

## Technologies

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### Message from the Director of Corporate Technology & Business Development Unit

We are actively working to strengthen the foundation for research and development, aiming to ensure sustainable growth over the next 10 to 20 years.

Aiming to expand the range of new technologies further to ensure the “seeds first” principle is delivered

In recent years, it is increasingly said that the outlook for the electronics market is uncertain. Last year, the U.S.-China trade friction had a significant impact, and this year, the spread of COVID-19 has thrown the market into confusion. For example, although major trends, such as introduction of 5G (fifth-generation mobile communication system) and electrification and automation of vehicles, have emerged, it is still not necessarily clear when demand stimulated by such trends may increase in earnest.

Looking back, we remember the times when miniaturization was the keyword in the electronics component industry. Everyone was pursuing it and knew what had to be done. Currently, by contrast, we are facing the requirement to enhance and diversify technology.

At the same time, there is the issue of the emergence of destructive technologies amid advances in technological innovation. Today's market has an aspect where no one knows who may initiate what and when against the background of innovation. This has become a risk when thinking about business.

What does Murata do in the face of such a situation? The company has a framework in place that allows it to respond precisely without floundering to whatever may happen, as it has an ample range of new technologies supported by its solid foundation of research and development. We are confident that no one else in the world can beat us on this point. It is my conviction that we can answer customer needs only if we have a wealth of technology seeds in the company. We are thus working to bolster initiatives on the belief that research and development toward “seeds first” is key.

Accelerating efforts to build a materials cluster to form the foundation for a competitive advantage, going beyond the boundaries of ceramics

In the past, Murata pursued unique ways of monozukuri (manufacturing) as the “Murata of ceramics.” Today, however, we are accelerating research and development efforts on materials other than ceramics.

This involves development of technologies that may reject the value of ceramics. As an example, it becomes possible to completely eliminate electricity transmission losses by embedding capacitors directly below a semiconductor chip, but we do not necessarily have to insist on using ceramics. This technology could emerge over the medium to long term as a threat to the multilayer ceramic capacitor, Murata's mainstay product. However, we are fearlessly working on its research and development, seeing it as an innovation. In the meantime, we continue to take challenges in our endeavor to establish technologies for the next generation that cannot be replicated by competitors.

At Murata, efforts to bring about innovation did not start just today or yesterday. As Akira Murata, our founder, once said, “good electronic equipment starts with good electronic components and good electronic components starts with good materials.” Materials technology has been, and will be, what Murata must attach the greatest importance to.

In recent years, our focus is particularly on building up a cluster of new materials. In the past, Murata's strength was mainly in the area of ceramics. But we have commercialized a group of products that use materials other than ceramics, including SAW filters and MetroCirc™, using an “effusion” approach in which a technological field is expanded gradually.

Furthermore, with a view to the future, there is a materials cluster for which we are working on research and development in a clear departure from ceramics. This includes glass-based materials, metal magnetic powder, and high-performance resin materials.

These are areas we are working on, aiming to make them blossom in 10 years. We have already identified promising materials, and have focused efforts on developing basic technologies, aiming to construct an integrated production system encompassing source materials to products, just as we have done.

### **We are promoting Murata-style open innovation, carrying out technology scouting.**

In addition to the pursuit of departure from the “Murata of ceramics,” another new policy in research and development is a shift away from the focus on in-house technology, which brought success to Murata in the past. Needless to say, it remains important for each department to develop technology in secrecy, but we have entered an age in which it is essential to take advantage of external resources in the aspect of innovation. For this, Murata has stepped up efforts on open innovation in a style unique to Murata.

Our new business creation department is focused on developing human resources that can identify innovative technologies outside the company. We are scouting across the globe for innovative technologies that make us say, “This is it!” through these members.

In recent years, Murata has organized technology proposition meeting in regions where rivals have yet to set up operation, including Eastern Europe, as part of efforts to scout for prominent local talent. In the Middle Eastern country of Israel, we had a similar initiative earlier, built relationships of trust, and are beginning to see achievements.

In such endeavors, we attach importance to accumulating elemental technologies and establishing production processes, including development of equipment, rather than relying entirely on external technologies. By doing so, we aim to build competitive advantages that cannot be replicated by our competitors in the age of open innovation. We believe this will help Murata greatly exert its comprehensive abilities, which encompass processes from creating products from elemental technologies to installing them in the customer’s circuits.

### **Aiming to create “solution business” through collaboration with external entities**

One of the major challenges over a medium to long term in research and development is to build a “solution business,” or a business model in the service field. We aim to provide solutions that address issues faced by society, using the seeds that we have developed through research and development of hardware, such as components and modules, as the foundation and combining software and communication networks with them. This is a way to create businesses for achieving the next generation of growth only Murata, which achieved remarkable success in electronic components, can realize.

It has been five years since we launched this initiative, which has given birth to a series of innovative technologies. One such technology is PIECLEX, a plant-derived fiber we developed jointly with Teijin Frontier Co., Ltd. It is the world’s first fabric with antimicrobial performance through the power of electricity. Using piezoelectric technology, a Murata specialty, the product realizes antimicrobial and deodorizing performance by converting expansion and contraction of fibers caused by bodily motions into electricity.

Murata’s goal goes beyond just creating PIECLEX. We envision a technology in which a sheet is formed using the fibers and used as a wearable device worn on the body, so that very weak signals produced by muscles can be collected and analyzed, using sensor technology, another of Murata’s specialties. The data can be used in the healthcare field, for example, for preventing locomotive syndrome. We have already launched a joint project with a Japanese local government that is expected to contribute to promoting the health of the elderly and, ultimately, reducing medical costs.

In India, we have launched a project in which we utilize a sensor that can visualize soil conditions to improve the farming environment. In the future, we plan to take advantage of Murata’s unique sensing and wireless technologies to help solve issues faced by society, including those targeted by the United Nations SDGs, through joint research projects with research entities around the world.

In terms of sensing technology, we have begun testing an “emotion and stress analysis service” for manufacturing workplaces, using our wearable device to collect biological information, in a joint project with an overseas startup and other partners. Through this technology, we hope to contribute to improving employee health in the workplace.

In addition, we have developed a technology to detect the influenza virus at an earlier stage by using a field-effect transistor (FET) biosensor that uses graphene, a new carbon material in a joint industry-academia team including university researchers.

Thus, research and development efforts to create a solution business are under way at Murata at a rapid pace. The business is aimed at offering solutions for issues to be faced by a future society. Through this, our objective is to construct a business model as a service. We aim to build a pillar for a new business, aiming to support the company’s sustainable growth, taking advantage of the solid business foundation we have established through the development of components and module technologies.

Going forward, Murata aims to create new markets and innovations by developing technologies and products in anticipation of the future, in order to shape the future of electronics. For that, I would like to ask our stakeholders for continued support.