SUMITOMO ELECTRIC
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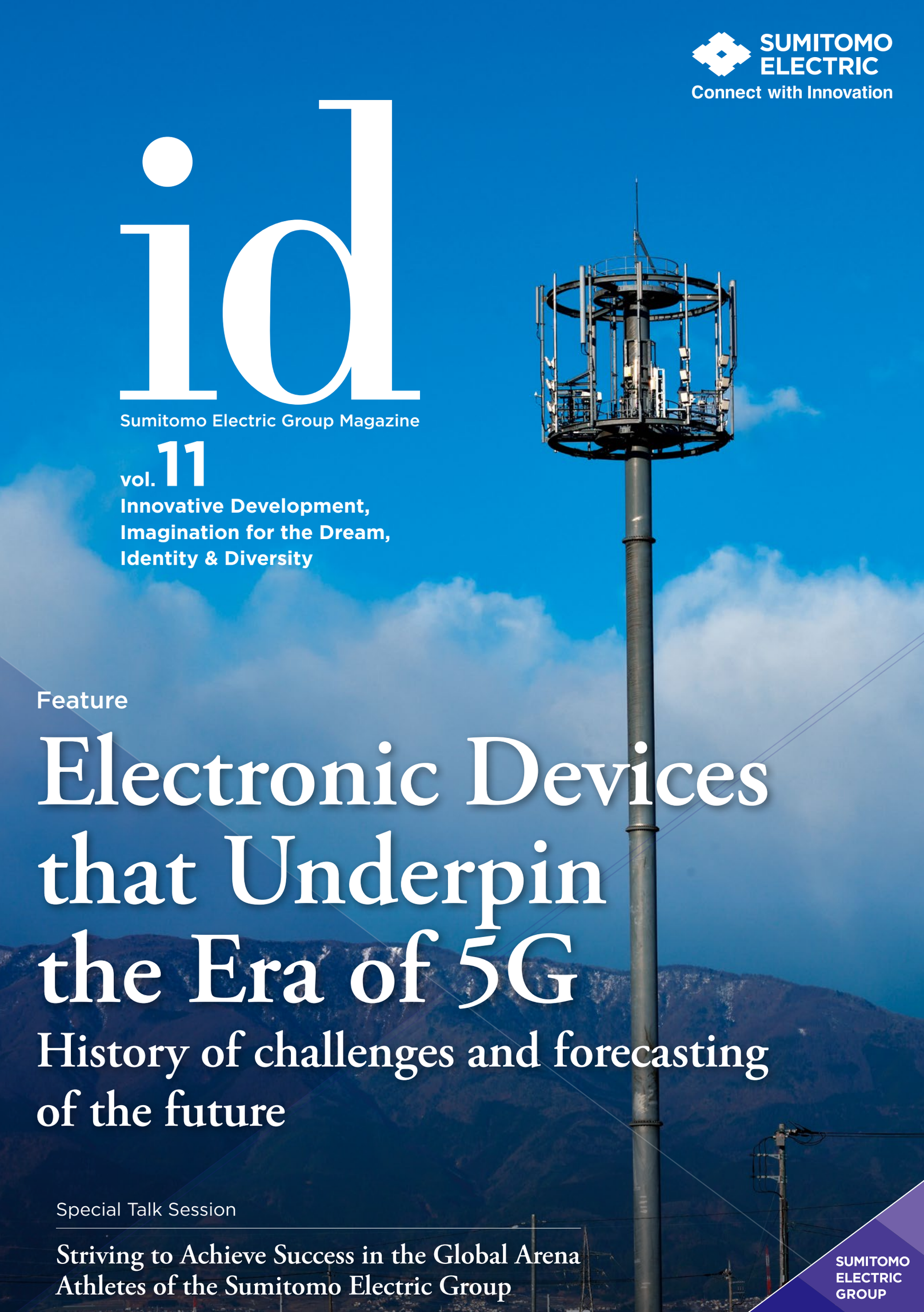
**Innovative Development,
Imagination for the Dream,
Identity & Diversity**



Feature

Electronic Devices that Underpin the Era of 5G

History of challenges and forecasting of the future

Special Talk Session

Striving to Achieve Success in the Global Arena Athletes of the Sumitomo Electric Group

SUMITOMO ELECTRIC GROUP

Advent of the Era of 5G that Will Change Society and Daily Lives

Opening up the possibilities of new communication

Mobile communication has evolved rapidly. Car phone service started in 1979, and mobile phone service started in the mid-1980s. Email and the Internet came into service in the first half of the 1990s and rapidly came into widespread use due to the release of smartphones in 2007. These developments were driven by wireless access technology.

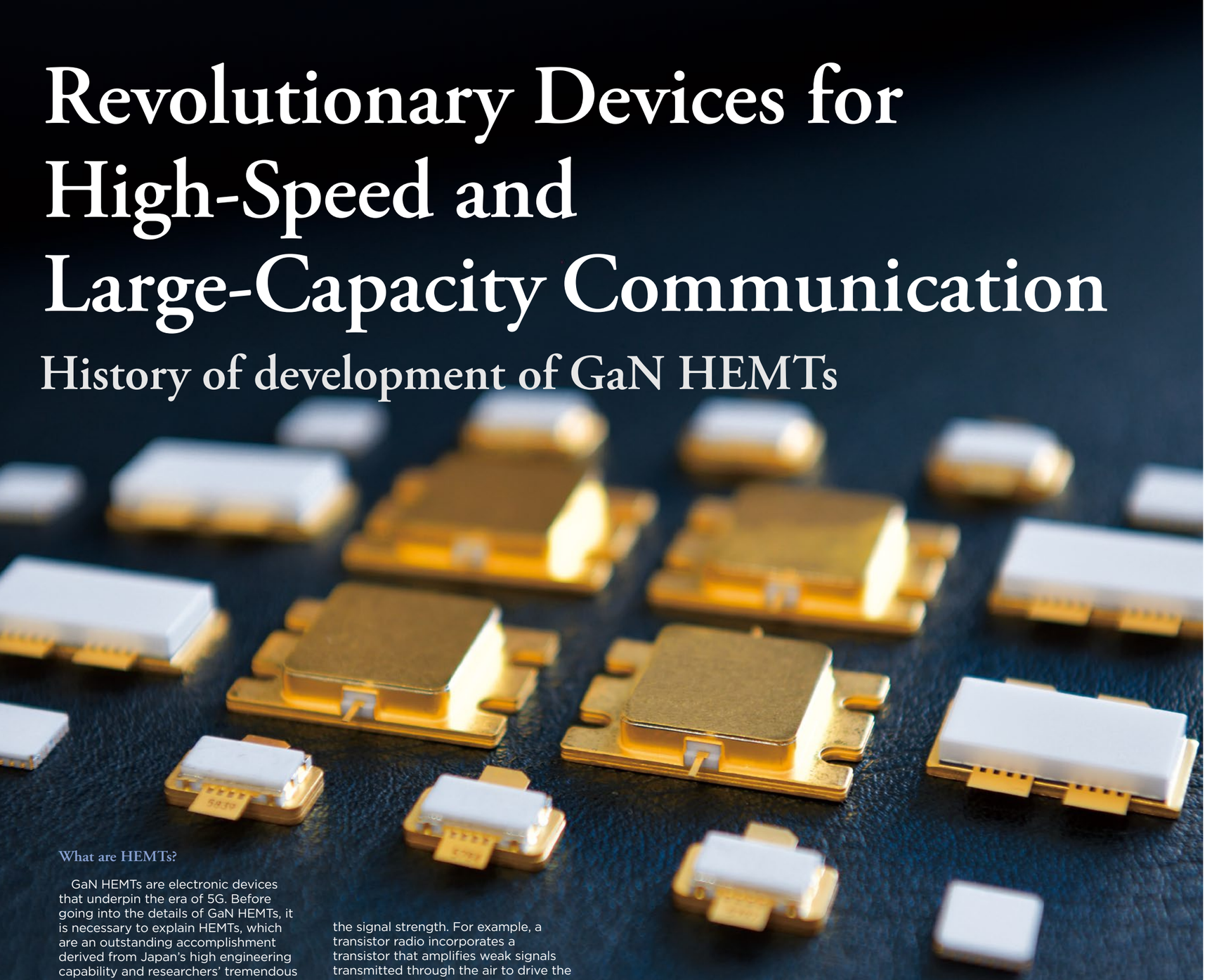
Mobile communication has contributed significantly to improving the performance of mobile phones. The transmission system have evolved from first generation (1G) to fourth generation (4G) and recently, fifth generation, which achieves ultra-high-speed communication considered to be 100 times that of 4G, has emerged. Characterized by high-speed and large-capacity communication, low latency and simultaneous connectivity, 5G technology is expected to offer new service platforms beyond conventional mobile communication and to bring about various applications in society and daily lives. High-speed communication and large transmission capacity will enable live streaming of high-resolution videos and online home medical care, while low latency will dramatically advance Internet of Things (IoT) technology and a way of communicating with various things, including vehicles. Suppose you are driving at 60 km/h. When brakes are remotely applied to your vehicle, the braking distance using 4G is about 1.7 m, whereas the distance using 5G is only a few centimeters. Furthermore, simultaneous connectivity will achieve connections dozens of times more than those of 4G. Commercial 5G services have already been launched in 19 countries, including the U.S., South Korea and the U.K. in 2019. In Japan, 5G was launched in March 2020.

In 2005, the Sumitomo Electric Group became the first company in the world to market gallium nitride (GaN) high-electron-mobility transistors (HEMTs), which are extremely high-performance transistors. The presence of GaN HEMTs has been growing all the more with the advent of the era of 5G. GaN HEMTs have attracted much public attention around the world as electronic devices that underpin the 5G era. This feature focuses on the history of challenges to develop GaN HEMTs and the future outlook beyond the 5G technology.

Antenna for 5G experiment (photo taken with cooperation from NTT DOCOMO)

Revolutionary Devices for High-Speed and Large-Capacity Communication

History of development of GaN HEMTs



Lineup of Sumitomo Electric's GaN HEMTs (packages)

What are HEMTs?

GaN HEMTs are electronic devices that underpin the era of 5G. Before going into the details of GaN HEMTs, it is necessary to explain HEMTs, which are an outstanding accomplishment derived from Japan's high engineering capability and researchers' tremendous creativity. The technology was developed in Japan and gave a strong impetus to the progress of telecommunications technology.

HEMT is the abbreviation for high-electron-mobility transistor. As the name indicates, an HEMT is a type of transistor. The transistor was invented by Bell Laboratories (in the U.S.) in 1948 and had the greatest impact ever in the world of technology. It heralded the beginning of the era of electronics. In fact, transistors are devices that laid the foundation for rapid development of electronic technologies, including computers. One of the functions of transistors is amplification to increase the signal strength. For example, a transistor radio incorporates a transistor that amplifies weak signals transmitted through the air to drive the speaker.

At first, transistors were manufactured using germanium. Eventually, germanium was mostly replaced by highly heat-resistant silicon. In the 1970s, a project was launched in Japan to improve transistors. Researchers focused on the speed of electrons. Conventional silicon transistors incorporated an electron generation layer and an electron transport layer in the same material. For this reason, the speed of electrons was reduced when electrons collided against impurities. To solve the problem, a HEMT was developed using a compound semiconductor by Fujitsu Laboratories Ltd. in 1979. A double layer structure was employed. An electron generation layer made of aluminum gallium arsenide (AlGaAs) crystals was placed on top of an electron transport layer made of high-purity GaAs. This device structure achieved high-speed and high-sensitivity processing of electric signals. In 1985, HEMTs were first used in satellite broadcasting receivers in many countries. They have become devices indispensable for various apparatuses in the microwave and millimeter-wave ranges, such as mobile phones and base stations, satellite navigation receivers, and millimeter-wave radar sensors for preventing collision of vehicles. To date, HEMTs have served as the fundamental technology underpinning the telecommunications society. GaN HEMTs were developed by combining the technological achievement of HEMTs with GaN, characterized by superior material properties. Sumitomo Electric Device Innovations, Inc. (SEDI) led the development and manufacturing.

Challenges to harness the potential of gallium nitride

For 1G analog mobile phones, silicon was used as the semiconductor material of high-output transistors (i.e., amplifiers at mobile phone base stations). For 2G in the first half of the 1990s, when digitalization started, the Sumitomo Electric Group was well prepared to market GaAs field effect transistors (FETs) in a timely manner. GaAs FETs attracted much public attention because these transistors allowed electrons to travel at a speed nearly five times that of silicon transistors and reduced power consumption. However, silicon laterally diffused metal–oxide–semiconductors (Si-LDMOSs), which were newly marketed transistors, had an advantage over GaAs FETs in all aspects, including characteristics and price, and dominated the market to drive 3G. The electronic devices sold by the Sumitomo Electric Group were completely expelled from the market. SEDI President & CEO Yuichi Hasegawa called it a "defeat."

"GaAs FETs were defeated by Si-LDMOSs in the market competition. We faced a difficult situation, where business continuity came into question. Under such a critical situation, we were informed about a new compound semiconductor, for which a basic development project was underway at our laboratory. It was GaN. The characteristics were superior to those of silicon and GaAs. GaN was expected to be applied to electronic devices to achieve high output and high speed. We had no choice but to commit ourselves to GaN in a do-or-die effort," recalls Hasegawa.

In 2000, the engineering team of SEDI started the development of GaN HEMTs with the future potential of GaN in mind. Masahiro Nishi, who is currently affiliated with the Device Manufacturing Engineering Dept. of SEDI, was one of the development members.

"In terms of the material properties of GaN, we were impressed by the high breakdown voltage (breakdown field strength), which was about 10 times that of silicon. The saturated electron velocity, which represents the maximum speed of electrons when voltage is applied gradually, was twice or more that of silicon. The characteristics of GaN were expected to enable high-voltage operation, attain high efficiency, reduce power consumption, and achieve high output. We thought that GaN had the potential to offer devices that could match Si-LDMOSs," says Nishi.

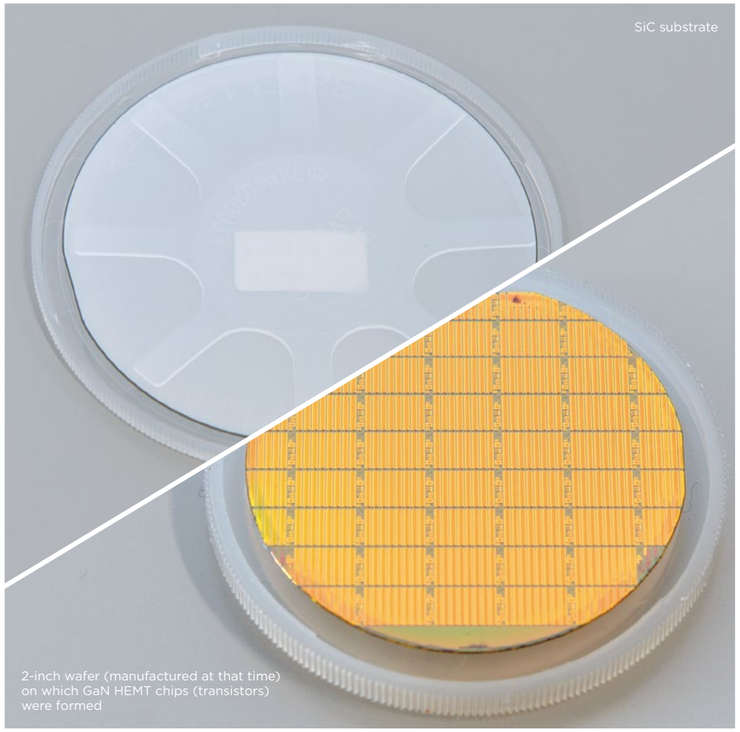
Yuichi Hasegawa
President & CEO,
Sumitomo Electric Device Innovations, Inc.

At that time, Kazutaka Inoue, who is currently the Department Head of the Device Process Development Dept. of SEDI, was struggling to revive the GaAs transistors.

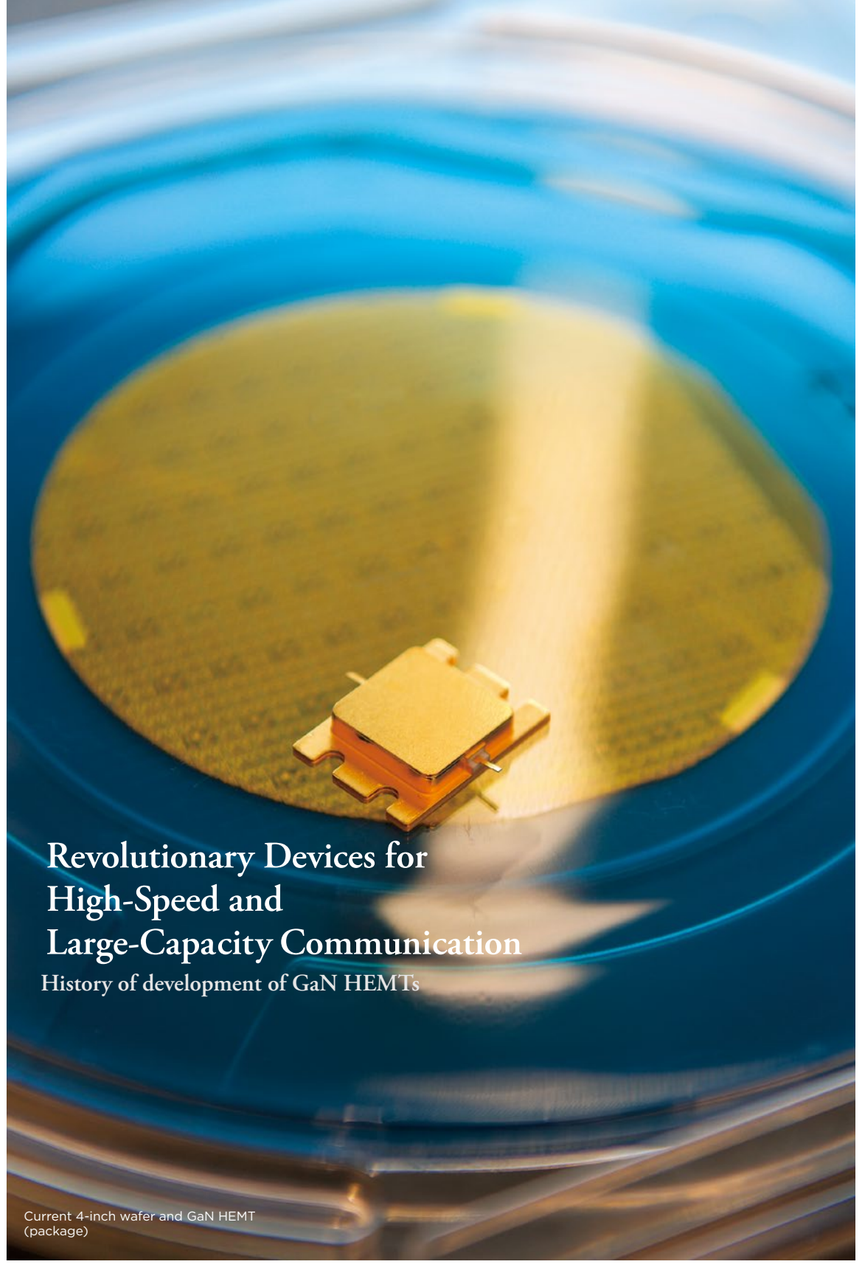
"We were planning to regain our market share, which had been dominated by Si-LDMOSs, by thoroughly investigating the structure of GaAs and creating a new transistor that took full advantage of the characteristics. The thorough investigation made it possible to know the limits of GaAs's performance. That is why we joined the development of GaN, but it was unknown territory for everyone. We had to start from scratch and tread a thorny path," recalls Inoue.

Masahiro Nishi
Manager,
Sumitomo Electric Device Innovations, Inc.

Kazutaka Inoue
General Manager,
Sumitomo Electric Device Innovations, Inc.



2-inch wafer (manufactured at that time) on which GaN HEMT chips (transistors) were formed



Revolutionary Devices for High-Speed and Large-Capacity Communication

History of development of GaN HEMTs

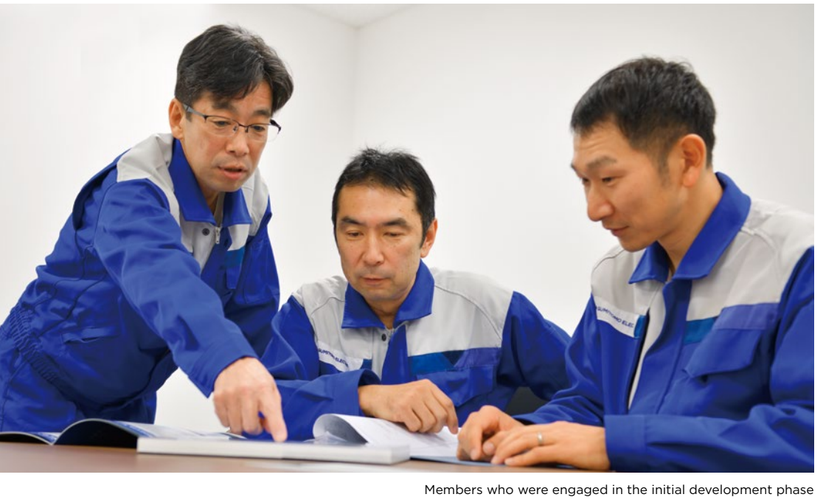
Current 4-inch wafer and GaN HEMT (package)

Development of new devices by applying the working principle of HEMTs

GaN HEMTs were developed based on the concept of HEMTs, which used a spatially separated double-layer structure (i.e., an electron generation region and an electron transport region) in a transistor. Aluminum gallium nitride (AlGaN) was used in the electron generation layer, and GaN was used in the electron transport layer. Silicon carbide (SiC), which is used for the substrate, is characterized by excellent thermal conductivity. This structure efficiently radiates the heat generated when a transistor is operated. A monocrystalline film of GaN and AlGaN each is allowed to grow on the SiC substrate using a technology called epitaxy. Finally, electrodes are formed. This is how GaN HEMTs are manufactured.

The first issue was that SiC was expensive and hardly available. It was difficult to set the optimal condition for the growth of monocrystalline films by epitaxy. Even after resolving these issues, it was extremely difficult to ensure reliability. The voltage resistance was high, but GaN HEMTs broke down easily when voltage was applied for energization and operation. Investigation of the cause revealed a quality problem in the SiC that was used for the substrate. Further efforts were made to ensure reliability by improving the quality of the substrate in close cooperation with the SiC substrate manufacturer. Fumikazu Yamaki was one of the members who worked hard to deliver GaN HEMTs. He is currently in charge of design and development of transistors at Electron Device Development Dept., #1 of SEDI.

"We had to improve the poor yield. To sell novel products to customers, we had to offer products of reliable quality. We continued to work to find the cause of the defects. To identify and remove defective products, we developed a proprietary screening technology and established a screening method. Instead of simply manufacturing products, we consistently placed top priority on quality," recalls Yamaki.



Members who were engaged in the initial development phase

To ensure reliability for customers

While concerted efforts were made to clear hurdles in the development of GaN HEMTs, a sales campaign was launched to raise the profile and awareness of GaN HEMTs by offering samples. Nobuhiro Kuwata, who is currently the president of Sumitomo Electric Asia, Ltd. in (Hong Kong), was one of the sales members in charge.

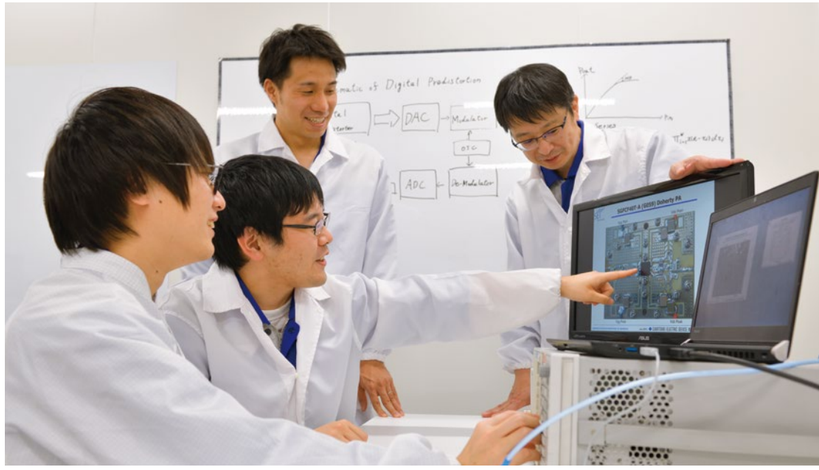
"Only users could experience the extremely high characteristics demonstrated by GaN HEMTs. We promoted a campaign, in which we asked many customers to let their engineers conduct measurements using the actual samples and helped them deepen their understanding about GaN HEMTs. GaN HEMTs demonstrate their advantage at 50 V, however, no base stations of that time had power supply units operated at that high voltage. Therefore, we asked a power supply unit manufacturer to develop and commercialize a 50 V power supply unit. While setting up the environment in which GaN HEMTs could demonstrate their performance to the fullest, we promoted sales activities toward commercialization. The key was in the introduction of a digital distortion compensation technology, which eliminates distortion of input signals in amplifiers at base stations, and guarantees the communication quality and operation with low power consumption. At that time, digital distortion compensators were optimized for Si-LDMOSs, so we had to present examples of distortion compensation measurement for the GaN characteristics by ourselves. These efforts helped customers gradually understand the characteristics and advantages of GaN HEMTs," recalls Kuwata.

Kuwata and other members were engaged in awareness-raising and sales activities not only in Japan but also in North America, Europe and Asia. They kept in mind the supply of GaN HEMTs to the global market from the outset. Shipment of samples began in 2005, and mass production started in 2006. In Japan, GaN HEMTs were chosen for 3G base stations in 2007. SEDI became the first company in the world to commercialize GaN HEMTs.

In the initial stage of development of GaN HEMTs, the development, manufacturing and sales departments of SEDI worked as a unified team instead of working separately.

"All the members shared the chagrin of defeat by Si-LDMOSs and a wish to turn the tables by marketing GaN HEMTs as devices for base stations," says Kuwata.

SEDI succeeded in delivering the world's first product, but issues remained unresolved. The yield improved, but the high price was inevitable. In Japan, there was a growing awareness about GaN HEMTs' outstanding operation with low power consumption, and GaN HEMTs were increasingly used by customers. However, Si-LDMOSs (which were competitors) remained dominant in the global market. The shipment volume did not readily increase. Under these circumstances, the SEDI engineers worked to cut costs extensively.



Young development members at present who have inherited the pioneering spirit

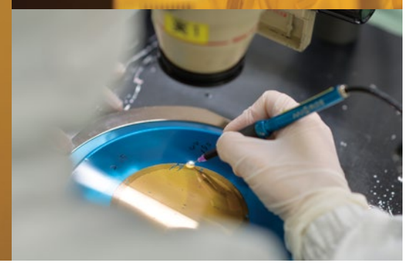
Yamanashi Plant, Sumitomo Electric Device Innovations, Inc.

Fumikazu Yamaki
Manager, Sumitomo Electric Device Innovations, Inc.

Nobuhiro Kuwata
President, Sumitomo Electric Asia, Ltd. (Hong Kong)

From the First Year of 5G to "Beyond 5G"

Current developments of GaN HEMTs that continue to evolve



GaN HEMTs are manufactured by combining state-of-the-art equipment with outstanding human skills (Yamanashi Plant, Sumitomo Electric Device Innovations, Inc.).

Challenges to increase the diameter of wafers and downsize packages

Many chips can be cut out from a large-diameter wafer. One of the important themes in the initial phase of mass production was to reduce costs by increasing the wafer diameter. Mass production of GaN HEMTs started using two-inch wafers. Production using three-inch wafers was achieved in 2007, and production using four-inch wafers was achieved in 2011. Wafer processing involves about 100 processes, and changing the wafer diameter means the entire rearrangement of apparatuses and materials. To optimize the production process, problems were solved one by one. Hitoshi Haematsu, who currently works in the Device Production Engineering Dept. of SEDI, is one of the members who worked on the challenge.

"Wafer processing consists of a front surface process to form electrodes and a back surface process to thin wafers and cut them into chips. SiC, which is used for the substrate, is an extremely hard material. Wafer thinning technology for SiC was unavailable anywhere in the world. We tried to grind wafers forcibly using a robust grindstone, but the yield was poor and the processing speed was low. We contacted a manufacturer of back surface grinders and developed an innovative grinding technology. The processing speed increased dozens of times compared to the conventional method. Defects caused by grinding were almost eliminated," recalls Haematsu.

Efforts were also made to downsize packages to accommodate the GaN HEMT chips. Norihiro Yoshimura, who currently works in the Electron Device Development Dept., #1 of SEDI, was one of the members in charge.

"We had to meet the cost requirements of customers. This was an important factor to beat Si-LDMOS transistors. Downsizing of packages translated directly into cost reduction. We worked on downsizing by changing the circuit system in the package and design methodology. The size has been reduced to one fourth compared to that in 2006, achieving total cost reduction," says Yoshimura.

The low power consumption of GaN HEMTs also helped reduce the cost spent by base stations. GaN HEMTs were gradually accepted in the market. The communication carriers that used GaN HEMTs praised such characteristics as high output, high-speed transmission and low power consumption, and the recognition by the market followed. GaN HEMTs started to be known as "monster devices." GaN HEMTs were rapidly accepted by the market when the communication protocol shifted from 3G to 4G and the required frequency bandwidth expanded with the advent of the era of high-speed and large-capacity communication. It is noteworthy that GaN HEMTs contributed to the downsizing of base stations. The power consumption of GaN HEMTs was low, which achieved low heat generation and eliminated the need for air cooling fans and other components. This helped reduce the size and weight of base stations, making the installation work easy and expanding the installable areas. The number of small base stations, which are called remote radio heads, increased sharply. GaN HEMTs were also used for terrestrial digital broadcasting transmitters and the Skytree broadcasting station. In 2013, the sales of GaN HEMTs skyrocketed in line with the growing demand outside Japan. In 2014, SEDI won the Minister of Education, Culture, Sports, Science and Technology Prize at the Technology Management and Innovation Awards for various accomplishments in the telecommunications field.

Hitoshi Haematsu
Manager, Sumitomo Electric Device Innovations, Inc.

Norihiro Yoshimura
Manager, Sumitomo Electric Device Innovations, Inc.

Ken Kikuchi
Assistant Manager, 5G-Radio Dept., Transmission Devices Laboratory,
Sumitomo Electric Industries, Ltd.

Isao Makabe
Assistant General Manager , Electron Devices Dept.,
Transmission Devices Laboratory,
Sumitomo Electric Industries, Ltd.

Expanding global market share of GaN HEMTs

The year 2020 is regarded as the first year of 5G. There has been an intense competition in the market between GaN HEMTs and Si-LDMOSs as transistors for base stations. SEDI has the top market share in GaN HEMTs for base stations, and in 2019 its sales were close to that of the top supplier of Si-LDMOSs. The sales of GaN HEMTs have been very strong, but the situation does not allow for an optimistic outlook. Global Si-LDMOS manufacturers have been preparing to knock SEDI off the table before GaN HEMTs becomes the mainstream. To ensure differentiation, it is necessary to improve GaN HEMTs. Isao Makabe, who works in the Electron Devices Dept. of the Transmission Devices Laboratory of Sumitomo Electric Industries, Ltd. is one of the members in charge. He is engaged in the development of thin film crystal growth technology, which is the core technology for GaN HEMTs.

"Die shrink has been further accelerating for high-frequency devices of 5G and beyond. It is important to develop crystals suitable for the structure. The current GaN HEMTs have a structure in which crystals of GaN and AlGaN are layered to generate electrons on the bonded interface. What is interesting about GaN is that the device behavior can be changed significantly by controlling the Al-Ga ratio and film thickness. My mission is to pursue novel GaN HEMT crystals that meet the characteristics, mass productivity and cost advantage," says Makabe.

Ken Kikuchi from the 5G-Radio Dept. of Transmission Devices laboratory is in charge of the operation analysis and modeling of GaN HEMT chips.

"The device requirements vary depending on the customer and application. I am responsible for identifying potential risks and problems during actual operation of devices at base stations and giving feedback to the device development team. The development of evaluation and simulation techniques is an important research topic. The potential of GaN HEMTs is very high, and there is still much room for further development. We serve as an intermediary between technology development, including crystal growth, and product design to accelerate the device development," says Kikuchi.

Along with these efforts, wafer processing technology has been developed, which is supervised by Inoue.

"Adaptation of GaN HEMTs to the high-frequency band requires further process shrink. For example, electrodes must be fabricated in the order of nanometers, which is thinner than the AlGaN and GaN layers. However, semiconductor processing requires high energy. Die shrink and the thinning of HEMTs cause damage to semiconductor due to the processing energy. We are developing processes to clear the hurdles. We envision communication technologies beyond 5G. The frequency band is millimeter-wave bands of 28 GHz or more. Expansion of the use of high-frequency bands means that the devices will become thinner. In this context, process development will become even more important," says Inoue.

Pioneering an Untrodden Communication Field

Future achieved by GaN HEMTs

Young sales members who lead sales outside Japan

Sales strategy to become the top company in the world

As competitors are expected to catch up rapidly, sales activities are entering a new phase. Takanori Fukasawa of the Communication Device Sales Dept., Infocommunication Device Sales Div., of Sumitomo Electric Industries, Ltd. is one of the members in charge of sales strategy in Japan. He has been engaged in GaN HEMTs from the initial phase of mass production with Kuwata and other members.

"Si-LDMOS manufacturers still have the top market share in the world in terms of devices for mobile phone base stations. They excel in application support by working closely with customers and developing circuits, and they have started to enter the GaN HEMT market. We must deeply understand customers' systems and quickly implement proposals that reflect customers' needs. We will aim to take the No. 1 position in the world by establishing an advantage in quality, cost, delivery and development (QCDD)," says Fukasawa.

Sales outside Japan have also been accelerating. Notably, activities are underway in the North American and European markets. Kohei Nagata of the Electron Device Sales Dept., Infocommunication Device Sales Div., is on the front line of the European market.

"At present, our main target is Northern Europe, including Sweden and Finland. Northern Europe is advanced in terms of IT, and there are many leading manufacturers of apparatuses for base stations. The demand for GaN HEMTs has been growing. However, the competition is becoming more intense over GaN HEMTs. The key to surviving the competition is to make optimal proposals by obtaining local market information properly and to gain customers' trust," says Nagata.

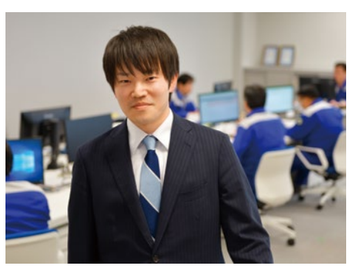
Increasing production capacity to meet the strong demand for GaN HEMTs

There has been growing global demand for GaN HEMTs. Kaname Ebihara, who was involved as a GaN HEMT device developer when the project was launched and currently serves as the Department Head of the Device Production Engineering Dept. of SEDI, points out that the impending issue is to increase production capacity.

"First, we have been reinforcing the production line of four-inch wafers at the Yamanashi Plant, which serves as the linchpin of our production system. We plan to double the wafer processing capacity in FY2019 and triple the capacity in FY2020 compared to FY2017. A new production center will be established in North America. It is important to improve the process and optimize the production system by maximizing the efficiency of business operations. As the competition is expected to become more intense, the pursuit of optimization will be our never-ending theme," says Ebihara.

Efforts have been made to reinforce the production capacity in response to the developments in 5G communication technology. In 5G, a wireless communication technology called massive multiple-input and multiple-output (MIMO) is used. This communication protocol dramatically increases the utilization efficiency of radio waves to achieve ultra-high-speed communication. The number of devices required will be 10 to 30 times that of conventional base stations. This will significantly increase the demand for GaN HEMTs. In FY2020, the demand in terms of the number of devices is projected to increase as much as 10 times that of FY2017. SEDI's GaN HEMTs are likely to dominate the global market in the near future.

Takanori Fukasawa
Project General Manager,
Communication Device Sales Dept.,
Sumitomo Electric Industries, Ltd.



Kohei Nagata
Electron Device Sales Dept.,
Sumitomo Electric Industries, Ltd.

Kaname Ebihara
Department Head,
Sumitomo Electric Device Innovations, Inc.

Interview with Dr. Iwao Hosako, a terahertz wave researcher

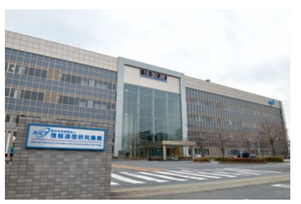
The frontier research field of telecommunications and wireless communication has reached the terahertz wave band, which is beyond the 5G millimeter-wave band. Dr. Iwao Hosako, Director General of the Advanced ICT Research Institute, National Institute of Information and Communications Technology (NICT), is an authority in research.

"Terahertz refers to the frequency bands between 100 GHz and 10 THz. Research started about 20 years ago. The terahertz wave is an ultra-high-frequency radio wave, and the technology is beyond that of the millimeter-wave bands. It achieves wireless transmission of very large capacity. The goal is to achieve high-speed wireless transmission of 100 Gbps in the 300 GHz frequency band. Electronic devices play a key role. The GaN HEMTs developed by the Sumitomo Electric Group are effective devices not only for mobile phone base stations but also for mobile edge computing, which reduces the physical distance between devices and servers and thereby reduces the communication time to ensure real-time performance," says Dr. Hosako.

In 2019, terahertz attracted much public attention. It was agreed at the World Radiocommunication Conference to use the terahertz band for communication. The band between 275 and 450 GHz, which had been used only for receiving signals in the fields of radio astronomy and earth observation, was identified as the frequency for terrestrial mobile communication.

"This identification has opened up the possibility of 100 Gbps ultra-high-speed communication toward "Beyond 5G (the next generation following 5G)" or 6G, which will enable instantaneous downloading of very large video files of 4K and 8K to mobile phone devices, massive machine-type communications (mMTC) for concerts and sports events at stadiums, automated driving of vehicles and Shinkansen bullet trains, replacement of optical fiber connection with wireless communication and many other solutions. Such ultra-high-speed communication is also expected to be deployed in three-dimensional applications, such as ocean, aviation, satellite and deep space, in addition to the two-dimensional applications of terrestrial mobile communication. Achievement of these solutions will require devices that attain a high speed of 100 Gbps in the 300 GHz frequency band, which is our target. I expect the Sumitomo Electric Group to deliver the devices. I hope that the Group will take on the challenge by harnessing its expertise, which has been refined through many years of operation," says Dr. Hosako.

In March 2020, 5G finally started in Japan. While technologies up to 4G were mobile network technologies for mobile phones, 5G is considered a mobile network technology that changes society and the driver of the era of IoT. In the new era, everything will be connected to the Internet, and GaN HEMTs will be indispensable devices. The Sumitomo Electric Group developed GaN HEMTs by leveraging its engineering capability refined over many years of operation and demonstrating resoluteness, and it has established a strong presence in the global market. The communication protocols have evolved in a cycle of almost every 10 years. The year 2030 will mark the era of 6G. The Sumitomo Electric Group continues to take on challenges to achieve evolution of electronic devices toward 6G.



Headquarters of the National Institute of Information and Communications Technology

Dr. Iwao Hosako
Director General, Advanced ICT Research Institute, National Institute of Information and Communications Technology

Striving to Achieve Success in the Global Arena

Athletes of the Sumitomo Electric Group
Shuhei Tada, Yuki Ito and Yuki Koike

The Sumitomo Electric Group has long been committed to the promotion of sports, thereby producing athletes who compete in the global arena.

In this volume, Yuki Koike and Shuhei Tada of Sumitomo Electric, who are drawing considerable attention as talented sprinters, and Yuki Ito of Sumitomo Wiring Systems, who underpins the Japanese women's rugby team as one of its key players, candidly discuss how they have thought and acted so far as athletes competing in the global arena. Although the immediate target of the three athletes is to qualify for the games, they are striving to go further and win medals by accelerating their efforts to raise their levels as athletes.

Rugby Players Striving to Score Tries through Teamwork, and Track & Field Athletes Aiming to Achieve Desired Results on Their Own – Each Sport's Attractive Features

— What made you start your sport and what attracted you to it?

Ito: I have a brother who is two years older than me, and I've been greatly influenced by him. Actually, I began practicing judo at the age of four, and that was because I wanted to give it a try after observing lessons of my brother's judo class. While practicing judo, I also continued to do classical ballet and gymnastics. After I entered junior high school, I began to concentrate fully on judo as a member of the school's judo club. There were very strong judo athletes at the national level, and I was seldom able to advance to the finals in competitions. But I'm very competitive by nature, and I continued to practice until I finally won second place in the 48 kg category of a national junior high school competition, which was the final event that I participated in in my junior high school days.

Koike: I also have an elder brother, but he played soccer. Unlike Ms. Ito, I wanted to do something different from him. I would often play catch with my father, leading me to start playing baseball when I was an elementary school student. Afterwards, I joined the local baseball club. This experience of participating in a new community made me aware of competing with others, and winning and losing games. When I entered junior high school, I joined the school's baseball club. I finally played as the ace and cleanup hitter of my team, but we did not qualify for the Hokkaido prefectural competition, and I retired in the summer of my third year at junior high school. I continued practicing earnestly without taking a day off, but this was simply because I enjoyed myself, as baseball made my three years at junior high school truly fulfilling.

Tada: When I was an elementary school student, I played soccer and did swimming, but most of all, I loved running. On field days, I volunteered to compete in running races and I loved finishing first. I began my track and field career at junior high school, and competed in inter-high school championships. I'm about the same age as Mr. Koike, but he was already well known in those days. My turning point came when I was a university student and I had the opportunity to think about my training menu on my own. This led me to work on muscle reinforcement, which I had not focused on so much, and also on improving my running style by taking advantage of my strong point, my jumping ability. Consequently, my record improved by 0.4 or 0.5 seconds (for the 100 m) compared to my high school days. I made rapid progress. After graduating from university, I joined Sumitomo Electric, expecting that I could practice track and field in the excellent environment of the company, representing the Kansai region. Ms. Ito, you used to practice judo and changed your sport to rugby, while Mr. Koike, you used to play baseball and then moved to track and field. What lay behind these changes for each of you?

Ito: I was again influenced by my brother. He played rugby at his high school. Watching him play, I simply thought it would be fun to play rugby, and I felt like giving it a try. I went to Fukuoka Chikushi High School, a prefectural high school famous for its strong rugby team, although it was a boys' rugby team. Since the school did not have a girls' rugby team, I trained together with the boys and belonged to a local club team. Rugby is particularly compelling in that all the team members share the same goal of scoring tries and that each player fulfills his/her own role to score a try. I joined Sumitomo Wiring Systems in 2019. Currently, I belong to Mie Women's Rugby Football Club Pearls, the local rugby club team whose main sponsor is Sumitomo Wiring Systems.

Koike: I thoroughly enjoyed playing baseball during my three years at junior high school. After entering high school, I wanted to try something that would be not only fun but also challenging, and where I could demonstrate some achievements. My physical ability was high but I knew I was clumsy, so I wanted to try a sport that did not require any equipment and allowed me to compete simply with my body. As a result, I chose a non-team sport, track and field. In my first year of high school, I qualified for a competition for the first time, and my record for the 100 m was 10.99. Actually, I didn't know that it was a good time until people around me told me so, showing how little I knew about track and field when I just began the sport. Since then, I've been running the 100 m and 200 m sprints. One of the attractive points of sprinting is that the results are presented clearly in figures. In a race, you're not hindered by the other runners, meaning that the race result is totally up to you. You have to demonstrate everything you have, and this determines whether you win or lose. I think this clarity suits my taste.

Tada: I agree. All the results are presented in figures. Working hard is the only way to generate good results. Track and field is a sport in which players cannot blame anyone but themselves for a poor performance, and this is part of the attraction of the sport. In addition, the race results are delivered in an extremely short time despite the considerable amount of time spent preparing for the race, and this point is also attractive.
So, both of you used to play different sports from what you do now. Do you feel that the experiences were useful to you in your current careers?

Ito: Both rugby and judo are contact sports and have some points in common. In terms of how to use my body, such as how to hit a player of the other team and how to release my power, my experience of judo has been beneficial. But the decisive difference between judo and rugby is that while the former is a non-team sport, the latter is a team sport. I feel that rugby has many elements that are different from judo, especially when it comes to realizing the goal of scoring tries.

Koike: In contrast to Ms. Ito, my experience of playing baseball was a disadvantage to me. When running between bases in a baseball game, you need to use the front sides of your muscles, including your leg muscles. In the case of track and field, however, you need to use the backsides of your muscles. I had difficulty eliminating my running habit that I had developed while playing baseball. In addition, while playing baseball, you need to run in such a way as to frustrate the other team's players, such as when running to steal a base. In track and field, however, you need to run straight without trying to frustrate anyone. The basic approaches are quite different, which required me to develop a new mindset and adopt a new training method for track and field.

Striving to Achieve Success in the Global Arena

Athletes of the Sumitomo Electric Group

Raise Your Awareness to Break through the Barrier into the Global Arena

— All of you are striving to achieve success in the global arena, but how do you actually feel about standing in the global arena?

Tada: I joined the 2017 World Athletics Championships, which was my first appearance in the global arena. I competed in the 100 m and the 4 x 100 m relay, but I just felt how high the barrier to the global arena was. In case of the 100 m, for example, Japanese athletes are able to run like their foreign rivals in the first half of the race, but end up by being overtaken in the second half. This was very shocking to me at first, because I found myself being overtaken by runners who had already begun to slow down their pace. It was like something that was happening in a different dimension. In those days, I had already achieved good results in races held in Japan, but my experience in international championships made me aware that I could never allow myself to become conceited, and stimulated my motivation to make even greater efforts to beat world-leading athletes.

Koike: Many Japanese sprinters feel what Mr. Tada has expressed. Actually, Japanese and foreign athletes differ in terms of their mindset and awareness regarding short-distance running. In the case of the 100 m, for example, it has long been typical for Japanese sprinters to compete well in the first half of the race but be defeated in the latter half. This is because Japanese athletes regard the first 60 m as the first half of the race and place their focus on the initial spurt. Some foreign athletes joke that Japanese athletes are always practicing making their start. Such foreign athletes don't care so much about making a good start and think that it's OK as long as they don't fail. Believing that the key lies in the final 60 m, they try to reach their top speed around the 70-m mark, where Japanese sprinters have usually already slowed down their speed. I've begun to try to run like a foreign sprinter, because I think that without this approach, it would be impossible to win a medal.

Ms. Ito, you're also competing in the global arena, how do you feel about it?

Ito: Japanese women's rugby faces a huge gap with the rest of the world. Players from New Zealand, Australia and other strong countries are superior to their Japanese counterparts in terms of body size, speed, technique, etc. When competing against teams from the world's top four countries, New Zealand, Australia, the U.S. and Canada, we are defeated by a considerable margin. We can't score tries, and once the ball is intercepted by the other team, they quickly score a try. Currently, we're competing in the World Series, but we keenly realize each time that there is a high barrier to entering the global arena.

Mr. Koike, what do you think you need to do in order to achieve success in the global arena?

Koike: Although rugby and track & field are different, it's important to set your standards at a higher level. I used to limit myself by thinking that the best thing I could do was to advance to the finals, but this approach was not correct. I need to raise my awareness as an athlete and set my target on winning a medal. On top of changing my awareness in this way, I need to directly experience the techniques of the world's top-level athletes and raise the level of my own technique so that I can equal them, thereby achieving a breakthrough. I believe that dreams and targets are different. While dreams are things you can talk about as you like, targets are things that you need to accomplish in reality. My dream is to win the gold medal in a global competition someday, but my target is to win any medal. And to do so, it's important to maintain my awareness at a high level.

Tada: Now, Mr. Koike, you talked about the importance of setting a target and actually accomplishing it, and I agree with you. Since my high school days, I have placed my focus on setting a high target, considering what I needed to do to achieve it, and actually doing it. If you continue to accomplish small targets, you will finally be able to achieve a big target. Accordingly, as indicated by Mr. Koike, it is essential to maintain a high level of awareness.

Ito: Honestly speaking, the Japanese women's rugby isn't strong enough to win a medal yet and hasn't reached the level of competing equally with strong teams around the world. Our target is to reach the quarter finals in an international competition, such as the World Series, but we haven't achieved it yet. Under this circumstance, we focus on every single training day by clarifying what we need to do. Another important element is that rugby is a team sport and the relationships between the team members are crucial. Some members are not selected for matches, but if this creates a bad atmosphere in the team, it negatively affects the matches. In order to compete in the global arena, it is also essential for team members to be considerate of one another and strongly unite themselves as a team.

Yuki Koike

Belongs to the Human Resources Development Department of Sumitomo Electric. Born in 1995 in Hokkaido. Began to devote himself fully to track and field after enrolling in high school and soon demonstrated his talent in his first year. Drew public attention for his rivalry with Yoshihide Kiryu, of the same academic year. Obtained the title in the 100 m at the Japan Junior Championships in his third year of high school. After graduating from high school, went on to Keio University and experienced an international competition for the first time by competing in the World Junior Championships when he was a freshman. Became the third Japanese runner to advance to the finals of the 200 m and won the silver medal. After graduating from university, joined All Nippon Airways Co., Ltd. and then transferred to Sumitomo Electric. Became the third Japanese to run in the 9-second range (9.98) at the finals of the 100 m of the IAAF Diamond League London in July 2019.

Shuhei Tada

Belongs to the Administration Division of Sumitomo Electric. Born in 1996 in Osaka. Began track and field in his junior high school days. After enrolling in Kwansei Gakuin University, achieved a victory in 2015 in the Kansai Region Inter-College Athletics Championships, while still a first year student. Achieved a victory again in the following year's championships, setting a new championship record. Selected as a member of the Osaka Dream Program by the Osaka Association of All Athletes in 2017 to participate in a competition held in the U.S. Competed in the 100 m at the Golden Grand Prix Kawasaki held in the same year. Also competed in the 100 m and the 4 x 100 relay of the Japan Student Individual Championships of Athletics, and won the silver medal in the relay. At the 2018 Kansai Region Inter-College Athletics Championships, became the first athlete in 55 years to win a fourth straight victory in the 100 m. After graduating from university in 2019, joined Sumitomo Electric. Represented Japan at the 2019 World Athletics Championships, ran the first leg of the 4 x 100 m relay, and contributed to winning the bronze medal.

Yuki Ito

Belongs to the Administration Division of Sumitomo Wiring Systems. Born in 1996 in Fukuoka. Continued to practice judo until she became a high school student, and won second place in the 48 kg category of a national junior high school competition. After graduating from junior high school, went on to Chikushi High School, a prefectural high school renowned for its strong rugby team, despite invitations from high schools with strong judo teams. Started her career as a rugby player and trained together with male students. After graduating from high school, enrolled at Nippon Sport Science University. Competed in the World Cup Ireland qualification rounds for the Asia and Oceania zone in 2017 and contributed to the team advancing to the final round. Joined Sumitomo Wiring Systems in 2019 and participated in Mie Women's Rugby Football Club Pearls, the women's rugby team in Mie Prefecture. Selected as a second candidate for the Japanese team of women's seven-player rugby for the Tokyo Olympic Games. Plays as a forward and boasts excellent defense skills and hard work.

People's Support, Advice and Encouragement Have Helped Overcome Difficulties

— All of you have probably experienced a lot of difficulties before reaching where you are now. How did you overcome them?

Koike: My career as an athlete was relatively smooth until my second year at university, and I didn't experience any serious injuries or troubles. But in my third and fourth years, I suffered a spate of injuries. In particular, an injury that I incurred in my fourth year prevented me from returning to the athletic ground for a long time, threatening my career as an athlete. I thought that if I gave my utmost but still could not generate the desired results, I should retire from track and field. That was why I desperately wanted to generate the desired results at any cost. At the same time, however, I decided that it would be impossible to do everything on my own to achieve my target. Until that time, I had done everything alone, but I thought that the best option would be to work with a coach. There were only three months left before the All Japan Inter University Track & Field Championships to be held in September of my fourth year. Under guidance from my coach who worked exclusively with me, I engaged in rehab and training. Consequently, I was able to achieve a victory. By allowing myself to depend on others, I was able to overcome my difficulty.

Tada: Like in Mr. Koike's case, my coach has also been extremely significant. Although I've never suffered any serious injuries, I experienced a slump when I was in my fourth year of university. At university, I somehow tried to pull myself out of the slump on my own. Now that I've begun to work together with my present coach after graduating from university, the situation has changed a lot. Even if I feel that I'm running very well, I'm actually not, seen objectively. Accepting advice from someone other than myself has improved my running performance. There's no absolutely correct answer in track and field, but I've successfully got out of the slump by listening to advice and opinions from someone other than myself, namely my coach, and mingling them with my own ideas.

Ito: I tore the ligament of my right knee just before the Women's 15-player Rugby World Cup in 2017. It was such a serious injury that it took about one year for me to recover completely and return to the field. While undergoing rehabilitation, I keenly realized that I was supported by so many people, including my teammates, coaches, family members and supporters. I was determined to definitely make a comeback for them. The support and backup I received from the people around me enabled me to recover from the injury. I'm now happy that I can play rugby. When I can please the people around me by demonstrating my best performance, it encourages me to strive harder and stimulates my motivation.

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Special Talk Session

Striving to Achieve Success in the Global Arena

Athletes of the Sumitomo Electric Group

The 100 m Sprint is an Ultimate Form of Mental Sports.

— Mr. Tada, Mr. Koike, how do you see each other as a track and field athlete?

Tada: Mr. Koike works hard by strategically thinking of what to do. But I'd rather depend on my feelings about running. I guess almost all athletes must have felt acute feelings when running very well, and this is what I emphasize.

Koike: I think what Mr. Tada is saying is pretty standard in track and field. For athletes, the feelings at their best are truly important. The only difference between us is that I try to verbally express the feelings, while he doesn't. My daily training has been organized to connect the "feelings" with "speed" as a numerical result. A good example is the feeling you have when you are able to reach a certain speed with the power 5% less than before.

Tada: He's talking about the condition whereby you can place your body under control without using unnecessary power. If your body moves more than expected, this means that your "feelings" are not acute enough. The "feelings" of athletes are, in a way, super feelings. Mr. Koike, you were the third Japanese athlete to break the 10-second barrier and run in the 9-second range. How were your "feelings" when you did that?

Koike: At that time, my condition was so good that I used unnecessary power and this is what I still regret. In other words, I couldn't control myself. As a result, even though I led the pack until the 70-m mark, I slowed down and ultimately could not win a medal. You know, the 100 m is an ultimate form of mental sports, and the experience made me keenly realize that I need to stay calm until the end. In addition, the media was excited that I had broken the 10-second barrier, but I'd like to state that a barrier is only a barrier as long as you think of it as such, and if you don't, it is no longer a barrier. I feel that 10 seconds is no longer a barrier.

Sumitomo Electric's Atmosphere of Enjoying Sports

— What do you think are the advantages of continuing sports as an employee, and the attractive features of the Sumitomo Electric Group?

Koike: To generate the desired results, the environment is important. The Sumitomo Electric Group has generously provided the training environment that I requested and promised to provide me with support. I feel truly grateful for these points. At the same time, I feel the advantage of belonging to the company as an employee. Even when there are no special events, such as a pep rally or an encouragement ceremony, athletes feel at ease that they can belong to somewhere and have some place in Japan to return to after completing an overseas training program or tour. Moreover, words I receive from other employees are truly encouraging. Many of them say, not "Do your best!" or "We have great expectations of you," but "I enjoyed watching you run" and "Your performance gave me a lot of energy." I'm happy that they enjoy sports, and these comments stimulate my motivation to work harder.

Tada: I joined the company in 2019 as a new employee, and I was nervous at first. When a competition approaches, however, everybody supports me and cares about my training. I'm simply moved that I can gain so much support at the company. All the more for this reason, I would like to repay the favor of everyone who supports me, by producing the desired results.

Ito: I agree. Like Mr. Tada, I joined Sumitomo Wiring Systems in 2019, immediately before recovering from a serious injury and being selected for the national team. Having returned to the national team, I need to join a spate of intensive training camps, which prevent me from working at the company on a daily basis. When I go to the company, however, I'm encouraged by coworkers who say "I watched your match." Every time I return to the headquarters in Yokkaichi, I feel warm. When a match was held in Suzuka, a city near the headquarters, the venue was filled with employees from Sumitomo Wiring Systems. I'd like to repay them for their support by producing favorable results.

Koike: I think the Sumitomo Electric Group is distinctive in that it provides support for athletes simply because all the members of the corporate group love and enjoy sports. Sports are one of the subjects taught at school, in the form of PE, but they are originally leisure activities, meaning that the basic focus should be on enjoyment. The atmosphere of enjoying sports is felt in the Sumitomo Electric Group, and I feel that this is very good for athletes.

Tada: I also love running, and my focus is on enjoying running. It goes without saying that I need to produce the desired results, but I feel that my spirit of enjoying sports is the same as what Mr. Koike described, namely, it comes from the atmosphere of the Sumitomo Electric Group. I believe that Chairman Matsumoto, an earnest supporter of athletes like us, also enjoys sports.

— Finally, can you tell us about your aspirations toward the Tokyo Olympic Games and your future targets?

Ito: Since Japan is the host country, it has already been decided that the Japanese women's rugby team will compete in the Olympic Games. My immediate target is to be selected for the national team. While working hard toward this end, I need to contribute to increasing the level of the women's rugby team of Japan so that we can catch up as close as possible to the strongest teams around the world. I will do my best at the Tokyo Olympic Games to win a medal.

Tada: The track and field athletes representing Japan will be selected in June, with the selection standards for the 100 m being a running time of less than 10.05 seconds and finishing within third place in the Japan National Championships. My current target is to satisfy the standards and to compete in the games as a runner representing Japan. If selected, I will strive to advance to the 100 m finals and win a medal in the 4 x 100 m relay.

Koike: Like Mr. Tada, I'm also aiming to compete in the Tokyo Olympic Games, but at the same time, I'm looking further into the future. I'd like to delight and astonish the audience and make them shout "Is this real?" by exceeding their expectations. I would also like to place expectations on my own results. I'll work hard to increase my level by setting my target to not only advance to the 100 m finals but also to go on further and win a medal.

Connect with Innovation

The Sumitomo Electric Group moves forward hand-in-hand
in its contribution to the development of society
by connecting with continuous innovation.

Sumitomo Electric
Athletics Club
Shuhei Tada

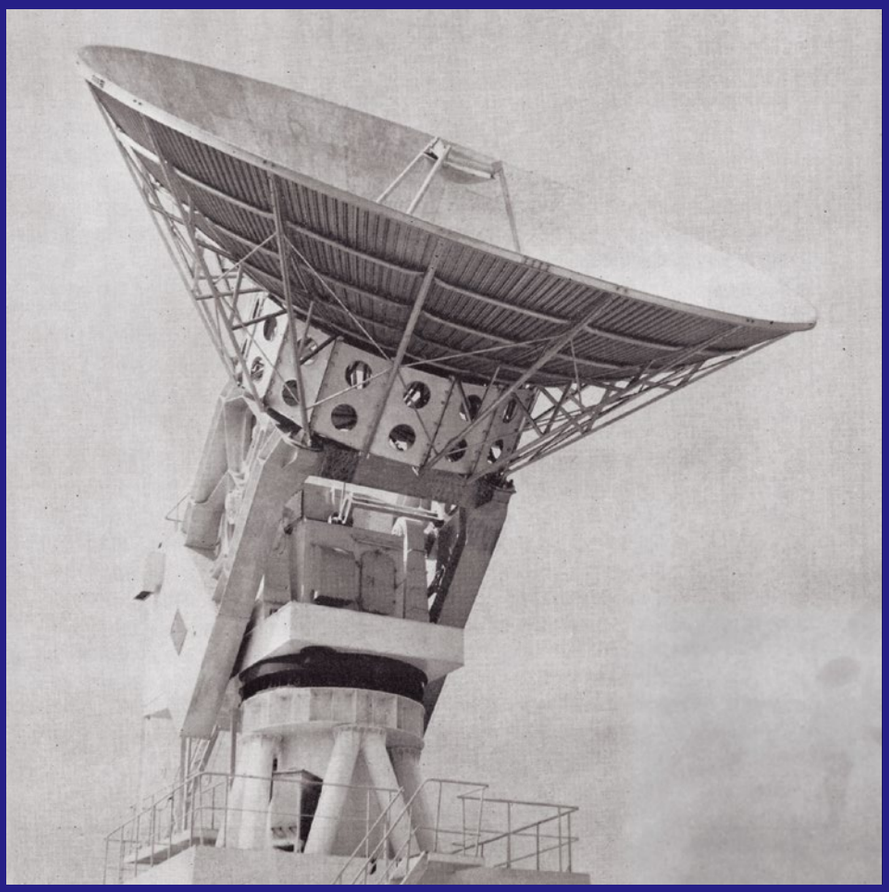
Sumitomo Electric
Athletics Club
Yuki Koike

住友電工
SUMITOMO ELECTRIC

A Picture of Sumitomo Electric in Those Days

1964

Adoption of Our Parabolic Antenna for a Syncom Satellite



Parabolic antenna for a Syncom satellite, installed in Kashima, Ibaraki Prefecture, to broadcast the Tokyo Olympic Games to the U.S.

Technology Underpinning the Excitement of the Tokyo Olympic Games

In 1964, the Olympic Games was held in Asia for the first time — the Tokyo Olympic Games. Preparation moved on at a rapid rate for the event, attracting much attention from around the world as the symbol of Japan's post-war restoration.

The preparation included the establishment of traffic infrastructures that were to underpin Japanese economic growth, such as the Olympic Road, the turnpike connecting the airport to the main stadium; Tokyo Monorail, the longest monorail at that time, connecting the airport to the city center; and Tokaido Shinkansen, the world's first high-speed railway. For constructing these facilities, our PC (prestressed concrete) steel bars and the Dywidag method*, which we were licensed to employ, were adopted, allowing us to manufacture products and to engage in the construction.

At that time, great expectation was placed on real-time dissemination of the drama and excitement of the Games throughout the world. Our parabolic antenna for a Syncom satellite was adopted as part of the antenna manufactured by NEC Corporation, helping realize the dreams and hopes of people all over the world — the first satellite telecast of the Olympic Games.

Sumitomo Electric supported the excitement of the Olympic Games behind the scenes with a wide variety of technologies and products.

* Dywidag method: Concrete bridge construction method developed by the German company Dyckerhoff & Widmann, and introduced into Japan in 1958 by Sumitomo Electric

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Information and videos not posted in this magazine are found on the "id" special site
https://global-sei.com/id/

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