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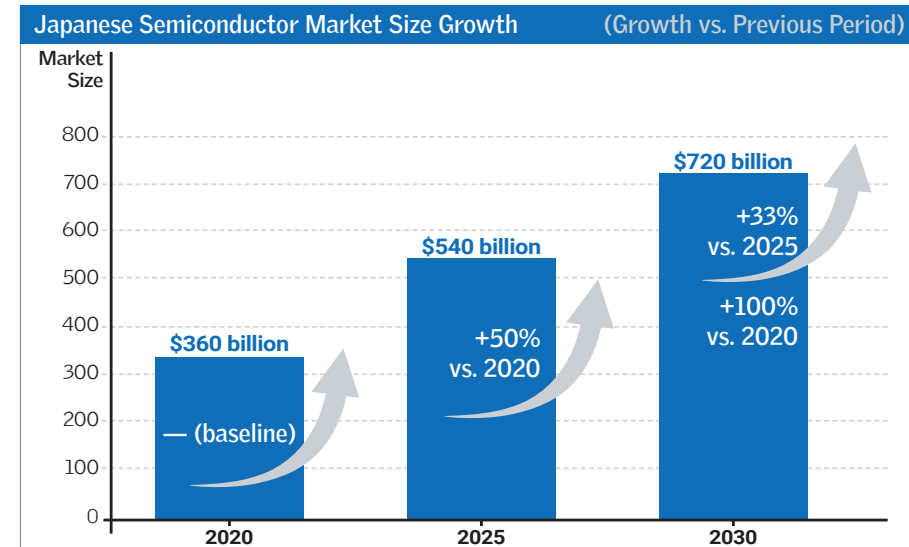
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Japan Crafts the Future of Innovation and Advanced Manufacturing

Japan's *monozukuri* spirit, built on precision, pride and innovation, is redefining advanced manufacturing, driving breakthroughs in semiconductors, materials, and sustainable technologies for a brighter global future. *By Daniel de Bomford*



Source: Commerce and Information Policy Bureau, Ministry of Economy, Trade and Industry

In a quiet workshop in Japan, an engineer adjusts a precision tool, the soft hum of machinery filling the air. Every movement calculated, every detail exact. To the uninitiated, it may seem like routine work. To the engineer, it's an art that transcends skill. This routine of refining, improving and never settling is known in Japan as *monozukuri*.

While the word translates simply into "making things," it carries a weight beyond its literal meaning. *Monozukuri* embodies the soul of Japanese manufacturing: pride in craftsmanship, respect for materials and the belief that innovation is born through dedication and thoughtfulness. It's a way of thinking as much as a way of working, and it's fitting for a country where manufacturing accounts for 20 percent of GDP.



"We will keep advancing precision, and we will align with the global shift toward automation and unmanned operations."

Masaki Wakabayashi, President, Mitsubishi Diamond Industrial Co., Ltd.

Today, that same spirit guides Japan's path at the forefront of advanced manufacturing. From bonding wires thinner than a hair to fiber materials that endure searing heat, Japanese companies are applying the timeless discipline of *monozukuri* to technologies that power our connected, digital world.

As the world rushes to shore up semiconductor supply chains for advanced technology, Japan is emerging as a reliable manufac-

turing partner at the forefront. The country's semiconductor investment in Kumamoto is projected to create about 10,700 jobs and generate an estimated ¥9.2 trillion (\$51 billion) in economic ripple effects nationwide.

Japan Leads in Solutions for Future Manufacturing

Nowhere is *monozukuri* more crucial or evident than in the semiconductor industry. Mitsubishi Diamond Industrial (MDI) has spent nine decades translating the art of Japanese craftsmanship into the precise language needed for semiconductor engineering. Founded as a maker of glass-cutting tools using natural diamonds, the company's journey reflects the evolution of Japan's manufacturing prowess, from hand tools to machines that cut crystal-line wafers with microscopic precision.

The company rose to prominence during Japan's LCD boom, commanding roughly 90 percent of the global market for glass-cutting tools. Yet even at its peak, MDI continued to refine its methods. President Masaki Wakabayashi describes this drive as the company's defining ethos: "Whatever the field, whatever the product, always deliver the very best to our customers. That is the only way to create the future."

This pursuit now manifests in MDI's pioneering Scribe-and-Break technology. This process replaces traditional blade dicing and laser cutting with a cleaner and more sustainable method that requires no water and produces fewer defects.

Continuous Improvement as a Standard

If precision cutting of semiconductor wafers represents one end of Japan's mastery in

microfabrication, the next begins at the point of connection. Nippon Micrometal Corp has built its reputation on something so small, it's almost invisible: the bonding wires that carry the signals through the chip and connect logic to memory.

The company has become a cornerstone of Japan's semiconductor ecosystem. It's copper and alloy wires, some thinner than a human hair, that power everything from electric vehicles to AI processors. "Japan's strength in manufacturing lies in our deep technological foundation," CEO Dr. Takashi Yamada says. "In our production processes, we emphasize the close, hands-on collaboration between skilled operators and engineers."

This creates a workplace culture where a feedback loop creates constant incremental improvements, known in Japanese as *kaizen*. "Kaizen isn't just a management buzzword in Japan—it's ingrained in our production mindset," Yamada says. "It's what enables us to pursue quality, efficiency, and innovation simultaneously." The company's flagship EX Series, a line of advanced bonding wire that has redefined global standards, embodies this continuous improvement.



"While providing a safe and comfortable work environment for our employees was a fundamental requirement, we also aimed to produce eco-conscious products."

Akinobu Ogata, President, NITTO KOHKI CO., LTD.

Materials That Power the Semiconductor Revolution

Nissan Chemical Corporation works further upstream, developing high-performance materials that make those connections possible. From the photoresists used in extreme ultraviolet (EUV) lithography to temporary bonding materials for high-bandwidth memory, its performance materials division sits at the core of the global semiconductor supply chain.

President Shinsuke Yagi says Japan's strength in its depth of scientific expertise. "Japanese chemical industry has strong advantages in advanced technology, quality, and reliability," he says. "At Nissan Chemical, precise organic synthesis skills and knowledge based on the freewheeling thinking by our researchers are the major backbone of our business." Those researchers have made Nissan Chemical a trusted partner to the world's leading chipmakers.

Chemistry Driving Precision and Sustainability
Japan's unique manufacturing landscape, centered on concepts like *monozukuri* and *kaizen*, naturally gives rise to companies that deliver one-of-a-kind products and services. Nippon Carbide Industries began producing carbide-based chemicals in 1935 and has evolved into a global supplier of advanced materials for semiconductor, electronics, and safety applications. "To achieve sustainable growth and contribute to society, our company is focused on creating unique value under the concept of 'Outstanding values = One & Only,'" says President and CEO Sugiyama Takahisa.

In the semiconductor field, Nippon Carbide's functional chemicals enable cleaner, more precise circuit formation, while its Nikalet ECR semiconductor mold cleaner has earned it a high market share across Asia. By combining innovation with reliability, the company's products uphold the "Japan brand" of trust and quality. Maintaining on that trust is essential in the digital age. As Takahisa says, "As we approach our 100th anniversary, we aim to remain a globally trusted company, one that embodies both innovation and the capability for sustainable growth."

Resilience in the Heat: Japan's High-Performing Fibers

At the material frontier of Japan's industrial landscape stands MAFTEC, a company whose heat-resistant fibers protect the world's most demanding technologies. Developed initial-

ly within Mitsubishi Chemical in the 1980s, MAFTEC's materials have become essential to industries where performance under extreme heat is a defining factor of success. "Our technology is also applied in heat insulation for industrial furnaces, and more recently in emerging areas such as EV batteries and stationary batteries," says President Kosuke Matsuzaki.

As semiconductors and electric mobility drive global decarbonization, MAFTEC's lightweight, energy-efficient insulation helps reduce emissions and improve safety across production ecosystems. Now an independent company under Advantage Partners, MAFTEC is expanding in the U.S. and Europe, guided by the Japanese principle of *sampo-yoshi*, good for the seller, good for the buyer, and good for society.

Engineering the Factories of the Future

If companies like MAFTEC and Nissan Chemical embody Japan's mastery of materials, Nitto Kohki represents the nation's precision in motion. The company has spent decades perfecting the unseen components that keep modern manufacturing running, from quick-connect couplers to pumps and power tools, enabling the world's factories. Its latest milestone is a state-of-the-art plant in Fukushima City, designed by renowned architect Kengo Kuma, where automation and architecture blend seamlessly. "Our goal is to operate the factory 24 hours a day, even during unmanned hours, to reduce the workload on our operators and make their jobs easier," says President Akinobu Ogata.

The Fukushima facility embodies Japan's next stage of *monozukuri*, a future that is smart, sustainable, and designed with people in mind. By pairing robotics and AI with eco-conscious design, Nitto Kohki advances efficiency and revitalizes the regional industry by hiring local talent and fostering pride in craft. Ogata says the mission is clear: "We will continue to drive innovation, create new value, and pursue further growth in the global marketplace."

Crafting the Future: Monozukuri in the Age of Automation

Across Japan's manufacturing landscape, from the diamond tools to bonding wires and smart factories, Japan's industrial philosophy thrives. *Monozukuri* is the thread connecting each innovation, where excellence is built and progress emerges from care, discipline, and continuity.

In an era defined by automation, global competition and digital transformation, Japan's makers continue to demonstrate that technology and humanity are not at odds. Their world, built with semiconductors and advanced materials, reflects a national tradition of craftsmanship that rises to meet modern challenges.

As the world pursues cleaner, faster and smarter technologies, Japan's manufacturing ethos is proof that innovation is not just invention, but also integrity. It's the patience and commitment to endure and make things better, one precise layer at a time.

Nippon Carbide's Bid to Be a 'One & Only' Materials Leader

Nippon Carbide Industries positions electronics and safety as its key focus areas and contributes to the realization of a more innovative and more sustainable society through its "One & Only" products, such as functional chemicals, semiconductor mold cleaner, retroreflective sheetings and 3D emblems. *By Cian O'Neill and Paul Mannion*

The innovations of the latter half of the 20th century were driven by Japanese industry. "Made in Japan" became synonymous with reliability, safety, and freedom from worry. Founded in 1935 and commencing operations the following year, Nippon Carbide Industries was one of the companies that led this transformation. Its founding philosophy: "Contributing to the welfare of mankind through ultimate research in the carbide industry" lives on in the company's current group mission: "Creating new value with our technological capability, we help make society more prosperous."

President and CEO Takahisa Sugiyama states that Nippon Carbide Industries is committed to contributing to society while achieving sustainable growth by focusing on high-

value-added products that only the company can deliver.

A prime example is its retroreflective sheetings used in road signs and license plates. These products are engineered with highly precise optical simulation technology to ensure excellent nighttime visibility and offer outstanding weather resistance against UV exposure and harsh environmental conditions. In fields where safety and reliability are essential, the company's products have established a solid presence.

In the semiconductor sector, the company offers functional chemicals like azole compounds that enhance adhesion between copper wiring and insulating resins, and resist crosslinking agents that enable the formation of highly precise circuits. Its semiconductor mold cleaner is renowned globally for its sta-

ble cleaning performance. They are seeing increasing demand, especially in the Chinese market, where the semiconductor industry is expanding.

The company's 3D emblems, which combine design and durability, are expanding from motorcycles to the broader automotive market. In Europe and North America markets in particular, the company is promoting these products alongside retroreflective sheetings and high-performance films to automotive manufacturers.

In 2026, Nippon Carbide Industries will mark the 90th anniversary of its operations. Looking ahead, President Sugiyama says, "As we approach our 100th anniversary, we aim to remain a globally trusted company, one that embodies both innovation and the capability for sustainable growth."



Retroreflective sheet



Functional chemicals



Semiconductor cleaning materials



3D emblem

NIPPON CARBIDE INDUSTRIES CO., INC.
www.carbide.co.jp/en

MDI Pushes Precision Manufacturing Limits

From glass cutting to semiconductors, Mitsubishi Diamond Industrial is advancing precision manufacturing through its pioneering Scribe-and-Break (SnB) technology by uniting Japanese craftsmanship, innovation and sustainability to drive the next generation of semiconductor production. *By Daniel de Bomford and Cian O'Neill*

90th
1935-2025



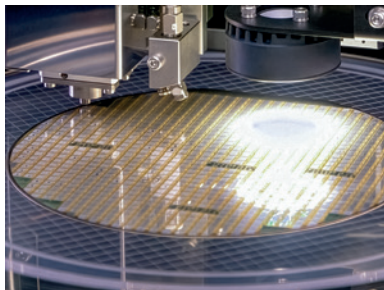
Headquarters in Osaka, Japan

The COVID-19 pandemic and the explosion of AI came as a one-two punch to the tech industry. The disruption to supply chains due to the pandemic, along with the ever-increasing demand for semiconductors for advanced technologies, led nations and companies to rethink how they source critical components.

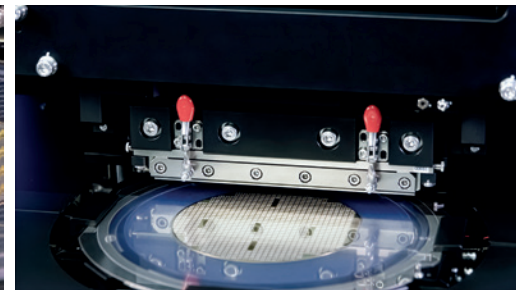
For Japanese firms like Mitsubishi Diamond Industrial Co., Ltd. (MDI), this realignment provides an opportunity. The company specializes in manufacturing processing equipment for brittle materials, such as glass and semiconductor wafers. President Masaki Wakabayashi envisions MDI becoming the first company clients turn to when facing post processing challenges.

A 90-Year Legacy of Craft and Innovation

The company was founded in 1935 to manufacture glass cutting tools with diamonds. Throughout its history, it has remained ahead



Scribe and Break for Si



of its peers, first developing tungsten carbide glass cutters and then advancing to commercialize synthetic diamond glass cutters.

The company truly came to prominence with the introduction of LCD screens in the 1970s, where it evolved from a humble tool maker into a supplier of tools and equipment that commanded around 90 percent of the market share in LCD glass cutting. The company continues to develop solutions for new verticals, such as LED lighting and CIGS solar



panels, while expanding overseas, where it now has boots on the ground in South Korea, China, Taiwan and Germany.

Simultaneously, it has expanded beyond tool-based cutting and developed laser processing, which is central to applications like perovskite solar cell manufacturing. Through these advances and the trust it has built with its global partners, Mitsubishi Diamond is looking to its next big challenge, full-scale entry into the semiconductor market.

The Precision Behind Scribe-and-Break

Semiconductors require precision measured in microns, imperceptible to the human eye. The difficulty and complexity are multiplied by materials such as silicon carbide, which is second only to diamond in hardness. Precision is paramount, where errors can lead to microscopic cracks or chipping that can ruin the die.

What sets MDI apart is the Scribe-and-Break (SnB) technique it pioneered. Put simply, scribing cuts materials like glass or wafers by using either tiny diamond tools or focused laser beams, depending on which provides the cleanest, most precise line for that material.

Breaking then occurs by gently snapping a material along the line, allowing it to separate cleanly. Controlled pressure is applied, and the material splits precisely along the scribed line without cracking elsewhere.

SnB is highly cost-effective and time-efficient due to its high processing speeds. It is more sustainable than conventional cutting techniques because it does not use water. "Our approach is fundamentally different from traditional methods, which means it can unlock processing for materials that were previously difficult or impractical," Wakabayashi says. "While SnB can directly replace some existing techniques, we see even greater potential in enabling new materials and applications."

Building Scalable Systems for Tomorrow's Chips

The DLP Series is MDI's flagship system, combining the company's technological prowess with a modular architecture that meets modern challenges and stands ready to conquer the next techno-

logical advances. "Its greatest strength is scalability. The system grows in step with the customer's production requirements," Wakabayashi says.

The DLP Series is easily scalable, allowing clients to start with a Scribe module and a Break module. The system's architecture allows the units to be docked and integrated with robotics, enabling complete automation as production increases. "This makes it suitable for both R&D and high-volume manufacturing," Wakabayashi says. "Looking ahead, when new processes or capabilities emerge, we can add new modules via docking—so the platform is genuinely future-ready."

Earning Global Confidence, One Wafer at a Time

Getting these units into the hands of customers is a matter of trust, and MDI has been laser-focused on demonstrating the performance and dependability of its technology.

Manufacturers are responding enthusiastically to MDI's groundbreaking SnB pro-

cessing technology. Early evaluations with partners have shown outstanding results in speed, precision and environmental performance, earning praise for its ability to cut wafers cleanly without water. "The outcomes have been very positive," says Wakabayashi, noting that several customer trials have already advanced into discussions on equipment deployment.

With the global semiconductor industry seeking more sustainable, high-yield production methods, MDI's approach stands out as a credible new standard. The company continues to showcase its innovations at major trade events such as SEMICON Taiwan and SEMICON West, demonstrating to global audiences how its scalable systems are redefining the future of semiconductor manufacturing. MDI will be attending SEMICON Tokyo in December, at booth number E6708 in the East Hall.

"Whatever the field, whatever the product, always deliver the very best to our customers. That is the only way to create the future."

Masaki Wakabayashi,
President,
Mitsubishi Diamond

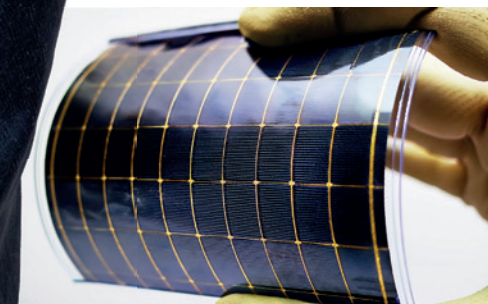
MDI MITSUBISHI DIAMOND
INDUSTRIAL CO., LTD.

www.mitsuboshidiamond.com

Through these events Wakabayashi aims to raise the profile of both MDI and position itself as the trusted name in brittle material processing. He says he wants the company's technology adopted by leading manufacturers in the semiconductor field. "When a critical post-process cutting challenge arises, I want MDI to be the first company that comes to mind," he says.

Expanding Worldwide to Support a Growing Industry

As semiconductor manufacturing has grown overseas, MDI has established itself in key markets.



Perovskite Solar Cell



R2R Type
Laser Patterning for
Thin-Film Solar Cell



Glass Cutter "OZREE"

The company is in the process of building demonstration environments at its overseas bases so clients can make on-site evaluations. "The goal is to combine global reach with local capability, ensuring that technical expertise and practical support are close at hand during pilots, ramp-up, and full production," Wakabayashi says.

However, this expansion is not just for sales. "In terms of geography, semiconductor production is expanding globally, and we aim to support customers wherever they operate," he says. Citing the United States' \$8 billion investment in Arizona and Texas as an example, Wakabayashi says that conversations with stakeholders have highlighted back-end process challenges that MDI intends to address with practical, high-value solutions.

As the only company providing SnB solutions, supporting clients is essential. The company is investigating AI as a solution for around-the-clock technical support. AI sensors can monitor operations regardless of factory locations. "With technology, we can eliminate that limitation and truly expand our capabilities globally," Wakabayashi says.

From glass cutting to semiconductors, MDI's evolution mirrors Japan's pursuit of precision and progress. The company has applied decades of craftsmanship to the demands of modern manufacturing, offering cleaner, faster and more adaptable ways to process brittle materials. Its Scribe-and-Break technology and modular DLP systems now place it among the innovators driving the semiconductor industry's next phase. As nations race to strengthen supply chains and reduce environmental impact, MDI's innovation and customer-centric philosophy position it at the center of that shift.