100 YEARS OF FORWARD THINKING

A long history of innovation and diversification has put ceramics products maker **NGK Insulators** in pole position for the world of 5G and the Internet of things.

A GOOD COMPANY HAS THE ABILITY TO THINK BOTH

big and small. Nagoya, Japan–based NGK Insulators can certainly do so. Last year, an over 11-meter-high insulator it manufactures earned a place in *Guinness World Records* as the world's "largest ceramic structure." Meanwhile, this January, EnerCera®—its series of chip-type ceramic secondary batteries, some of which are as small as postage stamps or as thin as 0.45 millimeters—won CES 2019 Innovation Awards in Smart Energy at CES, the world's largest consumer electronics show.

These accolades express something important about NGK in its 100th year. The company remains the global leader in its original insulator business, but it has also evolved to take leadership in multiple other categories, ranging from semiconductor production equipment to automotive ceramics. "Insulators have a long lifespan, so the market is saturation-prone. That's why NGK has always been focused on the next thing," says president Taku Oshima, pointing out that the firm started diversifying as early as the 1930s, when it began making corrosion-proof pumps and valves.

Whatever new directions NGK moves in, the underlying vector stays the same: to utilize the potential of ceramics to the full. The company has two complementary skills: know-how in controlling ceramic materials and the ability to make the production machinery needed for manufacturing them. "No one else has this combination," says Oshima. "That's our competitive edge."

That is certainly true for EnerCera. Although other manufacturers produce similarly small batteries, NGK's ceramics mastery has equipped EnerCera with a combination of high energy density and high heat resistance, allowing it to be embedded into devices by high-temperature processes such as reflow soldering and hot lamination. That's significant because the first major market Oshima is exploring for EnerCera is smart cards. "Illegal use of cards costs the industry millions every year," Oshima explains. "Cards fitted with EnerCera can run fingerprint authentication without the need for any extra power supply equipment. Around 30 card companies have already expressed strong interest."

TAKU OSHIMA
President
NGK Insulators

Ready for a 5G World

The incipient Internet of things (IoT) represents further opportunity. All of the everyday objects communicating and interacting with one another need a power source, and control circuit manufacturers are drawn to EnerCera's combination of small size and high power. Oshima is bullish. "Think of the smartphone," he says. "As soon as it came out, completely unforeseen new applications began springing up like mushrooms after rain. It'll be the same for the IoT when 5G comes along."

In fact, 5G is expected to give a powerful boost to many areas of NGK's business. A sharp rise in demand for semiconductors, for example, will drive demand for the semiconductor production equipment the company makes, which is why the company has just built a new ¥32 billion plant in Japan. But 5G's potential doesn't stop there. It will have a transformative effect on transmission speeds and data volumes, driving up data-center demand and helping enable new technological capabilities like autonomous driving.

That too is good news for NGK. The company makes ultraprecise piezoelectric actuators for the hard-disk drives used in data centers. (The actuator moves the head arm that reads and writes on the disks.) It also makes bonded wafers for surface acoustic wave (SAW) filters, which select the desired frequencies in mobile devices. Meanwhile, in the electronic vehicle (EV) space, Oshima sees gallium nitride (GaN) replacing silicon as the wafer material for next-generation high-output power semiconductors within five years. Here, too, NGK is a leader: Since 2011 it has been providing high-quality GaN wafers to Professor Hiroshi Amano, the 2014 Nobel laureate who is currently developing high-output power semiconductor devices.

Working for the Environment

NGK's relationship with the auto industry goes back a long way. The company started producing automotive exhaust gas purifiers in the mid-1970s, when air pollution was a widespread problem, and automotive-related ceramics now account for 54% of the company's approximately $4.2 billion (¥463.5 billion) in revenues. In typical forward-thinking mode, while producing its best-selling particulate filters and sensors for diesel, gasoline, and hybrid vehicles, NGK has also been preparing for the EV future by developing not just EV components but all-solid-state batteries.

The company is being equally innovative when it comes to next-generation energy. Its large-capacity sodium-sulfur (NaS) batteries, which are used to stabilize the output from volatile renewable energy sources such as wind and solar power, have been deployed around the world since 2002 in countries including Japan, Germany, and the United Arab Emirates. On a smaller scale, NGK is developing zinc rechargeable batteries suitable for buildings and communication facilities. These have the advantage of being safer and more secure than their lithium-ion equivalents.

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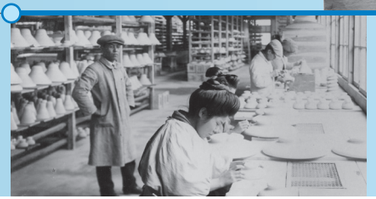
NGK's award-winning EnerCera ceramic batteries are small enough to fit into innovative IoT devices.

NGK's products are even helping to improve the productivity and environmental performance of the oil and gas industries. In the oil business, one emerging new technique to improve the recovery rate of crude oil is to inject CO_2 into the well. NGK has developed a DDR zeolite membrane with pores less than 1 nanometer in diameter that is capable of separating CO_2 molecules from associated gas (mainly composed of CO_2 and methane), enabling the injected CO_2 to be reused for the injection process, while a portion of it can also be stored underground, helping to reduce global warming.

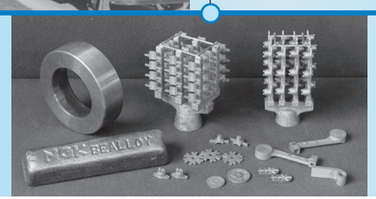
All of this innovation is not the result of chance. NGK launched a policy of generating 30% of total sales from new products in 2013. Having hit that target in 2017, it is now committed to maintaining it. The company has a two-pronged method of innovation, combining a seed-side approach based on in-house R&D with a more market-driven approach based on responding to customer needs. Clearly defined companywide projects are a way of getting all departments—development, production engineering, process design, procurement, and sales and marketing—to coordinate on making the leap from research to commercialization. "We have conducted several companywide projects, for example, the Wafer Project and the Ceramic Battery Project," Oshima says. "All of our recent innovations have come from them." ■

APPLYING CERAMICS KNOW-HOW TO A CENTURY OF MEGATRENDS

1919
NATION BUILDING
As Japan evolves into a modern, industrialized nation, NGK is established to manufacture high-voltage insulators.



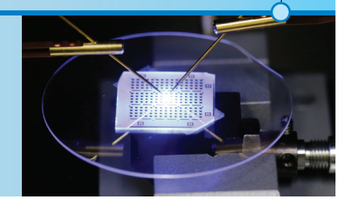
1950s
EXPORT CHAMPION
NGK becomes the world's top insulator producer in the 1950s; (*below*) it commercializes strong, lightweight beryllium copper alloy in 1958.



1976
CLEAN AIR
With automotive air pollution becoming a global problem, NGK moves into emissions control systems.

1996
HIGH TECH
NGK begins production of semiconductor production equipment such as ceramic chucks and electrostatic heaters.

2002
POWER OF ONE
NGK scores a world first with the commercialization of large-capacity sodium-sulfur NAS® Batteries.



2019
BRIGHT FUTURE
GaN wafers can serve as substrates for high-power semiconductor lasers and power semiconductors.