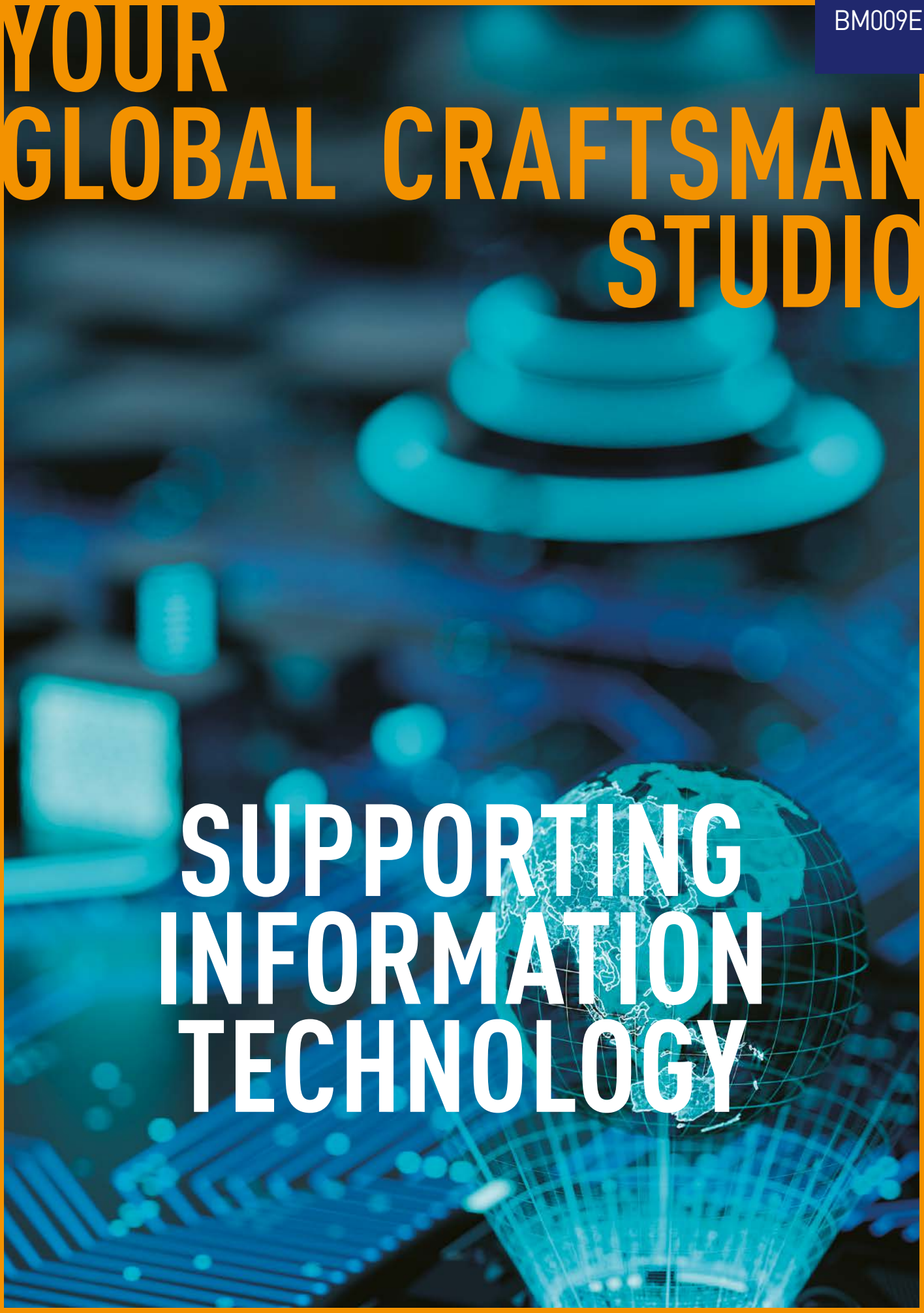
Mitsubishi Materials Craftsmanship Magazine

BM009E

YOUR GLOBAL CRAFTSMAN STUDIO



SUPPORTING INFORMATION TECHNOLOGY

Vol. 9 Stories

Don’t forget that we are craftsmen selling tools

When I visited a customer for the first time as a part of my training just after joining Mitsubishi Materials Corporation, one of my senior co-workers said “Do not forget that we are craftsmen selling tools.” I have been working in the cemented carbide tool business since joining the company more than 30 years ago, and I still keep these words in my mind.

The tools that we develop are essential to the manufacture of the components that our customers produce. These words have always served as a continuous reminder of our mission in society, which is to deliver tools with high quality and performance, to ensure that customers can achieve the productivity and quality necessary to compete and win in their markets.

Our tools are used by customers all around the world. The first product delivered to global markets back in the late 1980s was our highly-regarded CVD coated inserts. Mitsubishi Materials made its full entry into overseas markets in the late 1980s, and the articles in this feature highlight the significant evolution of our technology along with entry into these important markets. For the very latest CVD inserts, please check the MC6100 series introduced in this feature. Since the 1960’s, we have continued for over half a century to innovate as craftsmen and assist customers seeking cutting-edge technology; this feature showcases our commitment to being the best craftsmen partners we can be for our customers.

As craftsmen, we provide more than just tools to customers. As Your Global Craftsman Studio shows in the title of this magazine, we aim to provide something more. One example of this is the Mitsubishi Materials Intelligent Cutting Test System (MICS) included near the end of this issue. We are highly confident that MICS will contribute to customers in manufacturing as a great new tool that digitally connects our machining technology with the machining processes of our customers.

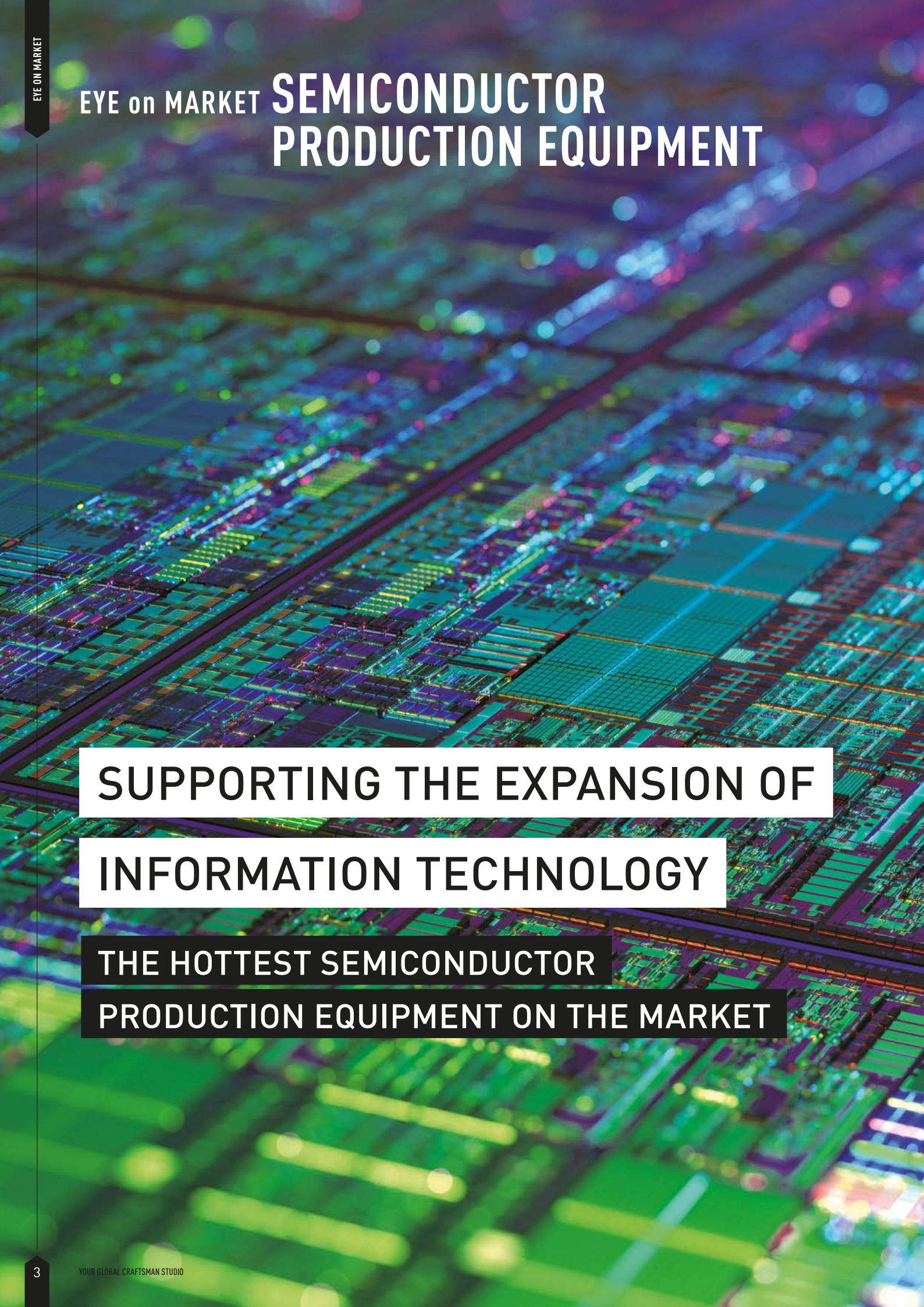
The manufacturing industry has also been exposed to the waves of change along with a wide range of technical innovations and social conditions that continue to rapidly evolve. Mitsubishi Materials continues to move forward with a keen awareness of our responsibility to create “something that does not change,” in other words, the concept of always creating “more sophisticated and advanced manufacturing” for customers. We look forward to your continuing support and cooperation as we continue to develop products that give you the edge.

Kazuo Ohara
General Manager,
Business Strategy Department

Metalworking Solutions Company
Mitsubishi Materials Corporation

YOUR GLOBAL CRAFTSMAN STUDIO

EYE on MARKET SEMICONDUCTOR PRODUCTION EQUIPMENT



SUPPORTING THE EXPANSION OF INFORMATION TECHNOLOGY

THE HOTTEST SEMICONDUCTOR PRODUCTION EQUIPMENT ON THE MARKET

Semiconductors as the foundation of industry and society
Supported by semiconductor production equipment

Japan was once the world's top producer of semiconductors

The majority of Japan-made semiconductors in the 1980s were DRAM, which accounted for 50 % of the world's share. However, following economic conflict between the United States and Japan over trade in semiconductors*1, Japan delayed shifting to logic semiconductors and surrendered the leading seat to manufacturers in other countries such as Intel Corporation (United States), TSMC (Taiwan), and Samsung Electronics Co., Ltd. (Korea) (Fig.1).

Japan currently produces logic and power semiconductors called legacy semiconductors whose line width is between 28 and 130 nm *2 although current production sites were reorganized through international alliances, etc.

In terms of leading-edge semiconductors, production of high-end circuit patterns with line widths of 5 to 16 nm for smartphones, DC*3, and 5G have rapidly grown due to global digitalization. Demand for middle-range semiconductors with line widths of from 20 to 40 nm has also expanded globally due to the increase in production of automobiles, industrial machinery and home appliances. This has the effect of accelerating technical innovation and the enhancement of production capability through national strategies for the stable supply of semiconductors. Japan has also implemented measures that prioritize semiconductor industries to compensate for the last 30 years.

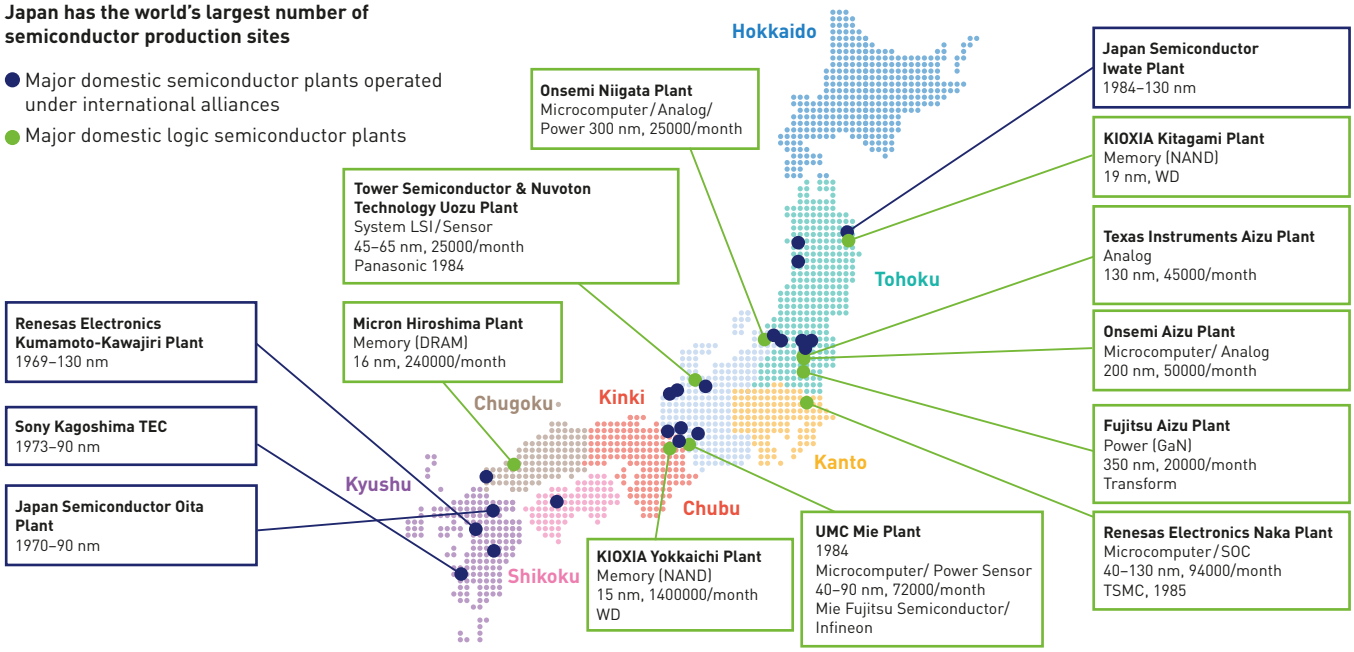
Semiconductor production equipment (SPE) essential for the manufacture of leading-edge semiconductors

While the production of semiconductors has been dominated by countries overseas, Japanese semiconductor production equipment (SPE) has maintained world-class quality through the accumulation of technological improvement and has been employed as the essential component for high-end ultra-precision semiconductor manufacture with production exceeding 30 % of the global share. The Semiconductor Equipment Association of Japan (SEAJ) predicted that SPE sales in FY2021 will mark a record high exceeding 3.3 trillion yen, an increase of 40 % from the previous year. This shows that Japan-made semiconductors have extremely high quality.

* Note 1: In the 1980s, the United States complained that prices of semiconductors made in Japan violated anti-dumping laws. In September 1986, the U.S.-Japan Semiconductor Agreement was signed to address the issue.
* Note 2: 1 nm equals 1/1 billionth of a meter.
* Note 3: The Data Center specializes in the operation of a wide variety of computers and devices for data communication.

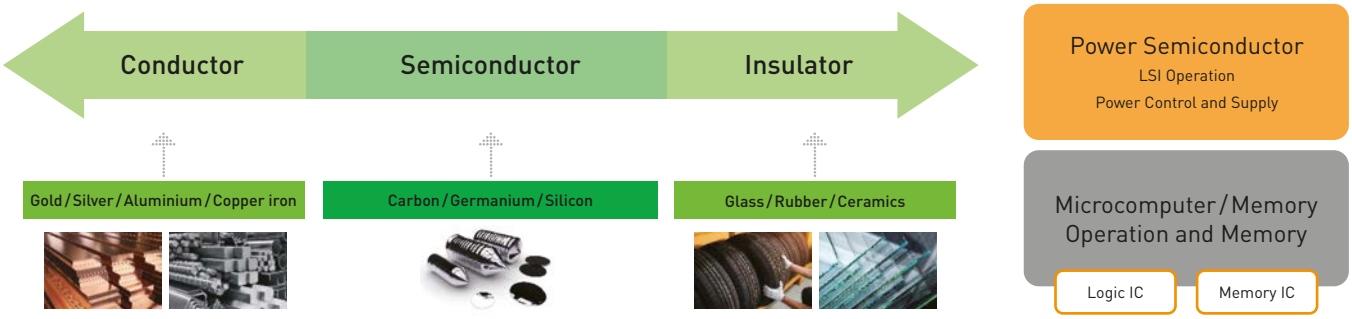
Japan has the world's largest number of semiconductor production sites

- Major domestic semiconductor plants operated under international alliances
- Major domestic logic semiconductor plants



[Fig.1 World's largest number of semiconductor production bases established in Japan]

Source: Map created by Mitsubishi Materials Corporation based on the METI Semiconductor Strategy data



[Fig.2 Power Semiconductors / Logic / Memory]

EYE on MARKET SEMICONDUCTOR PRODUCTION EQUIPMENT

Semiconductor manufacturing process (Front-end Process) and equipment

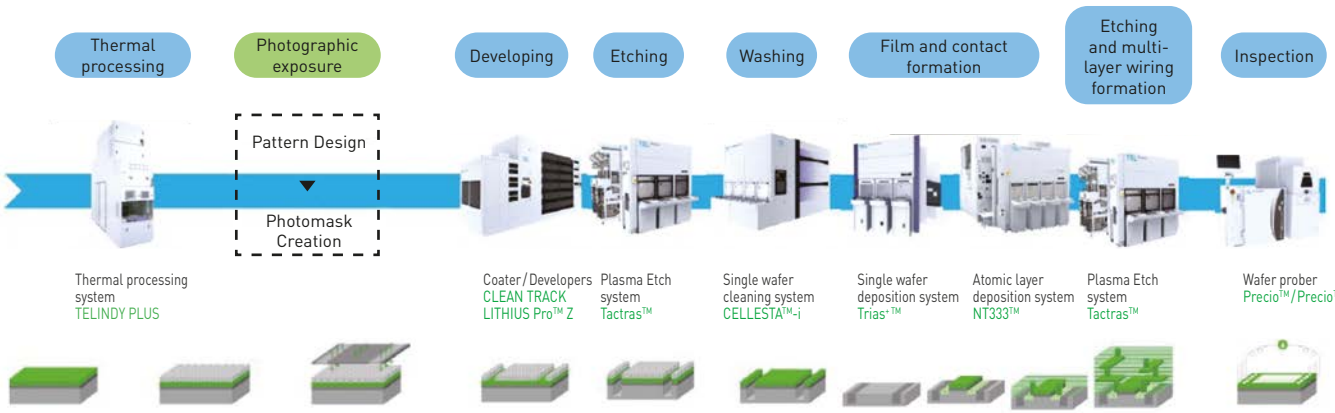
Semiconductor manufacturing is largely classified into the front-end process, in which circuits are formed on the surface of a wafer, and the back-end process, which include cutting of the wafer into chips, then inspection and packaging.

In the front-end process, similar to the principles of photography, the circuit pattern is projected onto the wafer using lithography technology and insulators and semiconductors are partially processed through repeated etching and deposition. Improving the yield rate is important for competitiveness, and this requires high-clean environment and ultra-precision and high-performance operations, therefore highly reliable Japanese semiconductor production and inspection equipment are broadly used (Fig. 3).

Coating equipment (global share: 90 %), CVD equipment (global share: 30 %), and etching equipment (global share: 30 %) in particular show the technical capability of Japanese made equipment.

A large number of chemical agents are used in vacuum in the front-end process because they must be highly heat and corrosion resistant.

Parts are made of a wide range of materials, from general materials such as aluminium alloy, stainless steel and FCD through to Inconel, Kovar and other difficult-to-cut materials such as ceramics, single crystal silicon, silicon carbide, quartz glass and other hard brittle materials.

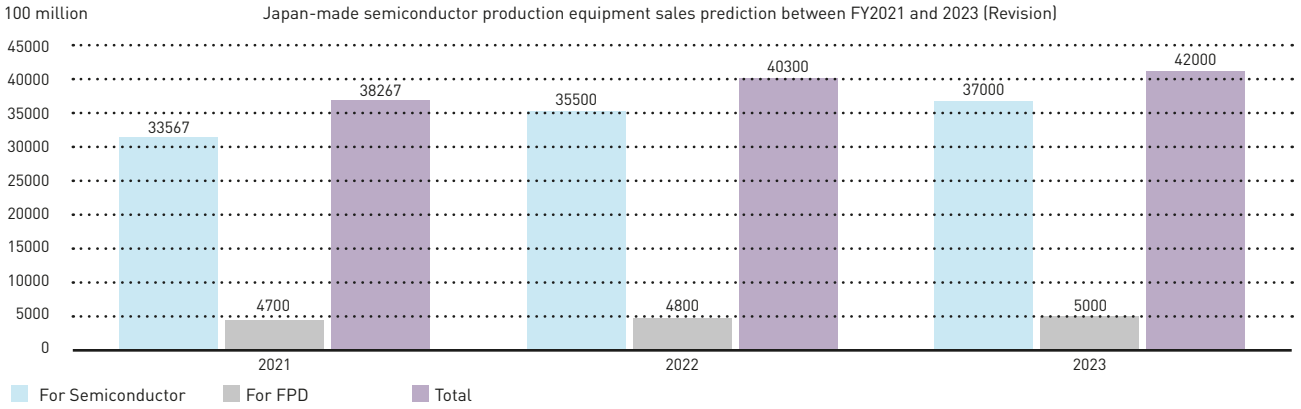


[Fig. 3 Semiconductor manufacturing (Front-end Process) and equipment]
Source: Created by Mitsubishi Materials Corporation with permission from Tokyo Electron Ltd. to use materials posted on their official website. (https://www.tel.co.jp/)

Product line-up responding to a wide variety of work materials

Mitsubishi Materials has a wide variety of products designed to machine a broad range of applications using accumulated materials and forming technology. The MP9 insert series for difficult-to-cut materials, the AXD cutter series for aluminium alloy and difficult-to-cut material machining, the DC drill for hard brittle material machining and the DF solid end mill series in particular have been highly regarded by a wide range of customers.

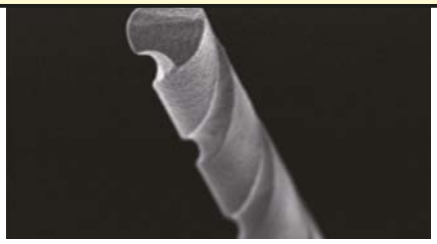
We continue to deliver a product line-up that achieves high-performance and high-efficiency machining of aluminium and other non-ferrous metals and difficult-to-cut materials.

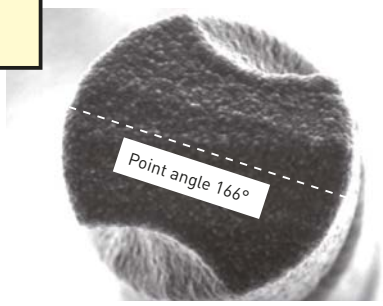


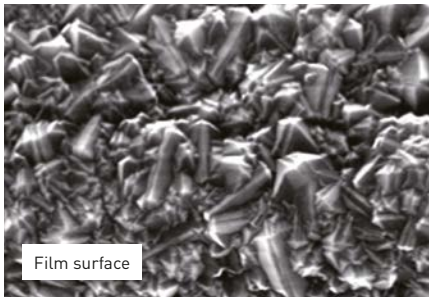
[Fig 4. Japan-made Semiconductor Production Equipment Sales Prediction between FY2021 and 2023]
*Source: Data released in SEAJ Newspaper/Graph is created by Mitsubishi Materials Corporation

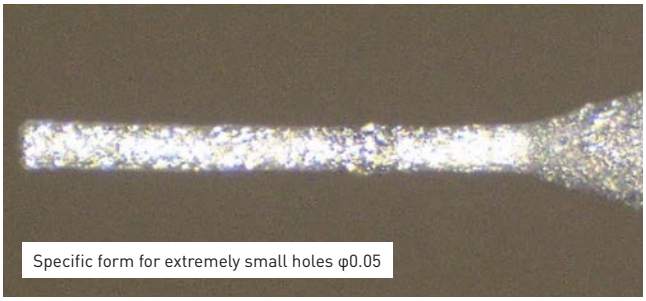
Product Line-ups

DC Drill for hard brittle material machining



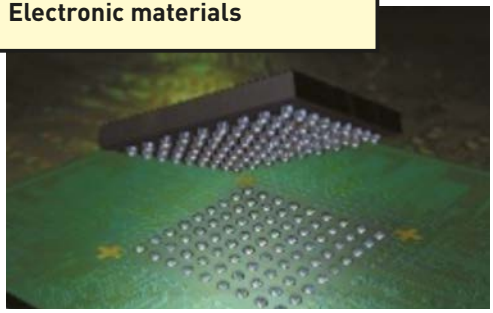






AXD Cutter series for aluminium alloy machining

Electronic materials



Speed and innovation

Sales of Japanese semiconductor production equipment is predicted to continue breaking records every year until FY2023 (Fig. 4). In addition, the Japanese government decided to support enticement of TSMC for the manufacture of leading-edge semiconductors (22-28 nm) and construction of new plants in Kumamoto. The government also decided to support the repair and expansion of legacy semiconductor manufacturing bases. Government support for semiconductor manufacturing that prioritizes economic security serves as a tailwind that expands the demand for semiconductor production equipment.

Mitsubishi Materials manufactures production equipment parts and materials such as silicon products and plating solutions for the back-end process and can promptly respond to requests from equipment manufacturers.

In other words, Mitsubishi Materials is the only manufacturer in the world capable of not only commercializing parts and materials, but also providing machining solutions by synchronizing machining technology from the research and development stage for new materials.

From now onwards, we need to advance technical innovation, including minimizing the line width of semiconductor production equipment (5 nm or smaller), and by responding to carbon neutral and saving energy to keep pace with the development of increasingly difficult-to-cut materials.

Mitsubishi Materials fully exercise company-wide synergy and use our world-wide networks for crucial business growth of equipment manufacturers and parts processing companies, focusing on speed and innovation.

Special Feature | Support the development of information technology with our products.

MELCO JAPAN CO., LTD.

(MARUMORI TOWN, IGU COUNTY, MIYAGI PREFECTURE)

A LARGE VACUUM CHAMBER MANUFACTURER WITH A HIGH TECHNICAL CAPABILITY IS ACHIEVING REMARKABLE GROWTH WITH AGGRESSIVE CAPITAL INVESTMENT REACHING 10 BILLION YEN OVER THE PAST 30 YEARS.

Manufacturing large vacuum chambers by implementing large equipment

Masuyuki Kurita
Chairman, Melco Japan Co., Ltd.d.

In the manufacture of semiconductor wafers, liquid and organic EL panels, it is essential to have a chamber (container) to create the vacuum environment required to prevent contamination by air, gas, steam, fine particles or other foreign substances. Melco Japan in Miyagi Prefecture has the largest market share of large-size vacuum chambers in Japan.

Masuyuki Kurita, Chairman of Melco Japan, founded Kurita Special Steel Corporation in Hitachi City, Ibaraki Prefecture in 1960. The company sold press mould materials and special steels. "My elder brother engaged in the wholesale of metallic materials in Tokyo, so I decided to start a business in a related industry. I could purchase materials from my brother's partner companies, which was beneficial in a start-up environment," he said. In response to the relocation of supplier's plant to the countryside soon after foundation, Kurita Special Steel Corporation also expanded its business to the countryside. The company established bases in the Northern Kanto and Tohoku Regions in locations such as Hitachinaka City in Ibaraki Prefecture, Iwaki City in Fukushima Prefecture, Sendai City, Kitagami City, Yamagata City to expand its sales networks. The company only had a single machine when it opened, but it gradually increased its range of equipment.

However, entering the 1980s, major special steel trading companies expanded their business to the countryside and this meant fierce competition started. Mr. Kurita knew he had to have something distinctive beyond special steels to survive in the industry, so he decided to handle stainless steels that were not commonly used at that time, he also felt that they had the potential for a broad range of applications in the future in such fields as industrial equipment and construction. His thinking was correct. Orders for stainless steels began increasing each year, prompting the company to establish storage space and logistic bases. The company built the Materials Stock and Machining Center in Marumori Town, Igu County, Miyagi Prefecture. The reason for choosing the town of Marumori was that the company could purchase a large tract of land to store a large inventory. The property was located almost at the centre of the business bases, which was very convenient for supplying materials.

A few years after the Marumori Plant started operation, a procurement manager of the partner company asked Melco Japan to accept outsourced work using five or six machines that the partner company would provide at a generous discount. Mr. Kurita jumped at the chance and secured a loan to purchase the machines for the Marumori Plant. Melco Japan handled simple work machining stainless steels for a while and their extremely accurate techniques and beautiful finishing became highly regarded and this led to an increase in cooperation with partner companies. After accepting the work of machining vacuum chambers, Melco Japan introduced welding equipment, hired new engineers and established the base of the current Marumori Plant.

The current Marumori Plant has an integrated manufacturing system, from stainless steel cutting, plate working, welding, machining and electropolishing through to sheet metal working. The plants' main feature is that it's equipped with many large machines. Mr. Kurita said, "We aren't manufacturing small products that other companies can also produce, but large vacuum chambers in the 10- to 20-ton range, and this has made Melco Japan a well-known name both at home and abroad. Our ability to supply products at all times, an ability supported by an approx. 8000-ton stainless-steel inventory, together with the technical capability of excellent craftsmen have helped us establish a trusting relationship with customers and grow our business."

In spite of such strengths, the Marumori Plant has focused on the manufacture of large vacuum chambers rather than small products and precision parts. They also encountered a huge gap between the peak and low demand seasons. In 2014, the company applied to the Subsidy Programme for New Business Establishment in the Areas Recovering from Tsunami and Nuclear Disaster towards Employment Creation (2nd) provided by the Ministry of Economy, Trade and Industry. In the following year, the company purchased property and built Seaside Plant I in Yamamoto Town, Watari County, Miyagi Prefecture for 2 billion yen. Then, applying to the same subsidy programme (8th) in March 2021, they built the 2nd plant for 2 billion yen. About half of the costs to build both plants were paid with the subsidies on condition that the company hired people from the local communities.

"Since the establishment of the Marumori Plant, we have invested about 10 billion yen over 30 years. The reason we could invest such a large amount of money is due to customer trust. We did not have manuals to manufacture large vacuum chambers. Our engineers gave exerted efforts to improve the technological capability by trial and error, and thereby accumulated our unique know-how."

We asked Mr. Kurita what he looks for in a tool manufacturer. He quickly answered, "A desirable tool manufacturer for me is the one capable of promptly supplying high quality at a low price." He continued with smile, "I'm hoping that Mitsubishi Materials will develop a wider range of tools suitable for machining a diverse range of stainless steel materials. Let's do it together."

Due to COVID-19, market demands have dropped slightly; however, Mr. Kurita predicts that a broad range of manufacturers will move forward with large-scale capital investment from now. "Along with increases in the size of car navigation screens and expanding energy-saving systems, demand for organic EL will certainly expand, and orders for vacuum chambers will likely grow. In addition, we think there is a good chance of receiving orders for vertical vacuum chambers developed by semiconductor production equipment manufacturers."

As the above demonstrates, Melco Japan is now enjoying favorable winds and Mr. Kurita is responding to the increase in demand for their products through aggressive capital investment. "Looking beyond the present, I would like to consider the company's environment and growth in five or ten years to continue capital investment to ensure the stability of the company for the next generation," he said enthusiastically. Looking young in spite of his 88 years, he is very energetic and always looking toward the future.

Precision Cleaning System for Large Chambers
Only owned by Melco Japan in Miyagi Prefecture

Yuki Izumi,
FMS Department, Seaside Plant,
Melco Japan Co., Ltd.

Yoshiya Ishizuka,
Manager, Seaside Plant, Melco Japan Co., Ltd.

Susumu Mito,
Production and Technology Department,
Seaside Plant, Melco Japan Co., Ltd.

Establishment of a flexible manufacturing system (FMS) that realises automation and unmanned operations

The Seaside Plant in Yamamoto town manufactures vacuum chambers, semiconductor production equipment parts, aircraft parts and components for nuclear power plant decommissioning equipment. Plant II, established in March 2021, has two lines, the MAZAK Line and the OKUMA Line. The MAZAK line has a flexible manufacturing system (FMS) for 24-hour automated and unmanned operation that connects four units of five-axis machining centres and unmanned pallets. When components are set on the pallets by an operator in the FMS, the machine automatically selects those to be worked on and conveys them to a machine tool for setting. After the materials are machined automatically according to the programme, they are returned to the pallet and the next machining cycle starts with the selection of the necessary materials.

"At plants like ours that are operated by a small number of people, automation is essential. Having employees operate machines during the daytime and implementing unmanned operation at night solves manpower shortages, reduces lead times and decreases human error," said Seaside Plant Manager Yoshiya Ishizuka. Hiroki Izumi of the FMS Department looked back on the difficulties they faced when designing the FMS line, and said, "Although we knew much less about conveyer systems than we did about machine tools, conveyer systems are extremely important for automation. Therefore, we learned the basics. The most difficult part was the use of multiple materials because it required more complex movements than transporting a single component. Also, because machines automatically determine the order of priority, we need an operator or a programme to adjust the order."

In addition to the FMS, the plant has implemented a wide range of innovations to improve efficiency. For the MAZAK machining centre, an IC tag is placed on the pull stud side of the main axis to manage tools. Originally, we wrote the type of tool, machining method and name of the responsible person on a sheet of paper when removing tools from tool magazines. Shifting to IC tag management reduced the time needed to document the information, and it also vastly reduced mistakes. The location of tools is now tracked by PC and the optimum tool/holder combination and other information can be shared among staff engaged in the machining process," said Mr. Izumi, emphasizing the merits of increasing work efficiency and reducing mistakes.

The Okuma Line consists of one large lathe and three machining centres. The Okuma portal machining centre can change spindles, which makes it possible to machine both stainless steel and aluminium. Machining aluminium requires high revolutions compared to stainless steels, so we set the max RPM at 10000 and increased the durability of the machine body.

Digitalizing the experience of veteran engineers to pass on to the next generation

The strength of Melco Japan does not reside merely in the power of its equipment, but also in the technological capabilities that have been so highly regarded by customers. Vacuum chambers need to have minimum gas leakage and permeation as well as occluded gas discharge as absolute requirements. Along with the improvement of high-precision liquid panels and semiconductor chips, quality checks by manufacturers have become increasingly stringent, therefore the strictest attention is paid to ensuring machining accuracy, airtight welding and that products are free of scratches. "Melco Japan has many experienced engineers capable of satisfying the tight range of dimensional tolerances in the machining required by customers. In addition, in terms of stainless-steel welding (TIG welding), our products are highly regarded because of their excellent airtightness along with the perfect finishing. For the final process of manufacturing, we have installed large precision cleaning tanks to ensure complete removal of all cutting oil on screw threads and in holes," said Plant Manager Ishizuka proudly.

Susumu Mito from the Production and Technology Department gave us an example of the high level of their machining accuracy. "We were asked to machine products to f6-class hole dimensional tolerance (-0.062 – 0.098) for Ø400. The customer was having difficulty finding a company that could handle the job, but Melco Japan decided to accept the order. Through basic discussion with engineers using drawings, we were able to manufacture

Adjustable Clean Room for Changes in Machining Environment

Machining Equipment for MAZAK


Inside the Flexible Manufacturing System (FMS)


Part used for Semiconductor Production Equipment

the product within the designated dimensional tolerance. Since then, we have continued to manufacture the product for others and we are proud to say that we have never had a single customer complaint," said Mr. Mito. However, even with such high accuracy, their products rarely have scratches. "We never reuse a machining method that has caused damage to products. For example, because spot milling caused damage when conducted after drilling, we changed the order and drilled holes after spot milling. As a result, we could prevent surface blemishes."

"Our task now is to pass down the technological capability of our experienced engineers to the next generation," said Mr. Ishizuka, Mr. Izumi, and Mr. Mito. "We are now digitalizing the experience of veteran engineers to avoid becoming dependent on subjective judgment. For example, when tightening with a clamp, we stay away from abstractions in our explanations by using specific values such as "45 degrees from this direction" to ensure every engineer can achieve the same accuracy," said Mr. Izumi as an example of their approach to cultivating young engineers.

Improving quality by prioritizing communication with cutting tool manufacturers

Melco Japan engineers prioritize communication with tool manufacturers. "For products that we are machining for the first time, we often consult with cutting tool manufacturers about the selection of tools and machining procedures," said Plant Manager Ishizuka. Mr. Izumi followed up by saying, "About the spot milling I mentioned before, I also received advice from Mr. Hiratsuka, Mitsubishi Materials Sales Division. Mr. Hiratsuka always replies promptly and is also quick to deliver tool samples to us, although cutting tool manufacturers are often reluctant to do so if they aren't sure yet that they'll be receiving an order. I feel comfortable and free to ask him about anything."

When asked what kind of tools people at production sites are looking for, Mr. Ishizuka, Mr. Izumi, and Mir. Mito answered without hesitation, "They have to be cost-effective and have a long tool life." "Tools provided by Mitsubishi Materials are slightly more expensive; but their quality is excellent, which improves productivity and durability, resulting in longer tool life and finally a better cost performance ratio. We would like to further increase our purchases," said Mr. Izumi. In response, Mr. Hiratsuka from the Sales Division said, "We recently delivered an AXD4000 cutter for machining aluminium alloys and difficult-to-cut materials. We first provided samples for the customer to compare on actual components, and this ultimately resulted in receiving the order." Plant Manager Ishizuka gave his impression about the delivered products, "The AXD4000 is expected to improve the machining processing rate and increase tool life by adopting helical machining." Mr. Shibata, in charge of technical support at Mitsubishi Materials said, "Reinforcing the partnership, we listen to Melco Japan's suggestions about products, which leads to new product development and improvement."

Mr. Ishizuka, Mr. Izumi, and Mr. Mito then finished up by telling us about what their focus will be in future manufacturing. "At present, we are advancing the construction of the fourth machining centre connected to the FMS, aiming to start operation next spring. We would like to continue machining during both day and night to improve productivity." (Mr. Ishizuka) "I was taught by my senior co-workers to assure customers that machining is absolutely possible with drawings alone. With the belief that everything with a shape can be processed, we strive to continue improving our techniques." (Mr. Mito) "Our current goal is to establish a 24-hour operation structure. Our chairman often reminds us to include the spirit of the Mitsubishi Materials Corporation in the design and manufacture of every product we produce to ensure that we always deliver the highest quality to our customers." (Mr. Izumi)

There are only a few companies, not just in Japan, but in the world, that handle the large amount of stainless-steel machining that Melco Japan does. Reinforcing this strength, Melco Japan will continue expanding its business from manufacturing vacuum chambers to parts for semiconductor production equipment and for aircraft parts.


Part of the Stainless-steel Inventory


Kiyoaki Shibata,
Assistant General Manager, Technical Sales Department, Sales Division, Mitsubishi Materials Corporation


Yasuhiko Hiratsuka,
Assitant to the Manager, Sendai Sales Office, Sales Division, Mitsubishi Materials Corporation

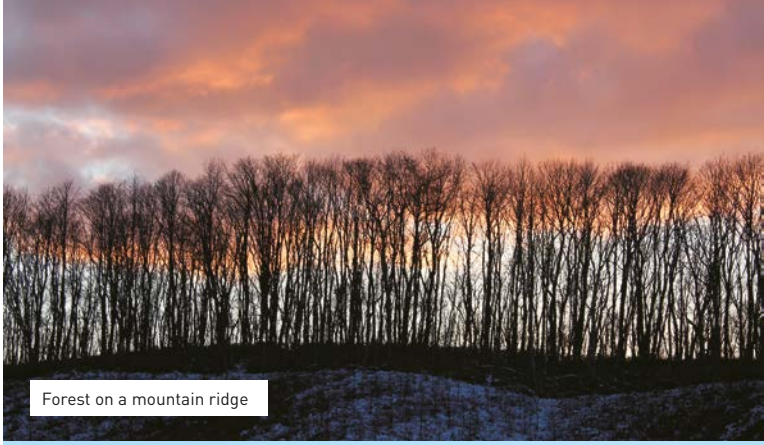
HISTORY OF MITSUBISHI

Vol. 9

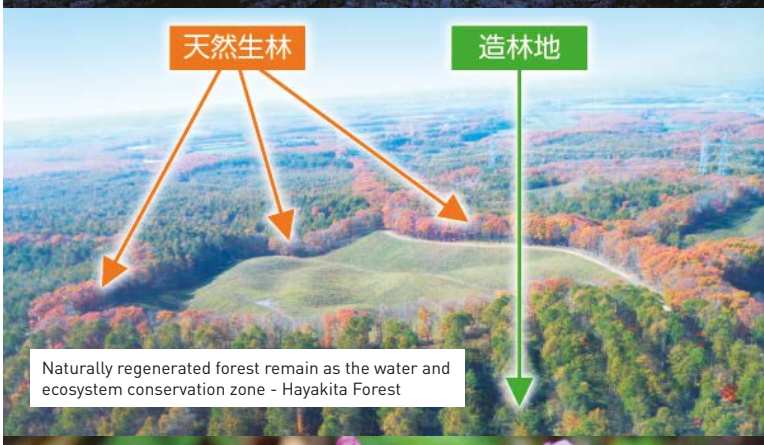
Contributing to communities and society through the maximization of public functions

Materials' Forests

Mitsubishi Shokai, the predecessor of Mitsubishi Materials Corporation, started purchasing forested land in Yoshioka, Okayama Prefecture in 1873, and continued its acquisition, mainly in Hokkaido, to become a major forest land owner with 14000 hectares (140 km^2) throughout Japan. The company's forests were originally purchased with the goal of supplying the pit props for tunnel supports in the company's mines. Along with the closure of mines in Japan, the role of such forest land changed significantly. This issue features what is happening with the materials in the forests, and the role of them.



Forest on a mountain ridge



Naturally regenerated forest remain as the water and ecosystem conservation zone - Hayakita Forest

Naturally-grown Japanese primroses

Maximizing the public functions of forests

Forests have many public functions. They produce timber, preserve the global environment and biodiversity through the absorption of carbon dioxide, prevent landslides and cultivate water sources. In order to fully and sustainably exploit such matters, we need to monitor the state of forests and ensure the correct appropriate management.

Forest lands owned by Mitsubishi Materials are spread throughout Japan. Therefore, the condition of the locations and the environment and the functions of each forest are different. Mitsubishi Materials classifies its forests into four zones and manages them in accordance with the functions to be enhanced in addition to the forest-specific management methods that are already in place.

Appropriate management of the forests

Mitsubishi Materials performs forest management by dividing the forests into four categories (zoning):

(1) Timber resource recycling zone: Sustainably producing lumber from needle-leaf forests.
(2) Water and ecosystem conservation zone: Maintaining the natural forest by watering and converting it into a natural forest if it was originally artificial and planted by man.
(3) Health and cultural usage zone: Creating a model forest and facilities for walking and other forms of forest recreation.
(4) Selective natural forest cutting: Producing useful broad-leaf trees in a sustainable manner by felling trees in naturally regenerated forests within a range not exceeding their growth

To maximize the functions required by each zone, we follow the management policy formulated for each, and strive to ensure beautiful forests that are rich in function under the slogan, " forests that will lead the way for other forests throughout Japan."

Contributing to society through the stable supply of timber

Mitsubishi Materials produces approximately 10000 m^3 of timber every year, mainly in timber resource recycling zones and selective natural forest cutting zones. The timber is supplied as a raw material for a variety of products, from building materials through to wooden biomass fuels. We thus contribute to building a recycling-oriented society.

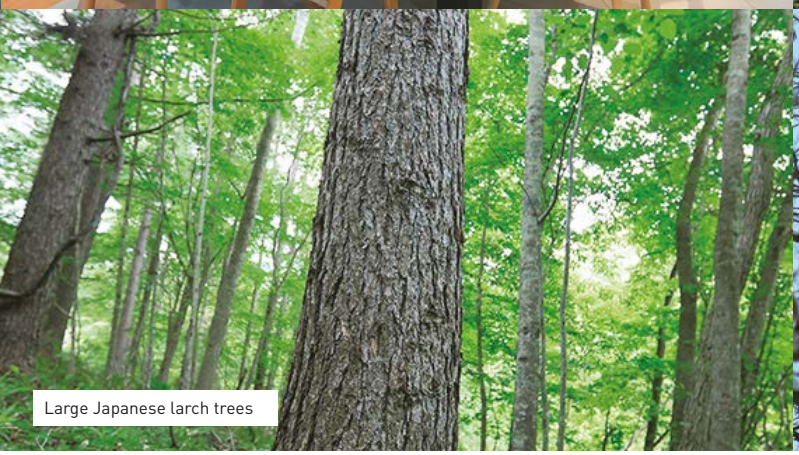
In timber resource recycling zones, where we manage artificial forests, the cycle of felling, planting and growing, thereby ensuring a sustainable, stable supply of lumber from needle-leaf trees such as cedar and Japanese larch. In addition, in selective natural forest cutting zones, we aim to achieve a sustainable supply of timber from broad-leaf trees. To do so, it is necessary to promote thinning and selective cutting within a range not exceeding their growth, as well as appropriate forest management. However, since natural forests have a wider variety of species of

Daily monitoring activities

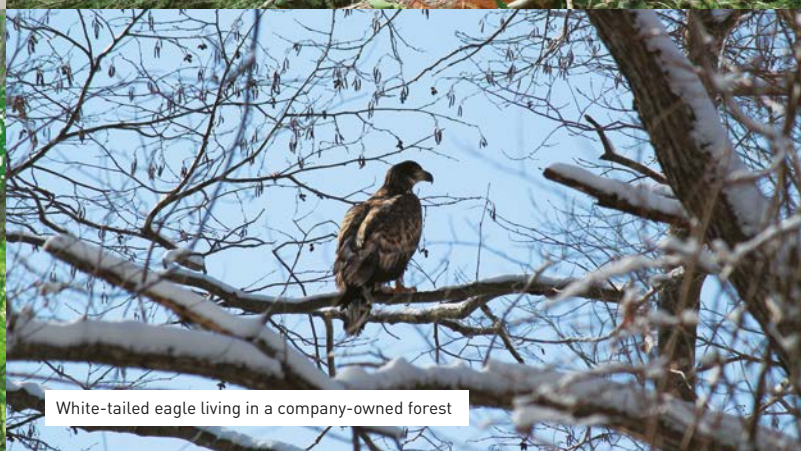
Timber from thinning to be supplied

Big table at the corporate cafeteria of the new head office

Forest development seminar with the participation of invited Swiss foresters



Large Japanese larch trees



White-tailed eagle living in a company-owned forest

trees compared with artificial forests, it is necessary to have a large knowledge and a broad range of skills to manage the entire range. Therefore, striving to improve knowledge and skill through initiatives such as inviting Swiss foresters with a wealth of knowledge on the management of natural forests to teach members of the team. As a part of the use of resources, timber from broad-leaf trees produced in our company-owned forests is used for the tables at the company head office.

Using company-owned forest lands where people in the community can interact with the wonders of nature

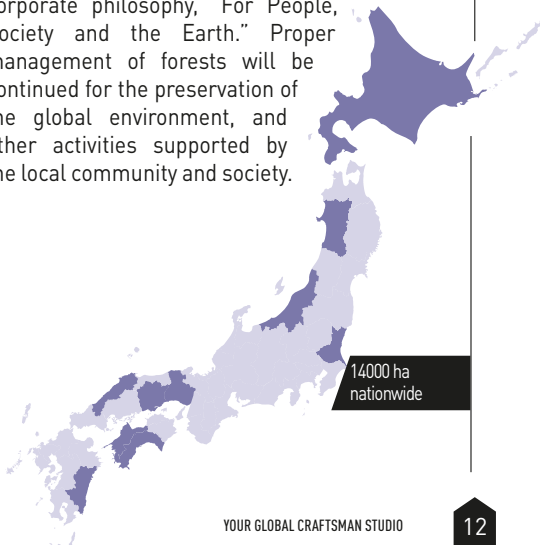
Forest lands owned by Mitsubishi Materials are open to the general public as forest recreation sites. These include the Citizens' Forest, a trail running course and a camping field. Through such activities, we contribute to society.

In addition, tree planting festivals are organised, tree growing festivals and other environmental events are held in the forests to highlight the value and fun that forests provide to visitors. Through these and other activities, we proactively reach out to local residents.

Being a company focused on sustainability and capable of fully exercising its public functions

Mitsubishi Materials performs forest management that maximizes a wide variety of public functions through the zoning of company-owned forestlands. On September 1, 2015, a forest certification was obtained under the new standards of the Sustainable Green Ecosystem Council (SGEC) for a total of nine forests in Hokkaido, including the Hayakita Forest.

Effective use of natural resources and business for society is based on our corporate philosophy, "For People, Society and the Earth." Proper management of forests will be continued for the preservation of the global environment, and other activities supported by the local community and society.



Craftsman Story

Vol.10

Kenichi Sato
Joined in 2012
Coating Development Section,
Materials Development Department,
Tsukuba Plant

Masakuni Takahashi
Joined in 1994
General Manager, Materials
Development Department,
Tsukuba Plant

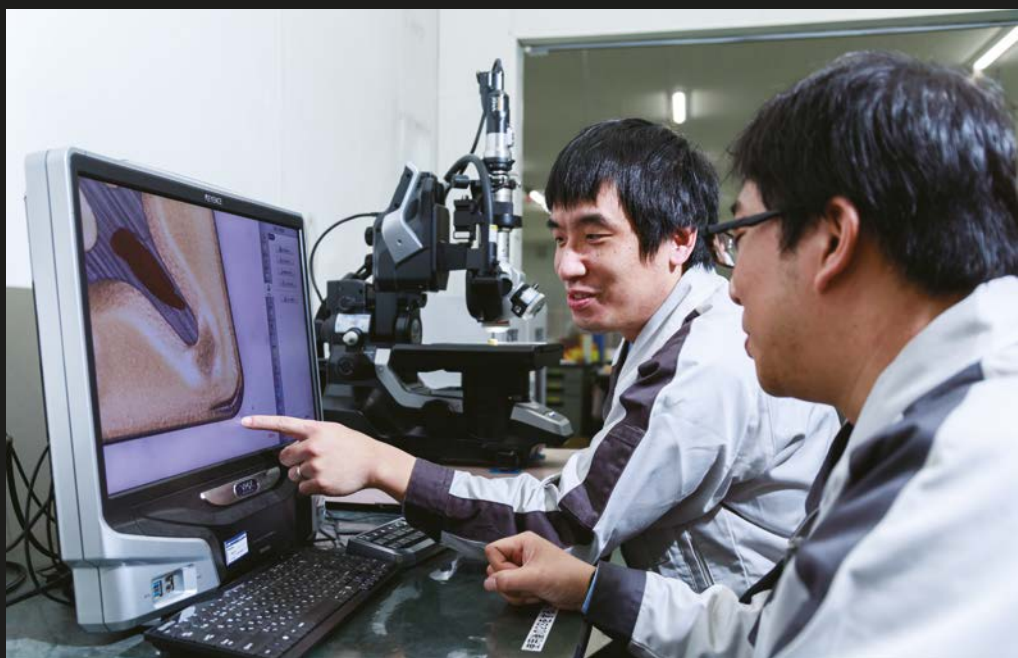
Takuya Ishigaki
Joined in 2008
Manager, Coating Development Section,
Materials Development Department,
Tsukuba Plant

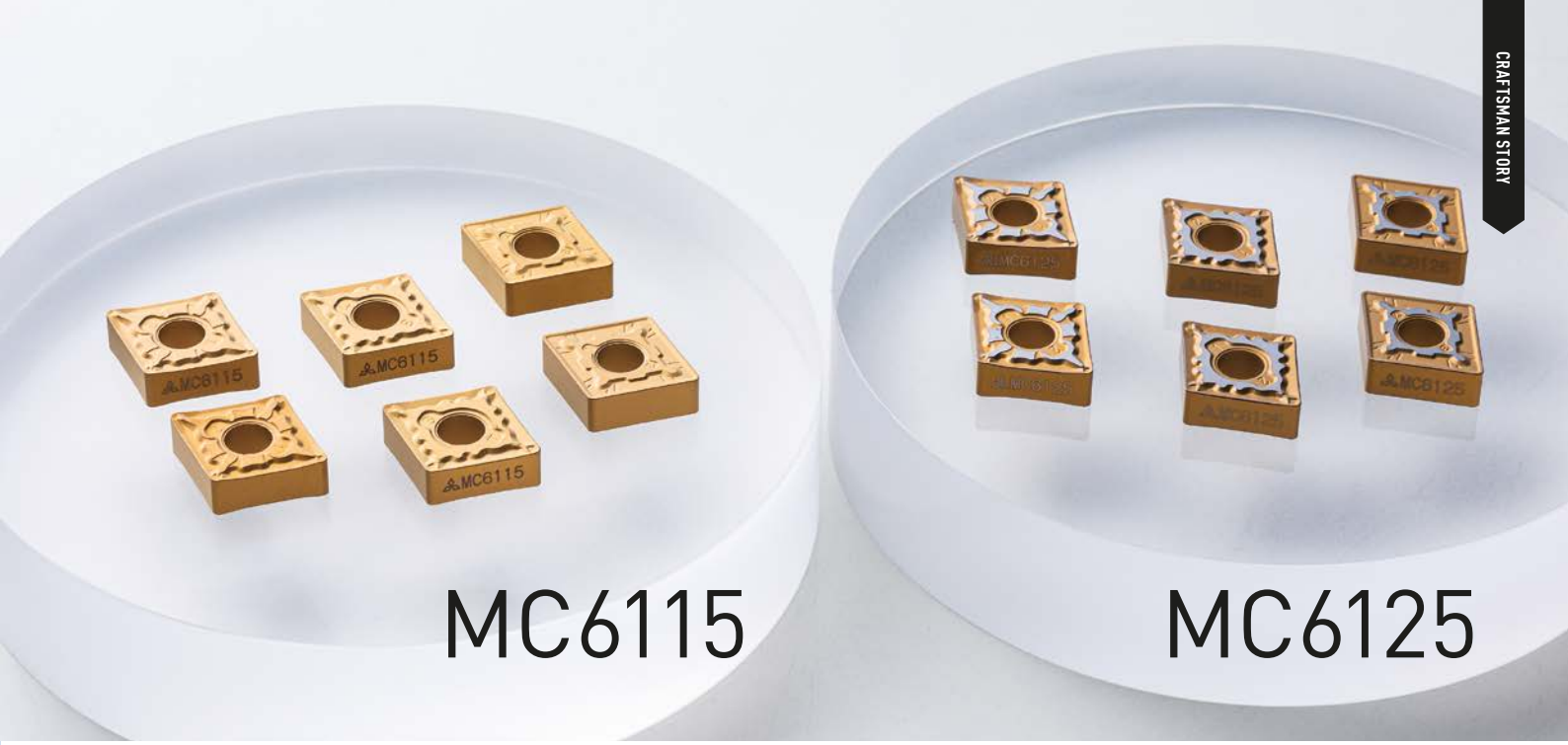
CVD Coated Cemented Carbide for Steel Turning

MC6100 Series

Performance has been drastically improved by using manufacturing technologies, feedback and thoughts of customers, together with the staff at the Central Research Institute.

With automobile parts at the top of the list, the material specified for these parts by manufacturers have become harder. Along with this tendency, cutting tools are therefore required to have greater wear resistance. However, increasing wear resistance leads to a greater frequency of tools becoming chipped, this in turn leads to defects in products, making it impossible to guarantee stability in production. Collaborative development in response to requests from customers to solve this problem had to begin. Based on findings at the Central Research Institute, Tsukuba Plant worked on tool development in close cooperation with the Plant Engineering Group. As a result, a solution was provided that significantly improved wear resistance and tool-edge stability.





Originated from customer requests

– First of all, please tell us what was behind the development of the new product.

Takahashi The rationale behind new product development can be classified into two main categories. One is requests from customers, and the other is the need to develop new technology. MC6100 series development began with a request by an overseas customer; but this request also aligned quite closely with new technology that was already under development.

Sato The request from the customer, an automobile parts manufacturer, was for longer tool life. In addition, the customer also wanted to increase machining efficiency, which required the improvement of tool performance. In this case, one thing was different, and that was the complete coordination with the customer during development. Work on new product development is usually done purely in-house, so this was an unusual case.

– Even if customers make requests, it's not easy to move ahead without the technology that can respond to them, is it?

Ishigaki Yes. Responding to the request for extended tool life meant increasing wear resistance. Mitsubishi Materials has products coated with CVD technology. CVD stands for Chemical Vapor Deposition, which is a method of forming a thin film made with a wide variety of substances. Our CVD coating technology is excellent and the CVD thin film coating has outstanding wear resistance; however, it needs to be controlled precisely to prevent peeling. Fortunately, we had been working on the development of technology that prevents peeling to maximize high wear resistance.

Sato The materials that can be used for hard coatings are limited. Considering ways to achieve both wear resistance and tool-edge stability in possible combinations and under different conditions is an eternal pursuit. We have accumulated technologies to increase wear resistance, and one of these is Super Nano Texture Technology.

Super technology to increase wear resistance

– Why did you add "Super" to the existing Nano Texture Technology?

Ishigaki Nano texture technology is one of the Central Research Institute's areas of research. We have been developing technology to increase wear resistance by unifying the direction of crystal growth, and have acquired patents since 2000. Since we significantly improved such technologies for this case, we decided to add "Super" to the name. In terms of technological improvement, grain size and direction of growth in Al_2O_3 crystal grains were uneven in the initial technology. Therefore, we tried to improve the evenness of the grain size. This is called Nano Texture Technology. Additionally, we improved the evenness of the direction of crystal growth. This is called Super Nano Texture Technology. Ensuring greater precision and evenness in crystal growth significantly improved wear resistance.

Takahashi I'm sure that Mitsubishi Materials now has the top-class technology needed to optimize crystal growth. The reason that we could achieve such high technological development is because we, the development group, and the Central Research Institute always cooperated to accumulate know-how. The elemental technology of Super Nano Texture Technology was developed by the Central Research Institute.

– However, it is not always the case that the development of new elemental technology immediately leads to commercialization, is it?

Sato Yes, that's correct. Customers want us to use our elemental technology to develop cutting tools capable of outstanding performance under their machining conditions. In other words, customers want the development group to develop the technology and tools that provide them with stability and superior quality. The ability to commercialize elemental technology is necessary for that next step.

From micro to macro – Issues caused by the difference in scale

– I wonder if it's difficult to apply the technology developed at the Central Research Institute to mass production.

Takahashi This is why the Development Center exists. Even if we are confident that the elemental technology developed at the lab will be successful, we need the manufacturing technology to mass produce it. Developing that type of manufacturing technology is our role.

Sato Until three years ago, I was working at the Central Research Institute on basic technology development for CVD coatings, and learned about the control of crystal growth direction at the Central Research Institute. After that, I was transferred to the Tsukuba Plant, where I started work on the MC6100 series. However, the preconditions for micro-scale experiments performed at the lab and macro-scale mass production are quite different. Fortunately, what I learned about basic technology at the Central Research Institute was very helpful for me in understanding phenomena I observed during testing for mass production.

– Since MC6100 series development was based on a customer request, did you feel pressure to move quickly?

Ishigaki Exactly. But that pressure didn't mean that we could take shortcuts. We proceeded through a steady and deliberate process of repeated trial and error, identified problems through testing, and made adjustments accordingly until we were confident that we could not only meet, but exceed the customer's expectations. It is also important that the PDCA cycle be applied efficiently at a high rate of speed. This is because the scale of production between lab testing and mass production is different, we see phenomena in the production phase that differ from those seen in the lab. And to establish an efficient mass production system, we needed close cooperation from the coating staff during the production technology and manufacturing phases to advance development. The more specialized staff involved in a project, the greater the need is to move forward quickly.

Takahashi It's important in the PDCA cycle to follow the rules and principles. If we follow the rules and principles, it is easier for us to find the parameters where problems occur.

– The parameters may influence changes in lab scale.

Sato The distribution of some parameters may change due to changes in scale. In such cases, it is also necessary to return to the basic principles, establish a hypothesis, and then test that hypothesis through experiments. We communicate closely with the staff responsible for production technology about the process to ensure that everyone is moving in the same direction when establishing a hypothesis based on the changes in parameters using calculated data provided by the Central Research Institute.

Overcoming difficulties through exceptional approaches and close cooperation with customers

– What was your biggest challenge in developing the MC6100 series?

Ishigaki Because this began with a request from the customer, we worked together with that customer from the initial stage. We talked at length to understand exactly what they actually wanted. Then, we examined prototypes made using machining equipment on the actual production line at the customer's workshop. We were unaccustomed to responding to customer's pin-point needs, and this was an extremely challenging shift in our approach.

Sato When testing on the customer's production line, our staff visited the site. Standing next to the actual machine being tested, our staff listened carefully to the operator's opinions. In addition, the staff and salespersons from Mitsubishi Materials talked with the customer's engineers to determine the direction of improvement. Repeating these processes, we continued improving wear resistance. Just as we reached a level that we felt was very close to our goal, however, we encountered a final problem that was difficult to solve.

– What was the problem you encountered?

Takahashi In a certain mode, the test machine at the customer caused specific damage. If we solved this problem, we would achieve the goal. Try as we might, though, trial and error using our equipment failed to replicate the damage that was being observed on the customer's line.

Sato According to our theoretical discussions on the causes of the problem, one idea occurred to us. We thought that the damage might be occurring during an early stage of machining. If we could identify the cause at that stage, we would be able to address the issue. However, to test our hypothesis, we had to use the customer's machining equipment and shut it down in the middle of the operation to check the tool edge. For the customer, it was out of the question to stop machining in the middle of the process. However, we explained how stopping the process would allow us to better understand the problem and how this would bring us closer to a solution.

– And how were you able to solve the problem?

Ishigaki The results of the experiment confirmed our hypothesis. Because of the fact that damage occurred in an early stage of machining, we could identify a solution to reduce it. We tested an improved prototype, and we were successful. This success, along with the required wear resistance that we had already achieved, made the customer very happy.

Adding two new technologies increased stability

– I understand that in addition to the Super Nano Texture Technology, other new technologies were applied to the MC6100 series.

Sato Yes, one of these was the reduction of sudden fracturing, which was solved by using the advice of a customer. CVD coating is formed at a high temperature, and tensile stress occurs in the coating layer during cooling. Machining with an unstable tool edge during that time creates uneven impact wear and cracks tend to become larger because the tensile stress is unable to reduce the expansion of cracks. This is how fracturing occurs. The challenge is to mitigate the tensile stress to solve the problem.

Takahashi How we mitigated the tensile stress is a secret, but the solution came through a deliberate process of repeated trial and error. We also applied the PDCA cycle.

– What is the other technology, Super TOUGH-Grip?

Ishigaki Mitsubishi Materials had already developed the TOUGH-Grip technology, which firmly bonds two different coating layers. Specifically, it is used to bond the Al_2O_3 (aluminum oxide) layer and the TiCN (titanium carbon nitride) layer, which is the base of the Al_2O_3 layer. Making the crystal grains finer increased the adhesive surface of the Al_2O_3 and TiCN layers, and enhanced the adhesive strength between the coating layers. In other words, this new technology more effectively reduced the peeling of coating layers compared with the existing technology. The peeling resistance test for the Super TOUGH-Grip showed that adhesive strength increased 1.6 times.

Sato To bond Al_2O_3 and TiCN, which have different crystal structures, we needed to first learn as much as we could about the basic characteristics of each crystal structure. With such knowledge, we could work on increasing adhesive strength. During the specific development processes, cooperation from the members of the Plant Engineering Department allowed us to conduct repeated experiments using the actual coating furnace.

Takahashi Our development team and Plant Engineering Department proceeded through every step of the process in close communication. The entire staff at the Tsukuba Plant frequently exchanged opinions with the aim of maintaining a clear focus on the goal. One of our major strengths is this emphasis on cooperation.

Wear and defect resistance are eternal themes

– The outcome of these new technologies is the MC6100 series, isn't it?

Ishigaki The MC6115 is for high-speed cutting. Applying a thick Al_2O_3 film made using Super Nano Texture Technology makes it possible to achieve excellent wear resistance during machining when tool edge temperature tends to become high, similar to the conditions found during high-speed cutting and high-efficiency machining. As for MC6125, adding the Ti-based substances or Al_2O_3 lamination layer to the Super Nano Texture Technology Al_2O_3 layer, we achieved a level of machining performance capable of responding to a broader range of applications.

– How have customers reacted?

Sato What satisfied customers most was the extension of tool life. Since conditions such as processing and machining speeds could be improved, we hear from customers that productivity has also improved. We are extremely happy because such achievements were the goal of development. Another thing we did was to use gold for the outer colour. During development, the customer wanted a distinctive tool edge to show its status as "used or unused." When we deliver the MC6100 series to customers, most of the customers seem to be impressed with the colour. The colour also seems to help negotiations. It's only a small thing, but we are glad that we chose it.

– How about the cost of the new technologies including the gold coating?

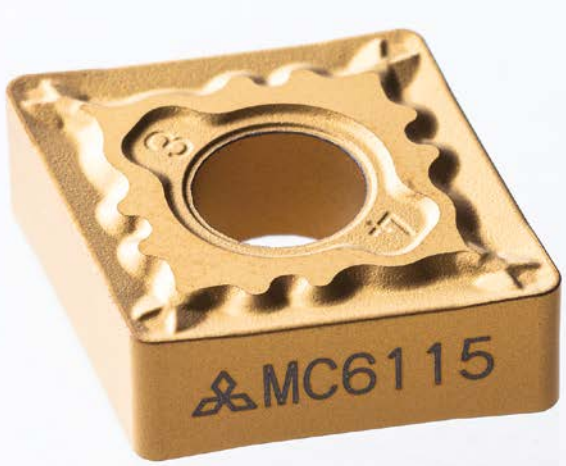
Ishigaki Prices are at almost the same level as existing tools. Cost was a priority issue from the mass production stage, so we checked aspects of the production lines, including the flow of each item through plant-wide cooperation. Costs are determined by the time in production. However, because customer sales have been going so well, production according to the initial specifications has also been smooth without a need for changes.

– What direction do you think you'll be moving to now?

Takahashi Improving wear and defect resistance are eternal themes for cutting tools, so we will continue working on these areas. We also need to consider changes in automobile engines. We have to observe how customer needs change as automobile production shifts entirely to electric vehicles. Changes in their needs directly influence the direction of technological development. Considering needs in quality and machining speed as well, we will continue striving to meet customer expectations.

TEHCNOLOGY ARCHIVE

History of CVD Coating for reduced size and weight



Contributing significantly to stable machining of difficult-to-cut materials

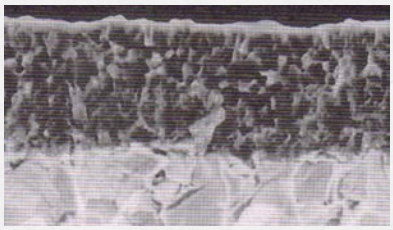
Cutting tools are like people working behind the scenes. They work out of the spotlight to steadily support the advancement of industrial products. This advancement has passed a few major milestones. Cutting tool material has progressed from high-speed steel, called Haisu in Japanese; introduced at the end of the 19th century, to cemented carbide. Then much later the coating method was developed and this represented significant progress by coating the surface of cemented carbide with a very hard, thin ceramic film layer. We interviewed staff of the Innovation Center (former Central Research Institute) about the technological development that created cemented carbide tools using the CVD method.

CLOSE UP

What is CVD coating technology?

Chemical vapor deposition (CVD) coating is a process that heats mixed gases to 800 to 1100 degrees C to deposit hard ceramics on the surface of the cemented carbide. First, titanium carbon (TiC) was developed as a coating material, followed by titanium nitride (TiN), titanium carbon nitride (TiCN), aluminium oxide (Al_2O_3) and others. Currently, multi-layering technology using bonded layers is developing rapidly and has become the main trend.

Single-layer Coating Technology



Characteristics of CVD Coating

- Enhancing adhesion and crystal orientation controlling technology and drastically improving stability and wear resistance
- Significantly improving thermal stability and wear resistance for high-speed cutting
- Achieving reliable cutting for a broader range of machining

1 1970 ~ Establishing mass production technology using decompression coating

In 1969, the world's first coated cemented carbide (CVD) tool was introduced. CVD tools are made by coating the surface of cemented carbide tools with a very hard, thin ceramic film layer. The first CVD tool was introduced to the market by WIDIA, an old-established cemented carbide manufacturer in West Germany. A few months later, the Swedish manufacturer Sandvik, also started selling CVD coated tools.

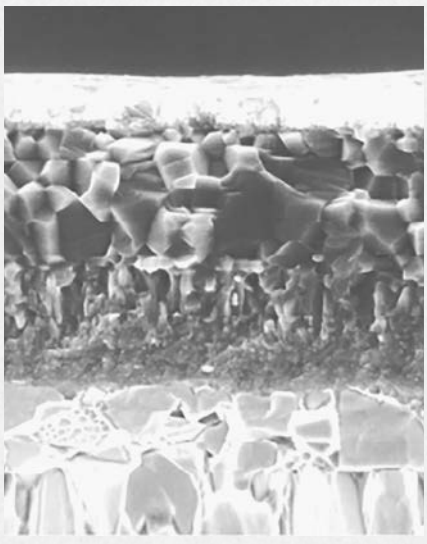
In the 1970s, CVD tools with an Al_2O_3 layer on top of a TiC coating were released by several manufacturers. These are the original type of the present-day CVD multi-layer coating.

Mitsubishi Materials also began research on coatings in the late 1960s, and worked on the CVD technology development at both the former Tokyo Plant in Shinagawa and the former Central Research Institute in Omiya. Based on the results of this research and development, Mitsubishi Materials released CVD coated tools in 1971.

Mitsubishi Materials first conducted research on coating technology for TiC and Al_2O_3 separately, and then expanded the research to adhesion technology to bond these two different films. This adhesion technology led to TOUGH-Grip and Super TOUGH-Grip development.

Meanwhile, the Company also began the development of mass production technology. Coating was initially performed under increased atmospheric pressure. Theoretically, diffusion of gas components is accelerated under decompression conditions, which makes it possible to process a large amount of high-quality film. The Company established mass production technology through the development of outstanding equipment and decompression processing technology.

The Company worked on multi-layer coating using adhesion technology in the mid-1970s. Ti compounds with high wear resistance and a multi-layer structure of chemically stable Al_2O_3 satisfied the conditions required for machining in a well-balanced manner. Research on high-intensity adhesion of these two layers confirmed that using TiCO layer as the middle layer maximized the adhesion. Using this technology, the Company released U77 in 1977.



TEHCNOLOGY ARCHIVE

2 1980 ~ Development of Cobalt diffusion prevention technology to further improve wear resistance

The next issue was preventing the diffusion of cobalt contained in substrates. CVD processing at 1000 degrees C causes cobalt diffusion. Diffused cobalt from the substrates enters into the TiCN layer above it, and the ceramic layer becomes a composite material composed of ceramic and metal materials (cermet), resulting in reduced wear resistance.

To address this, we established a barrier technology to prevent cobalt diffusion. Specifically, it's a new method of using a highly activated gas, acetonitrile (CH_3CN). Being highly activated, CH_3CN can produce coatings at about 100 degrees C lower than conventional CH_4 gases. The low temperature significantly reduces cobalt diffusion from substrates, which made it possible to create a TiCN layer with high crystallinity and a columnar structure. This has remained the standard technology even 30 years after its development.

The major products using this technology are the UC6010 and UC6025 series that were launched in 1992. However, because of the outstanding technology, both products continued to enjoy great success even after 2000.

3 1990 ~ Development of a new manufacturing method responding to the needs of high-speed and high-efficiency machining equivalent to a patented competitor's technology

In the 1990s, Mitsubishi Materials focused on the development of technology to create thick Al_2O_3 coating. The Al_2O_3 layer is produced by the reaction of $AlCl_3$ and H_2O, which is generated by a gas phase reaction between H_2 and CO_2. However, the speed of Al_2O_3 production is extremely fast, which makes it extremely difficult to produce coating with uniform quality.

Meanwhile, as the need for high-speed and high-efficiency machining increased in the market, the need for coatings with thick Al_2O_3 increased as well. At that time, there was a way to add an extremely small amount of H_2S to reactant gases to form thick coating while maintaining uniform quality. However, because this technology was patented by an overseas competitor. Mitsubishi Materials needed to develop a new method.

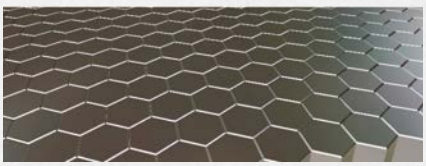
To do this, we performed repeated testing using a wide variety of gases while clarifying the mechanism of thick coating formation. We ultimately succeeded in ensuring uniformity in quality equivalent to that achieved by adding H_2S (patented by a competitor) using NO as the source of oxygen in the inert gas atmosphere.

4 2000 ~ Aiming to develop harder, more stable, more wear-resistant cutting tools

Entering the 21st century, Mitsubishi Materials started improving the wear resistance of the Al_2O_3 layer. When thermally transforming k-Al_2O_3 in a metastable phase at 1050 degrees C, α-Al_2O_3 in a stable phase is formed. We found that this α-Al_2O_3 has excellent wear resistance. Using this discovery, we established a technology to form a coating by controlling the growth of α-Al_2O_3 with a c-axis orientation. We worked on the development of the technology that naturally orients crystals to improve the hardness. This became Nano Texture Technology and has been further expanded into Super Nano Texture Technology.

At the same time, work continued on the development of technology that elongates tool life by increasing the thickness of Al_2O_3, which led to an increase in the thickness of coatings. The patent we obtained for the series of such Al_2O_3 coating forming technology led to the establishment of the strong presence that the Mitsubishi Corporation has throughout the industry today.

We started developing TOUGH-Grip technology, which increased the adhesion of TiCN and Al_2O_3, around the year 2010. Before then, we had already conducted research on adhesion technology for these two coatings while working separately on the coating technology for TiC and Al_2O_3. Different materials are layered in CVD coating, therefore what needs paying the closest attention to during CVD coating is making fine layers from the base material. An important point is the thermal expansion coefficients that change according to the differences in materials. TOUGH-Grip technology expands the adhesion area of the lower TiCN layer and the upper Al_2O_3 layer through microstructure refinement, leading to improved adhesion and the prevention of peeling.

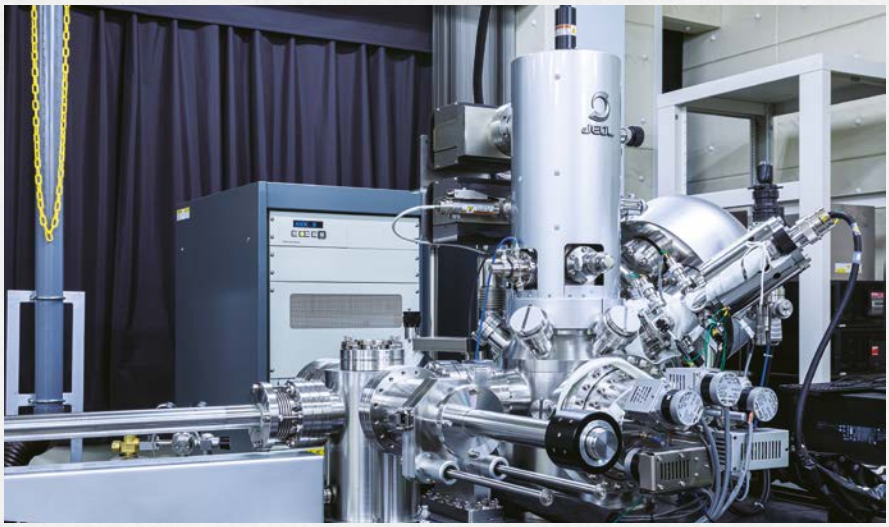


5 Future Vision

Technological development aiming for four to five years from now is key for commercialization in 2030

We are looking at developing an alternative technology for TiCN. The standard TiCN coating has been maturing for over 30 years, and it will be difficult to develop something that exceeds its performance. On the other hand, if we develop new technology, we will be able to establish a firm position in front of other competitors in the industry. We've already started research for the development of new technology.

However, it is extremely difficult to predict what the situation will be 10 years from now because it is impossible to imagine what kind of machining will be used in the future. After specifying the parts needed for a finished product, such as an automobile, the tools required to manufacture those parts will be determined.



As the shift from internal combustion engine vehicles to EV proceeds, we'll see significant change in the cutting tool market.

We also need to consider the potential of new difficult-to-cut materials. Semiconductor devices may also shift from SiC to diamond; therefore, we also need to consider how to manage the shift. If flying automobiles are commercialized, we need to minimize the weight of components. There are so many things to consider for future potential, including future components and cutting tools.

We continue taking steps forward every day to achieve breakthroughs for the difficulties encountered.

Looking back over the history of CVD coating technology

Oshika When I look at aluminium image data, it's from the viewpoint of the aluminium ion. When I think about my skin, I see it from the viewpoint of carbon dioxide. Let's think about the origin of the countless carbon atoms contained in our skin. They may be from 100's of years ago, or passed down from dinosaurs that lived millions of years ago. Considering the potential age of the carbon that composes our body while looking at the data, the images come alive in my mind.

Okude The most important in my work at the Central Research Institute is ensuring that I observe the data very well. When looking at photos of samples, different people notice different things. Understanding data really well and discovering the differences makes it possible for us to identify the direction we should move in our research. As someone in a leadership position, I feel that passing down such ways of thinking and looking at things to the next generation is an important part of passing down technology. Recent improvements in analytical devices allow us to notice changes that could not be seen before. I would like to continue emphasizing the importance of observing and reviewing things deeply.

Tatsuoka What I always keep in mind while conducting basic research is the attempt to discover unknown fields. Originality leads to the development of new technology and products. In regard to CVD technology, whose history goes back more than half a century, I use accumulated knowledge to find new things from my own viewpoint as well as a brand-new viewpoint. The supportive climate of the Central Research Institute makes it possible for me to continue moving forward to develop new technology.

(Left) Masaki Okude, Principal Researcher
(Middle) Takatoshi Oshika, Project Management Officer
(Right) Sho Tatsuoka, Associate Researcher

ABOUT US

MTEC NC

Introduction to MTEC NC

On the Frontline of Mitsubishi Materials in the United States
Maximum response to requests from customers in diverse industries in North Carolina

Delivering high-quality products and cost-performance to customers in diverse industries

Interviewed Mike Pace, Executive Director!

Mike Pace
Executive Director Marketing, Engineering and Business Development

The United States' southeastern state of North Carolina is home to many manufacturers in the automobile, healthcare, aerospace, energy and general machining industries. One of the fastest-growing areas in the US, North Carolina is an attractive location to an increasingly wide range of customers. Understanding this, MTEC decided to relocate to this area to provide training and expand its solution services.

As part of its relocation, MTEC-NC significantly increased its capacity for training from 16 to 50 people and expanded its capability to machine a broader range of components as well as to demonstrate new products. In line with this expansion, a full-time medical industry solution and development team was created. Integrating Technical Support, Commercial Marketing and Product Marketing Teams at one facility, we created an environment capable of integrated management, from product development through to sales.

Our training covers a wide range of levels, from the basics of cutting tools, through to complex applications and cost-performance products. Our Solution Team focuses on the improvement of operational efficiency throughout the whole machining process to enhance individual components. This includes the optimization of CAD, CAM, CAE and the recommendation of the optimum tooling.

The Commercial Marketing Team works on improving recognition of the DIAEDGE and MOLDINO brands using a wide variety of digital marketing tools. This team has significantly enhanced individual brand images over the past few years through the improvement of MTEC-NC machinery, top-level technical support and through cooperation with regional partners.

MTEC-NC has also established favourable and important partnerships with other organizations, which is one of its strong points and this plays a significant role in providing superior support to customers. We are capable of providing outstanding support, guidance and training to customers, visitors and employees. This includes suppliers of machinery, equipment, measurement devices and software, partners for transport, entertainment and accommodations.

Visit here for a virtual tour. https://mmusa.reallyinteractive.media/

SOLUTIONS

Leveraging extensive machining knowledge and experience accumulated over many years, the Solution Team continues innovation and development in cooperation with customers and partners in related industries. In addition, using cutting-edge CNC machines, high-function CAD, CAM, and CAE software, measurement devices and process analysis, the team provides digital machining solutions that deliver optimized productivity and an excellent cost-performance ratio. Utilizing its global network with group companies' technical centres around the world, MTEC-NC improves and publicises knowledge and best practice in machining technologies to contribute to technological advancement. The Solution Team continues its close cooperation with the Sales Team and technical engineers to solve application problems for customers and the whole metal cutting industry.

In addition to its past activities, the team has significantly enhanced its functions and resources based on the use of digital tools, including the most recent 5 axis CNC machining centre operated by skilled and experienced engineers. This has enabled the team to quickly grasp trends and meet needs regarding components, work materials, and quality requirements in the healthcare, aerospace, automobile, mould and die and general engineering industries.

The solutions developed through an ongoing process of repeated trial and error bring advantages to customers through the selection of the latest-generation tools and optimized programming technology, to achieve shortened cycles and improved operation times. This ensures the development of solutions with high productivity, cost-effective production and outstanding performance at customers production sites.

The functions used for the solutions:

- Five-axis CNC Machining Centre: 1unit
- Five-axis Swiss-type CNC Machining Centre: 1 unit
- Three-axis CNC Vertical-type Machining Centre: 2 units
- CNC Turning Centre: 1 unit
- Measurement and Tool Setting Device
- Tool Management System
- CAD/CAM/CAE (Digital Tools)

Jogendra Saxena
Senior Manager,
Engineering

TRAINING & TECHNICAL SUPPORT

Experience as a customer in manufacturing is extremely important for education and training. Introduction of new cutting tools and the provision of technical training for innovative applications are important for customers, engineers, designers, programmers, machining engineers, students and employees of MTEC.

MTEC periodically provides classes on machining technologies and training in manufacturing, targeting end users (customers), distributors, industrial partners and vocational school students. Its education program offers participants outstanding opportunities for study and the chance to establish networks while offering customised online training sessions that include webinars and live demonstrations using CNC machines. In-house programs include group sports and cultural activities in the evening.

The training programs cover the functions and benefits of new products used for productive manufacturing, application technology regarding the trends of machining materials and alloys in the applicable industry, best practice in cutting methods using CNC machines, identifying available machining technology space for production sites and many other practical demonstrations.

The Technical Support Hotline (via phone and e-mail) is another MTEC strength that provides continuous customer support through the provision of knowledge and information for the selection of cutting tools and rationalization of tooling, the optimization of support for machining data, application technologies and programming as well as the sharing of successful case studies.

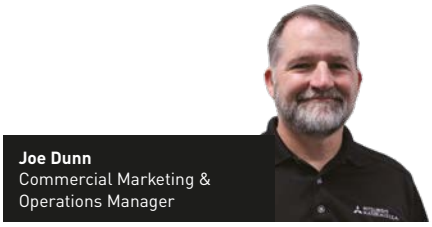
Peter Dunster
Training & Technical Support
Manager

COMMERCIAL MARKETING & OPERATIONS

The Commercial Marketing Team continuously strives to improve communication with both employees and customers. An important asset in maintaining and improving communication is the in-house intranet (dashboard). Dashboard functions include notifications from the company, messages from the president, news about the launch of new products, price lists and tool news (introduction of products). Furthermore, information about engineering, quality assurance and new-product request forms for the Project Team are always upgraded and publicised via each page.

To support approaches that improve communication, the Commercial Marketing Team uses a mail magazine function called Constant Contact for both employees and customers. Constant Contact allows the creation of high-quality e-mail formats, plus confirmation that messages have been received and read.

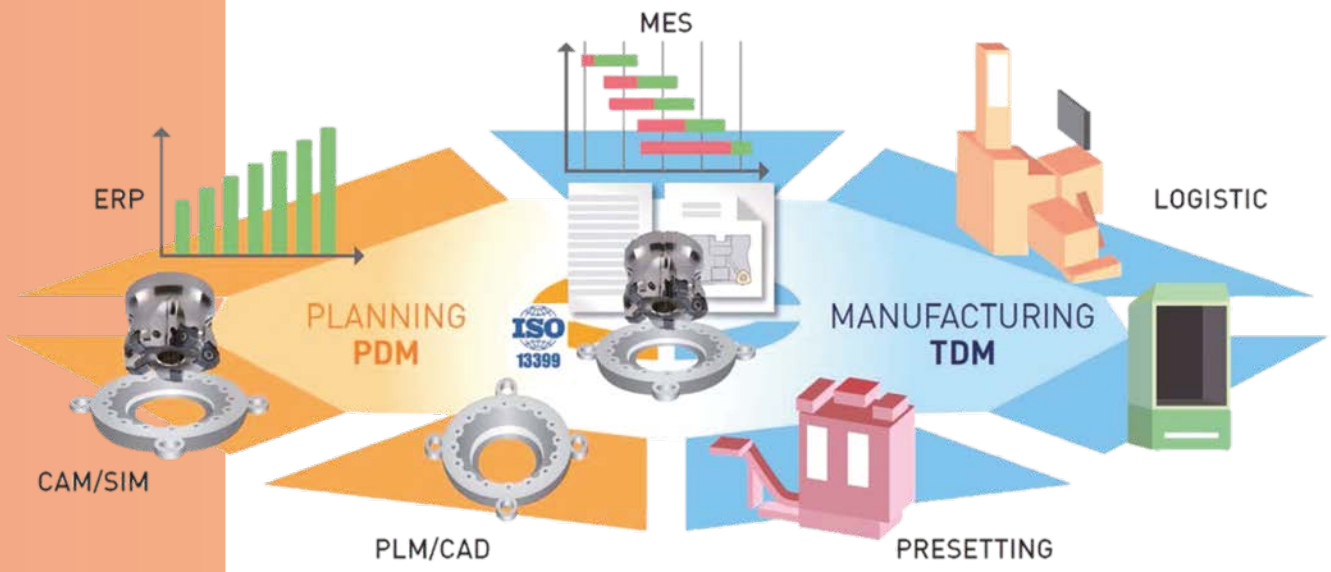
An important priority is social media. The team utilizes LinkedIn, Facebook, Instagram, Twitter, and YouTube. With more than 31000 followers and 120000 visits annually, social media has become an effective marketing tool capable of widely publicising the team's messages. To support approaches using both social media and e-mail marketing, the team also created some landing pages. Through these approaches, it was found that preparing a web address that includes all information is quite effective. Also used widely is the "mtectraining.info" to provide information about all training programmes, including webinars, online and on-site training.



Joe Dunn
Commercial Marketing &
Operations Manager

CUTTING EDGE Vol. 9

Achieving highly-reliable manufacturing with a new machining monitoring system



User solutions
Cutting tests at the technical centre

The Technical Centers (East Japan/ West Japan) improve customer satisfaction with cutting tests by connecting the Mitsubishi Materials Intelligent Cutting Test System (MICS) to test equipment.

When measuring cutting resistance, it was sometimes difficult to conduct cutting tests with the work materials supplied by customers due to their size. The application of the MICS to the load value measurement makes it possible to conduct cutting tests under an environment conforming to their production lines without any limitations.

In addition, when conducting lifetime tests, conventional measurements required a tremendous number of processes to obtain complete machining data, which is a practical impossibility. With MICS, it is possible to confirm the processes until the end of tool life because the load value can be maintained throughout.

Therefore, the sequence of events immediately before drill breakage or insert chipping can be visualized, which provides reliable measures to allow improvements to be taken.

Mitsubishi Materials Intelligent Cutting Test System

Confirming tool behaviors by actual use in customers equipment

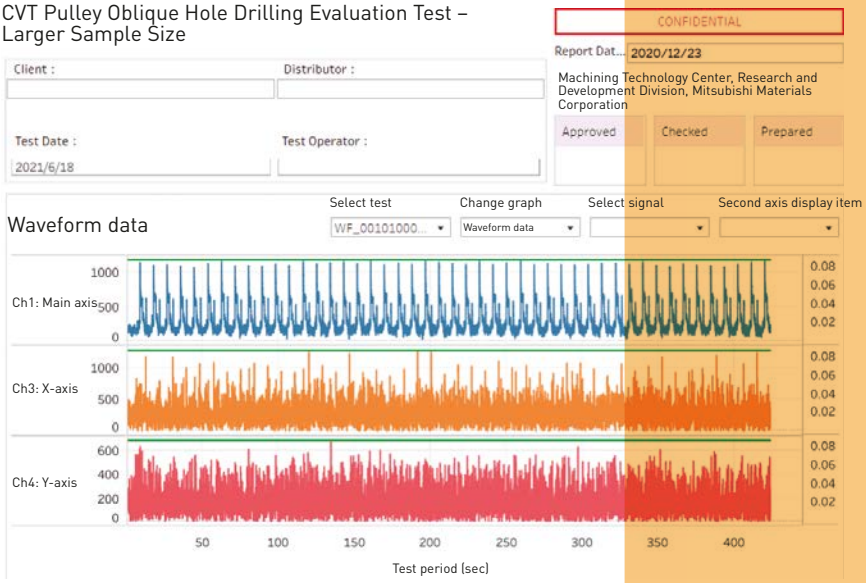
- Responding to equipment that the customer actually uses for their machining
- Making proposals for optimum machining through the analysis of machining data

MICS provides completely new solutions through the acquisition, accumulation and analysis of load values for machine tool spindles and table axes.

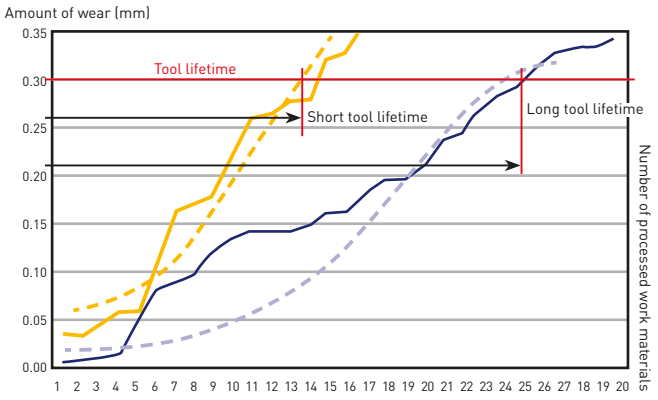
In addition, this does not require the purchase of new machine tools. Simply connecting tools to the line production equipment actually used by the customer makes it possible to quickly create a database for monitoring.

Furthermore, since the analysis of trend processing and threshold setting for the database can be conducted inside MICS, use at production sites for improvement is expected. The accumulated database is output in CSV data, making it possible to analyze data using the BI tool that customers are already using.

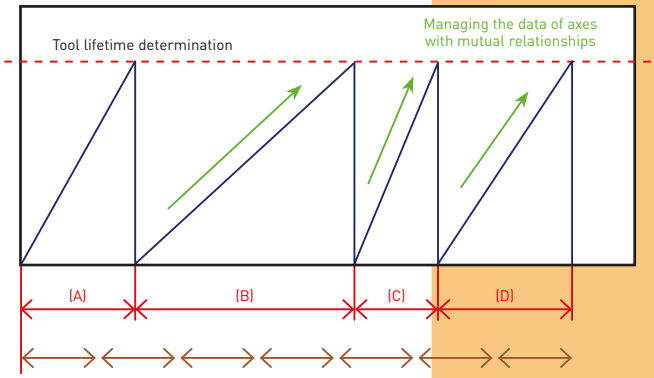
CVT Pulley Oblique Hole Drilling Evaluation Test – Larger Sample Size



Provision of solutions

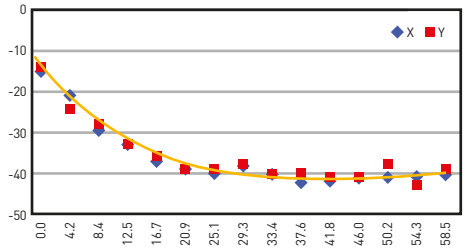


A graph created of tool life based on the acquired data and analysis results. Contributed to the reduction of tool replacement.

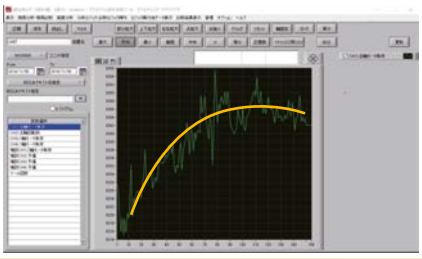


A graph created showing the dispersion of lifetime due to a wide range of reasons in machining. Management based on the short tool lifetime data makes it possible to achieve more stable production.

Results and achievements of analysis



*Quoted from the GOT Window of the IQ Monozukuri – Tool machine wear diagnosis device



Confirming the correlation between main axis load value and hole diameter

Possible to predict the amount of change based on the results

Results of analysis based on the correlation between hole diameter (Oversize) and main axis load

Future expansion

In cooperation with many customers, we have been focusing on the effective utilisation of database information. Using analysis results for the prediction of tool life and selection of the correct methods and cutting tools for new production lines makes it possible to reduce the time and number of processes required to establish an efficient production line.

In addition, using database information with sensing tools allows us to simultaneously analyse machining, quality of work materials and operation of equipment for the optimization of production, including ease of measurement and equipment maintenance.

Enjoy Japanese Style

WA

Wagashi –

Traditional Japanese Confectionery

Written in collaboration with: Keiko Omori (YUIMICO)

Traditional Japanese confectionery deeply rooted in Japanese lifestyles

Traditional Japanese Confectionery developed in the Edo Period

Traditional Japanese confectionery is not only tasty, but also visually attractive because of its colours and shapes. The beauty of traditional Japanese confectionery is in its very artistic style.

The history is long and it began when people in the Jomom Period (about 14000–1000 BCE) called fruits they picked and ate as a snack or light meal "kashi" which means "sweets" in Japanese.

Later between the Asuka and Heian Periods (592–1185), kara-kudamono or togashi, literally "assorted pastry confections of Chinese origin," made by kneading wheat and rice flour with sugar and frying them, were introduced to Japan from China. During in the Kamakura and Muromachi Period (1185–1573), sweet bean jelly (yokan) and sweet buns (manju), called tenshin, which means "Chinese sweets," were also introduced from China.

Then, cakes made with white sugar and eggs, such as castilla and biscuits were also introduced from Portugal and Spain. These were collectively called namban-gashi, meaning "sweets adopted from Portugal and Spain." Around that time, the Japanese tea ceremony began and light refreshments were created to be served with the tea, although they were very different from what we know now.

In the Edo Period (1602–1868), along with the increase in imported sugar and the spread of the Japanese tea ceremony, sweets also developed significantly. As they developed, they began to approach what we recognize now a wagashi, the traditional Japanese confectionery.

The term wagashi was coined in the Meiji Period (1868–1912). After many western sweets were introduced to Japan, traditional Japanese confectionery came to be called wagashi to distinguish it from yogashi, or sweets brought from western countries.

Expressing ever-changing seasons

Although being simplified recently, Japan has a wide variety of annual events, which are deeply associated with traditional Japanese confectionery.

For example, flower petal rice cakes (hanabira-mochi) for New Year's Day, rice cakes made with the mugwart plant (kusa-mochi) for the Doll Festival, rice cakes wrapped in oak leaves (Kashiwa-mochi) for the Boys Festival, rice balls covered with bean paste (ohagi) for the equinoctial week and dumplings (dango) for autumn moon viewing are offered to the Gods and Buddhas for purification and to pray for health and happiness. In addition, for festivals held to pray or give thanks for a bountiful harvest, rice cakes and dumplings are essential. Confectionery is deeply connected to our daily lives.

Furthermore, lots of Japanese confectionery is also related to seasons. Soft sweet bean jelly and dumplings are a specialty during the hot summer. Rice cakes made with sweet bean paste and chestnuts (kuri-kanoko) is an autumn specialty made of seasonal ingredients. There is also a type confectionery that expresses the seasons through colours and shapes. Nerikiri is an artistic sweet featuring white bean paste, rice cake made from glutinous rice flour (gyuhi), and Japanese yam. It is moulded into the shape of a cherry blossom in spring, a green plum in early summer, a chrysanthemum in autumn and the cold wind in winter and are sold in stores throughout Japan.

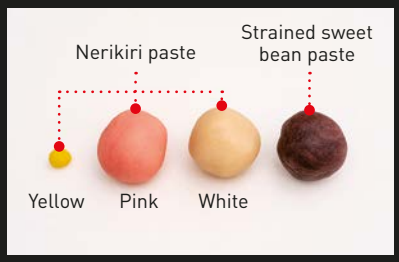
The motifs of the confectionery are not limited to the four seasons, but expanded to 24 seasons (one season is about 15 days), or 72 seasons (one season is about five days). Buds gradually swell, leaves sprout and turn red and the atmosphere of the clouds and wind changes as time goes by and confectionery is the result of heightened sensitivity to the subtle beauty of the natural environment that the Japanese people cherish.

Classification of Traditional Japanese Confectionery

Confectionery is classified into three major categories depending on the water content; unbaked, semi-baked and dry. Cakes made of white bean paste and glutinous rice flour (nerikiri), rice cakes filled with sweet bean paste (daifuku) and soft sweet bean jelly (mizu-yokan) are unbaked sweets containing 30 % water. Hard candies (rakugan), rice crackers and millet or rice cakes (okoshi) are dried sweets containing less than 10% water. Wafers filled with bean jam (monaka) and firm sweet bean jellies are semi-baked with a water content between unbaked and semi-baked sweets.

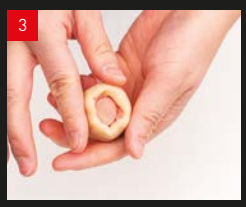
How to make nerikiri cherry blossoms

Nerikiri are a mixture of white bean paste made with white kidney beans and white adzuki beans, then sugar is added to kneaded rice cake made from glutinous rice flour (gyuhi). They are often accented with pink and yellow food colouring.



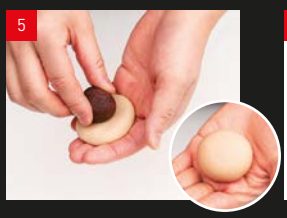
(1) Place white nerikiri in your palm, and spread into a circle.

(2) Place pink nerikiri paste on (1) and wrap.

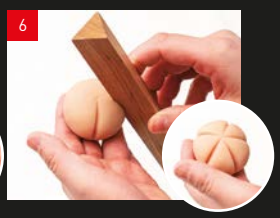


(3) Spread the white nerikiri paste with your thumb.

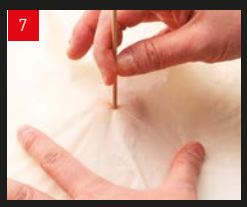
(4) Then, gather the edge of the white nerikiri paste to the centre and wrap the pink nerikiri paste completely around it to form a sphere.



(5) Spread (4) into a circle, and wrap strained sweet bean paste in the centre as above.

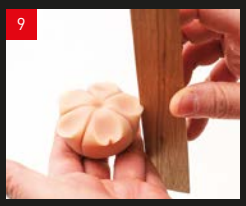


(6) Use the triangular spatula. Pressing from down to up on the bean paste ball, make five lines.



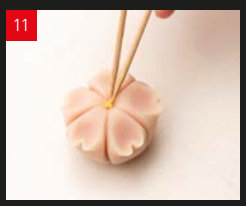
(7) Wrap with a cloth and make a hole in the centre with the tip of a bamboo skewer.

(8) Press with your finger-tip to make the petals.



(9) Place a cut on each petal using the triangular spatula.

(10) Strain the yellow nerikiri bean paste using a strainer to make a pistil.



(11) Place the pistil in the hole at the centre of the flower with a bamboo skewer.

Seasonal Traditional Japanese Confectionery

There are many popular motifs.

Spring 春

Spring: Peony (Nerikiri)

Peonies blooming in spring are a lovely motif. Nightingales are also a popular motif in spring. Light pink and green are often used.

Summer 夏

Summer: Goldfish (Kingyoku-kan)

Goldfish swimming in a river are very refreshing to see. Red goldfish made with sweet bean jelly are placed in a transparent agar. River, fish, fireflies and the moon in the sky are popular motifs for summer.

Autumn 秋

Autumn: Autumn Foliage (Kinton)

Autumn foliage is expressed by covering adzuki bean paste with bean paste in three different colors made by mixing white bean paste, agar and starch syrup. Persimmons, chestnuts, chrysanthemums and fallen leaves are popular motifs.

Winter 冬

Winter: Snowstorm (Manju)

This sweet bun is made with dough mixed with Japanese yam and it has a thin surface. Bean paste is seen on the surface, and it expresses the snow driven by the wind. Yuzu and winter camellia are popular motifs for winter.

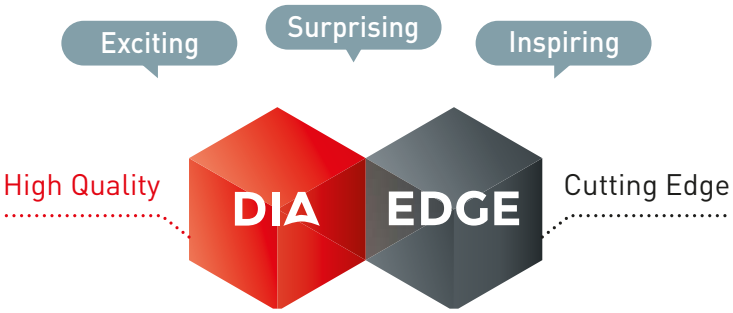
Tools used for making traditional japanese confectionery

1. Branding Irons: Used to make patterns on the surface of manju (sweet buns) and dorayaki (bean-jam pancakes).
2. Cutters: Used to make shapes of nerikiri and yokan (sweet bean jelly).Each leaf for the kinton shown in the photo is made with a cutter.
3. Molds: Used to make patterns on the surface of nerikiri and other doughs by pressing.
4. Triangular Spatulas: Used to make patterns on the surface of nerikiri and other dough using the corners of the triangle.
5. Bamboo Skewers: Used to place stamen or pistil of flowers, and kinton (mashed sweet potatoes), and make a hollow to place stamen and pistil.

DIAEDGE

Together with our customers, creating a better future

Announcing DIAEDGE, our new brand of tools,
that brings together our cutting-edge technologies, exciting all who use them.
Our aim is not only to offer value with our tools,
but to think together with our customers, share inspiration with them,
and continue to take on new challenges.



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