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Based on New Automation, Aiming for Business Development
That Leads “In Series” to a Sustainable Society



Special Feature

The Possibilities of Biodegradable Plastics

A Potential Key to Solving the Problem of Ocean Trash

The Possibilities of Biodegradable Plastics



According to the United Nations Environment Programme's calculations, about 8 million tons of plastic are discarded annually and drift into the world's oceans, thus making it a worldwide problem. One possible solution is biodegradable plastic. We interviewed Professor Kenichi Kasuya of Gunma University about marine pollution and his research concerning the development of biodegradable plastics. The types of biodegradable materials he is developing are effective even in the deep ocean as well as the ocean floor, where there are particularly few enzymes to break down plastic.

Efforts by mainly developed countries to prevent marine pollution



Plastic was invented about 150 years ago as a durable, light, and inexpensive material; accordingly, it is used in various everyday applications. Although plastic is convenient, at least 8 million tons of plastic trash a year end up in the world's oceans. This causes serious problems, with as many as 700 species—including endangered species—becoming entangled in the refuse or injured by acci-

dentally ingesting it. Approximately 150 million tons of plastic trash are currently littering the world's oceans, accounting for about 92% of all ocean trash. Notably, according to a report at the World Economic Forum in Davos, the amount of trash will exceed the weight of all fish in the oceans by 2050. Plastic trash deteriorates when exposed to ultraviolet (UV) light as it drifts in the ocean and is broken down by wave action to become known as "microplastics," small plastic debris measuring 5 mm or less. In fact, the waters around Japan are called a "microplastic hotspot" because the region's density of microplastics is an order of magnitude greater than that of the world's major oceans. It has been pointed out that plankton and small fish may ingest this microplastic, thus leading to potential negative effects on the ecosystem through the food chain.

The Sustainable Development Goals* (SDGs) were adopted at a United Nations (UN) summit in 2015. One of the specific targets is defined as follows: "By 2025, prevent and sig-

nificantly reduce marine pollution of all kinds, particularly from land-based activities, including marine debris and nutrient pollution." Consequently, many countries and companies are making various efforts to prevent marine pollution caused by plastic trash.

Making organic recycling possible even where the ocean has few microorganisms



As part of these efforts, there is a movement to develop technology that will prevent plastic trash from remaining in oceans. Professor Kenichi Kasuya of Gunma University, who is engaged in research on biodegradable plastics that can be decomposed by microorganisms, is playing a part in this movement and says the following:

"In the past, decomposition using oxidants was the mainstream approach, but we discovered that this would actually lead to an increase in microplastics. Therefore, in recent years, especially in Europe, proposals have been made to use biodegradable plastics for products such as fishing gear that would be very difficult to col-



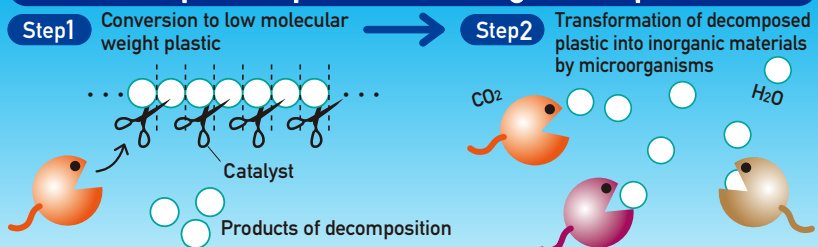
Kenichi Kasuya

Born in Hyogo Prefecture. Professor at the Faculty of Science and Technology, Gunma University. He graduated from the Faculty of Agriculture, Tohoku University in 1992 and received a doctorate in engineering at the Tokyo Institute of Technology in 1997. He has held his current position since 2010.

What is a biodegradable plastic?

It is plastic that can be decomposed by microorganisms. After decomposition, biodegradable plastics are turned into carbon dioxide and water, meaning that they do not require recovery or treatment. However, such plastics are more expensive to manufacture than existing ones and they lack the durability and functionality of current products. Furthermore, they also present the problem of being difficult to decompose in the ocean.

Decomposition process of biodegradable plastics



The plastic is decomposed by the catalyst substances produced by microorganisms and is converted to molecules that are small enough for the microorganisms to take into their bodies.

The decomposed plastic is converted to inorganic material via microbial metabolic activity.

Created with reference to illustrations provided by Gunma University



Nets that break during fishing drift into the ocean and become marine debris.

will happen, but when it sinks to the ocean floor and stays in contact with the ground for a certain period in a low ORP environment, it starts breaking down. Normally, biodegradable plastics have a decomposition rate of 90 days, but this plastic will almost completely decompose in just 30 days.”

Meanwhile, the biological trigger is based on the use of microorganisms. Special microorganisms that can decompose plastic into water and carbon dioxide are trapped in the plastic as spores in a dormant state. The plastic will not decompose even if used as a container, but it will do so when it becomes damaged after being discarded, as the microorganisms activate when exposed to air and water. This causes them to proliferate and decompose the plastic. Biodegradable plastic that had been scratched put into seawater also decomposed in about 30 days. Overcoming cost issues will allow it to be used in practical applications in the future.

“Biodegradable plastics alone cannot directly solve the problem of plastic trash in the oceans,” states Professor Kasuya. “To solve the problem, we must achieve the proper combination of reducing how much plastic products we discard into the environment and promoting organic recycling through biodegradable plastics. I believe in the potential of biodegradable plastics as one of the approaches to achieve this.”

lect and whose impact on the ecosystem would be extremely large if they end up in the ocean, and promote organic recycling through the action of microorganisms.”

Fishing gear accounts for about 10% of marine plastic waste and causes “ghost fishing,” which occurs when abandoned fishing gear entangles marine life and is a serious issue facing ecosystems.

“The barrier to using biodegradable plastics for general-purpose products is reduced strength and durability during use. For example, fishing nets are made of very strong materials, such as nylon, to withstand the weight of fish being lifted out of the water. In the future, we must make nets that can decompose easily if they break and drift into the ocean. Our highest priority in our research is how to achieve both strength and rapid decomposition.”

There is a need to design and develop a biodegradable plastic that could be used like a general-purpose product but which can also be organi-

cally recycled—even in parts of the ocean where there are few microorganisms. Given this, Professor Kasuya devised the concept of adding the triggers required for decomposition to the plastic itself.

Time-degradable plastics that react by the action of triggers

Professor Kasuya was the first researcher to have the idea of including triggers in biodegradable plastics. He developed a biodegradable plastic called “time-degradable plastic” whose initiation time and rate of degradation could be easily controlled by two triggers: a non-biological factor and a biological factor.

The non-biological trigger utilizes oxidation reduction potential (ORP), which indicates the abundance of enzymes in the water.

“We focused on the fact that, while ORP on land is -50 mV or more, in the mud on the ocean floor it is extremely low at -80 mV or less. We then designed a plastic whose molecular bonds would break down in an environment with a low ORP. Microbial decomposition is started by this mechanism as a trigger. When the net is simply lifted from the ocean or left floating in the ocean, nothing



Mineralization of decomposed products by microorganisms. It can be observed that agar film containing plastic powder has been decomposed around the microbial colony in the center of the dish.

The information in this article is accurate as of April 2019.

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Toward Sustainable Growth in a Post-Coronavirus World

Since the name change from Yamatake to Azbil in 2012, Azbil has carried out medium-term plans in two phases: the four years from 2013 to 2016 and the three years from 2017 to 2019. During that time the company strengthened business profitability and growth potential by improving the foundations for business. In June 2020, a change in management took place, which included a new chairman and new president. In a business environment that is changing drastically on a global scale, Azbil will strive to achieve further sustainable growth while building upon the foundations it has inherited.

Medium-term plans in two phases resulting in better profitability and business growth

Since its founding in 1906, Azbil Corporation has kept the vision inherited from its founder of freeing people from drudgery with the power of technology, and we have



Hirozumi Sone
Executive Chairperson
Azbil Corporation

developed automation technology based on the idea of solving problems in a people-centered way.

In 2006, our 100th anniversary, we established the Group philosophy: “To realize safety, comfort, and fulfillment in people’s lives and contribute to global environmental preservation through human-centered automation.” In 2012, we changed the company name from Yamatake to Azbil. In the same year, we established three fundamental policies for building up our foundations: being a long-term partner for the customer and the community by offering solutions based on our technologies and products; taking global operations to the next level by expansion into new regions and a qualitative change of focus; and being a corporate organization that never stops learning, so that it can continuously grow stronger. Based on these fundamental policies, various organizational reforms and profitability enhancement measures have been taken in each of the azbil Group’s three business pillars: building automation (BA), advanced automation (AA), and life automation (LA). We have suc-

ceeded in achieving stable growth while adapting to rapid changes in the business environment.

At the same time, the azbil Group set its long-term targets for fiscal year 2021: to become a top-class global corporate group that enhances the safety and security of its customers, helps to improve their corporate value, and helps to solve global environmental problems by putting people first and striving to bring about a world of automation created by human ingenuity and technology. We also established medium-term plans to be carried out in the two phases of 2013–2016 and 2017–2019. Additionally, we have been working to improve business structures to enhance profitability and business growth.

In particular, in the medium-term management plan for the three years from 2017 to 2019, we strengthened the three fundamental policies themselves as a challenge for further sustainable growth. Specifically, in order to solve problems at customers’ sites and to be a long-term partner for society and our customers, we decided to focus more on developing technology,

products, and services that include the Internet of Things (IoT) and AI. In addition, we decided to make qualitative changes overseas by developing solutions that include services like consulting, in addition to new products that meet the needs of our customers. Also, in order to flexibly respond to changes in the environment, we decided to further develop our policy of being a “corporate organization that never stops learning” by strengthening partnerships with customers and by human resource development activities that will accelerate our global expansion.

Strengthening of global foundations and setting up production, HR, and business continuity planning

In connection with these measures, we have made significant progress in establishing the foundations for global business development. Specifically, we established overseas subsidiaries and bases in more than 20 countries and regions to strengthen our service network and supply chain, and we established a three-pillar system for technological

development and production in Japan, Asia, and the West.

In Japan, with the Shonan Factory and the Fujisawa Technology Center (a base for technological development) together positioned as a “mother factory,” we are working to strengthen our global production system based on 4M innovation (man, machine, material, and method) and the three functions of creating, verifying, and leading. On the basis of this technology development and production system, products and services incorporating advanced IoT, AI, and cloud computing technology are being developed and produced one after another and delivered to customers.

By implementing the measures for sustainable growth described above, it has become possible for the azbil Group to deliver enhanced value to customers, and also to enhance business profitability.

In terms of the personnel who support the azbil Group’s business, we have actively promoted HR system improvements and optimal allocation of personnel in response to changes in the business environment. For ex-

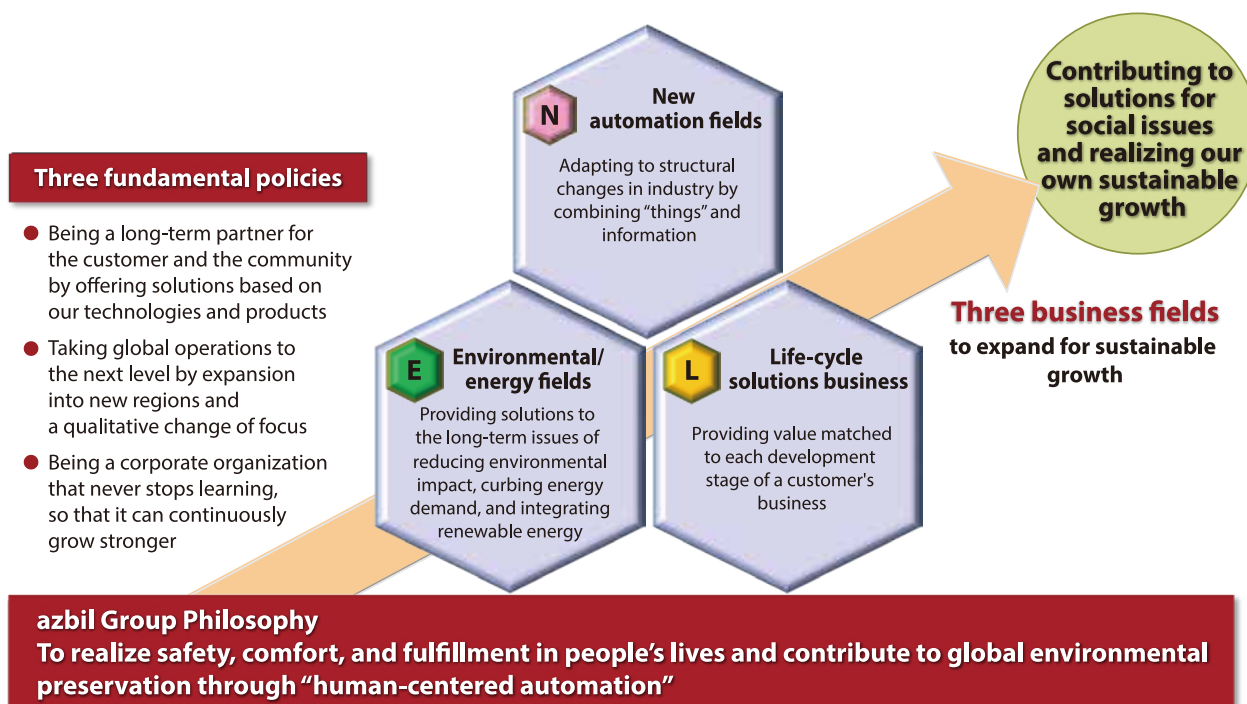


Kiyohiro Yamamoto

President and Group Chief Executive Officer
Azbil Corporation

ample, at the Azbil Academy, which promotes human resource development, by fostering and retraining employees who can adapt to technological innovation and market changes, and by increasing the transfers of the Group’s personnel, we are striving to put in place a system by which we can

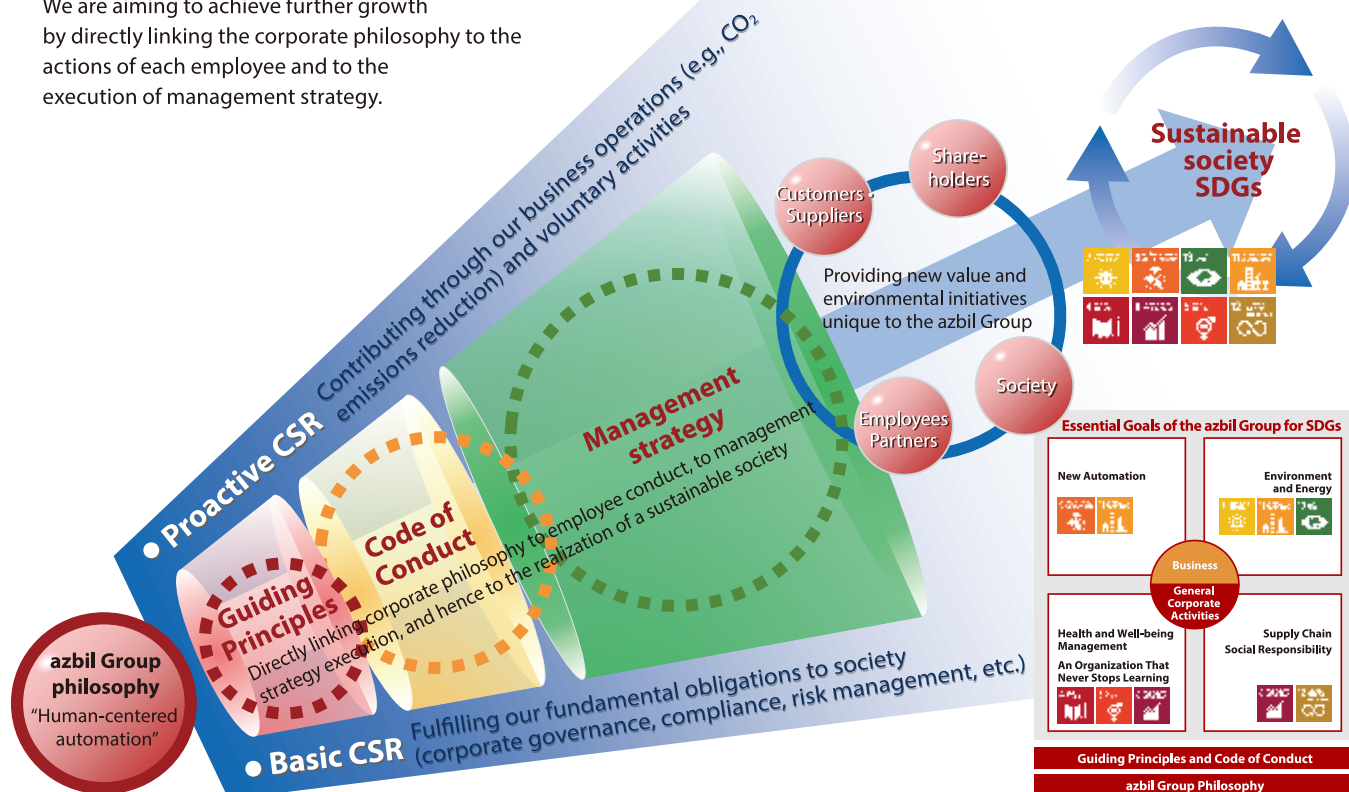
■ The azbil Group, the three fundamental policies, and expansion into three business areas



■ Business activities and growth contributing “in series” to a sustainable society

The azbil Group's Guiding Principles and Code of Conduct were renewed as a mechanism for sustainable growth.

We are aiming to achieve further growth by directly linking the corporate philosophy to the actions of each employee and to the execution of management strategy.



bring out the best in personnel in any business environment. In addition, as a part of our efforts, we are securing and fostering personnel who are skilled in international business to lead our overseas expansion, and we are promoting diversity.

Business continuity planning in preparation for natural disasters, pandemics, and other situations is an important matter. As disaster-prevention measures, in addition to improving our three-region R&D and production system, the azbil Group is working on seismic retrofitting of buildings, hazard inspections, stocking of emergency supplies, emergency communication infrastructure, education and training, etc. We are also building a solid financial base for uninterrupted provision of products and services to customers, securing inventory of

products and parts, and putting systems in place for personnel and production facilities.

At the same time, we have made steady progress in strengthening corporate governance rooted in CSR-focused management. With the aim of formulating the next long-term targets and improving the system for developing measures to achieve them, and in order to strengthen governance, the ratio of independent outside directors on the Board of Directors has been steadily increased, leading to the current composition of 5 out of 11.

Changes in people's lives and ways of working are driving demand for new automation

In this context, on February 28, 2020, a new president was announced to take over for Hirozumi

Sone, who has led the azbil Group since assuming the position of president and group chief executive officer in 2012. After approval and decision by the general meeting of shareholders on June 24 and by the Board of Directors, Kiyohiro Yamamoto, who served as executive vice president starting in April of this year, became president and group chief executive officer, and Mr. Sone became executive chairperson.

According to Mr. Yamamoto, "Under this new management, in a business environment that is changing drastically on a global scale, the azbil Group, while building upon the foundations it has inherited and holding fast to its accomplishments, will develop new measures for expansion in three areas. We will develop new automation opportunities, expand our

environment and energy businesses, and strengthen our life-cycle solutions business.”

The business environment for companies is expected to remain severe because worldwide economic activity is stagnating due to the spread of COVID-19. On the other hand, if we think about the medium- to long-term situation, we can expect new demand for automation to increase, so we think this is a great opportunity for the sustainable growth of the azbil Group.

Specifically, the spread of COVID-19 has brought about behavioral changes in people’s lives and in the ways they work, so that now working online and teleworking have become subjects of serious consideration by companies. To solve various problems under the current circumstances, the role of automation is becoming increasingly important, and we can expect the demand for the automation technology provided by the azbil Group to grow steadily.

Furthermore, advanced automation technology utilizing the IoT, AI, and cloud computing has a major role to play not only in dealing with the current coronavirus problem, but also with the declining birthrate and aging population, globalization, and changes in methods of working, which are constant challenges for companies and for society; not to mention climate change and various aging infrastructures, which are urgent issues for a sustainable society. There is no doubt that we can expect the role of automation to expand further.

For this reason, along with the new management structure, on April 1, 2020 the IT Solution Department was established. It reports directly to the company president, and has the aim of business expansion by developing new automation opportunities. The Cloud Operations Center has also been recently established. With these changes we will accelerate the application of IoT and AI technology, and the commercialization of cloud-based products, and strengthen the cloud-computing system for the entire azbil

Group.

Promoting digital transformation based on our abundant assets, and business development for a post-coronavirus world

The azbil Group’s advantages are the following: a large number of products and applications incorporating digital and other advanced technology, a system that provides high-quality engineering services at customers’ sites, and the accumulation, through many years of business, of a vast amount of data, enabling the aG to cultivate advanced know-how. By combining these abundant assets, which are unique to the azbil Group, we will promote digital transformation (DX) in order to provide customers with new value that has never existed before. In this way, we believe that azbil Group business development and growth can be expected.

An example of a solution for a post-coronavirus world is an air volume control system for hospitals and other medical institutions. By changing the pressure of a regular hospital room to negative pressure, the airflow can be controlled so that the outflow of viruses is prevented; and additionally by increasing the volume of ventilation, the room can quickly be converted to an infection isolation room.

With this solution, it is possible to secure the needed bed occupancy rate during normal times, avoiding the need for medical institutions to increase the cost for customers, while at the same time ensuring a safe environment for all medical staff.

The practice of the Group philosophy itself helps to realize a sustainable society

As stated in the beginning, providing safety, comfort, and fulfillment in people’s lives and helping to preserve the environment through human-centered automation is the philosophy of the azbil Group. When we strive to accomplish the Sustainable Development Goals

(SDGs)* of the United Nations in order to realize a sustainable society and solve the increasing problems faced by society worldwide, such as energy shortages, the burden on the environment, and widening economic disparities, what we are doing is putting our Group philosophy into practice.

Based on our relationship of trust with customers, our experience, and the knowledge that we have cultivated, we will carry out further product development and produce new types of automation by utilizing advanced technology. In this way, we will expand in the fields of environment and energy, and promote life-cycle solutions business, because business development in these areas is connected “in series” to a sustainable society.

In 2019, we significantly revised the Group’s guiding principles and code of conduct so that the azbil Group can achieve steady growth and make contributions that lead “in series” to a sustainable society. At the same time, the azbil Group’s own SDGs have been set. By making sure that each and every employee of the azbil Group is aware of the clear goal of a sustainable society, and that they comply with the new principles and standards, we will be ready to make further contributions to society and further increase corporate value.

“The impact of the coronavirus on the business environment is uncertain in the short term, and it seems that a continuing difficult situation can be expected,” says Mr. Sone, executive chairperson. “But the azbil Group, with its strengthened corporate structure and business foundations, and with thorough crisis management, will overcome this difficult situation. We will boldly tackle the problems brought about by changes in society and its values, and we will achieve solutions to the problems as well as the sustainable growth of the company.”

***► Sustainable Development Goals (SDGs)**

The Sustainable Development Goals are international goals for 2016–2030. They were adopted at a United Nations summit in 2015. Seventeen goals and 169 targets were established in order to achieve a sustainable, diverse, and inclusive society where no one will be left behind.

MEMS refers to ultra-compact devices or systems which integrate mechanical components like sensors and electronic circuits on a substrate such as silicon by applying microfabrication techniques based on the technology used in semiconductor manufacturing. MEMS are used to miniaturize equipment, save power, achieve high functionality, and reduce cost.

A variety of MEMS are at work inside various devices

Smartphones are now an indispensable tool for our daily lives. Making a phone call, getting various types of information from the Internet, enjoying music, movies, and games, and knowing where you are—life without a smartphone is now difficult to imagine.

It is thanks to microelectromechanical systems inside the case of the smartphone that it can provide such a variety of functions. Since MEMS refers to various devices or systems such as sensors that incorporate microscopic electrical and mechanical elements on one chip, they are sometimes called microsystems or micromachines.

Taking smartphone functions as an example, magnetic sensors and pressure sensors are used in addition to GPS sensors to detect location, and an accelerometer is used for the function that rotates the screen automatically when the orientation of the smartphone is changed. Also, an ambient light sensor automatically adjusts the screen brightness according to the amount of light in the environment. In addition to these sensors, devices such as ultra-small microphones and speakers built into smartphones are also a type of MEMS.

Of course, the smartphones mentioned here are just one example of MEMS-incorporated products. MEMS are built into a wide range of devices such as automobiles, printers, video equipment, health-related equipment and other consumer products, air conditioning equipment used in office buildings, manufacturing equipment operating in factories, etc. They make an enormous contribution to people's lives and to industrial activity in virtually every situation.

Born of microfabrication technology utilized in semiconductor manufacturing

Generally in MEMS, electrical elements and mechanical elements—specifically, sensors, actuators, and electronic circuits—are integrated on one chip. Various microfabrication and laser processing technologies used in semiconductor manufacturing have played an important role in the development of MEMS up to this point.

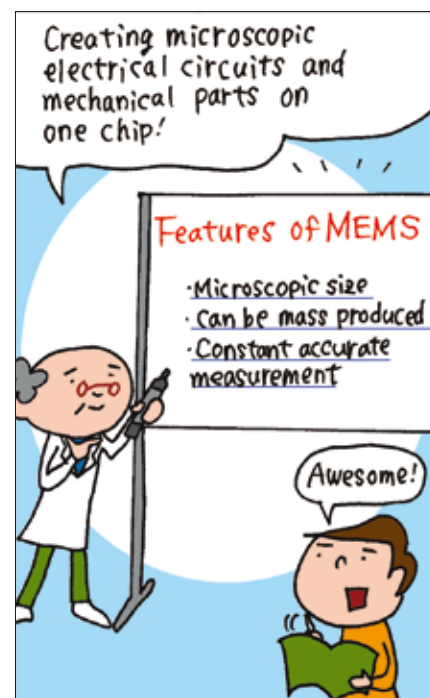
For example, so far semiconductor integrated circuits have had a two-dimensional structure, and to manufacture them for improved performance and reduced power consumption, the circuit line width has been progressively reduced in order to fit more transistors into smaller circuits. As a result, microfabrication technology on the order of a micrometer (1 millionth of a meter) has been realized, making it possible to create MEMS with a three-dimensional structure with complex and advanced mechanical properties.

Also, the silicon chip itself, which has been used in semiconductor integrated circuits, has also become an important element for making MEMS. Normally, extremely high-purity silicon with a single-crystal structure is used for semiconductors. Silicon crystals are much more stable than other material such as iron, and they are suitable for controlling electrical characteristics. In addition, silicon is easy to process in three dimensions, which is a great advantage for MEMS manufacturing. The presence of silicon, which is an excellent substrate material, is one of the driving forces behind the invention of microelectromechanical systems and their subsequent development.

In addition to silicon, materials such as sapphire, ceramics, and glass have

been used as the substrate for MEMS. For example, since sapphire has excellent heat and corrosion resistance, it is used in the MEMS incorporated into industrial equipment, and its expanded use for various applications can be expected.

Various devices that add color to your life, such as smartphones, automobiles, and home appliances, have been developing at an accelerating pace against the backdrop of digital technology innovation, providing us with new value such as greater convenience, comfort, and enjoyment. This kind of progress is possible thanks to the existence of MEMS working quietly inside digital devices. As a kind of “unsung hero,” microelectromechanical systems, which contribute to our daily lives and social activities, are continuing to shrink in size. We are really looking forward to what the future holds!



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