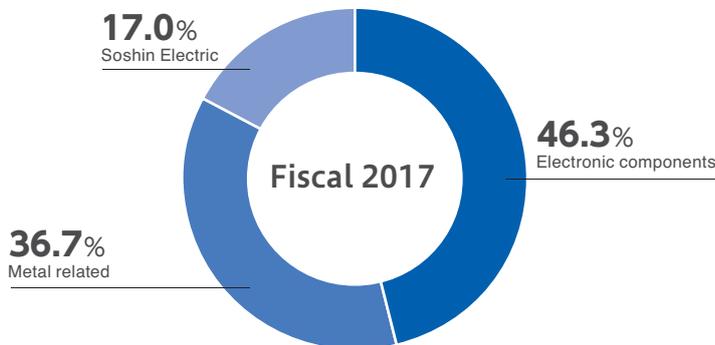
In addition to HDD piezoelectric micro-actuators, bonded wafers for electronic devices, and other products developed using the proprietary ceramics technology which NGK has cultivated over the years, our product lineup includes Soshin Electric's components for telecommunications devices and NGK Electronics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



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.

Sales ratio by business



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.

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.

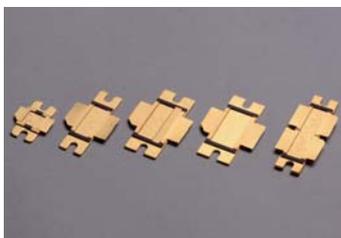
With regard to ceramic packages, the increase in infrastructure investment focused on the establishment of 5G next-generation high-speed communication standards is projected to foster an increase in demand for next-generation high-frequency packages for communication base station power semiconductors. 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.

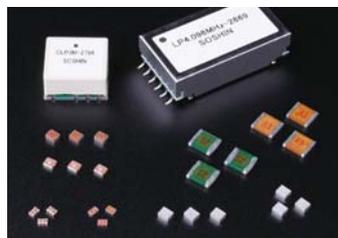
In April 2018, our business group took over the theretofore company-wide projects to develop micro-lenses for UV LEDs*¹ and gallium nitride (GaN) wafers*² and moved these into commercial production. Demand for these products is predicted to ramp up from 2020 onward as alternatives to ultra-high-pressure 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.

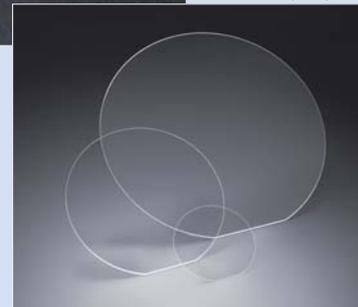
Micro-lenses for UV LEDs are made from transparent quartz glass and are used to improve the sterilization efficiency of UV LEDs, which can be used in place of mercury lamps as a sterilization light source, by effectively narrowing their irradiation area. GaN wafers are used in light sources for lasers 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