

Green Tech, AI and Fusion: Inside Japan's Manufacturing Renaissance

Japan's return to manufacturing prominence is being driven by innovators who are leading the world in AI, green technology and advanced materials.

By Daniel de Bomford, Megah Bintang and Bernard Thompson

The history of manufacturing has been punctuated by breakthroughs that continually propelled humanity forward throughout the years. Postwar Japan exemplified such progress, transforming its manufacturing sector to become a global leader by the late 20th century. Although the 1990s ushered in a period of economic stagnation, the assumption that Japan's manufacturing industry has since declined in relevance is misleading. Despite widespread perceptions of diminished competitiveness, Japanese manufacturers continue to lead in technological innovation, particularly in areas such as advanced materials for fusion power generation, robotics and artificial intelligence-driven systems. These developments underscore Japan's ongoing contributions to the evolution of global manufacturing.

"We're working to streamline our operations through digital transformation (DX), automation and the integration of AI."

Akira Fukawa,
president,
Konoshima Chemical Co. Ltd.

Consider Konoshima Chemical: the company's groundbreaking transparent ceramics are transforming advanced sectors, where its high transparency enables the stable, high-output lasers required for advanced physics and fusion energy research. The company stands alone in its ability to create ceramics that surpass the quality of the crystal typically used. "Our prod-

ucts maintain stable quality throughout their use, and I think that consistency is our greatest strength," President Akira Fukawa says. This focus on quality and productivity sets Japanese companies apart from competitors who prioritize volume.

"We're proactively exploring overseas expansion of our production facilities as part of our strategy to hedge against future uncertainty."

Yoichi Murata,
president,
Heat Energy Tech Co. Ltd.

Heat Energy Tech embodies that quality promise. President Yoichi Murata states that the company's heat treatment technology and equipment represent the highest quality and have applications in various industries, including automotive manufacturing, food and pharmaceuticals. As demand grows for environmentally conscious products such as EVs, that demand flows upstream to materials and equipment suppliers. The company leads the industry in developing decarbonization technologies, such as its hydrogen co-firing burners, which significantly reduce CO₂ emissions. "We see this period of change as an opportunity and believe that evolving and adapting our technologies for new applications will be key to creating a sustainable growth model and ensuring the long-term survival of our company," he says.

The green revolution is well and truly taking root in Japan, with innovative companies like Green Sci-

"We are now making batteries in Shiga prefecture and Europe, based in Switzerland."

Ryohei Mori,
president,
Green Science Alliance Co. Ltd.

ence (GS) Alliance investing in an incredible array of technologies. From natural biomass-based nail cosmetics to quantum dot fertilizers, president Ryohei Mori says that he searches for underdeveloped technologies and works with his team to develop them. "Everything is based on the purpose for CO₂ reduction and plastic pollution reduction, so I'm always chasing the same goal with different materials," he says. In a world where recycling lithium-ion batteries often involves melting them down with toxic chemicals, GS Alliance has developed a more environmentally friendly process that utilizes nontoxic materials. Then, from the reclaimed product, the company has created the world's first rechargeable, recycled lithium-ion battery.

"The power of *monozukuri* comes from the combination of quality, cost-efficiency and operational excellence."

Keitaro Harada,
CEO,
Japan Co. Ltd.

Happy Japan's catalog of creations, from home sewing machines and industrial embroidery equipment to its leading microchip testing technology, is a result of another Japanese advan-

tage, *monozukuri*, according to CEO Keitaro Harada. "The greatest strength of Japanese *monozukuri* lies in manufacturers' ability to create products that precisely meet the detailed needs of their customers, ensuring a high level of satisfaction," he says. Happy Japan embodies this philosophy; its machines are quieter and more efficient than those of its competitors, thoughtfully developed with a focus on quality rather than quantity.

"We've always prioritized entering the fields of AI and semiconductors because these fields are experiencing rapid growth."

Takuya Iwata,
president and CEO,
IWATA & Co.Ltd.

Japan's manufacturing dominance is evident in companies like Iwata & Co., with its high-performance fluoro-resins that are vital for semiconductors and chips for advanced computing. President and CEO Takuya Iwata says that no other country can offer technology-driven solutions like Japan can. "Japan is widely known as a country that drives technological solutions and is able to leverage DX, IoT and precision manufacturing," he explains.

The world needs manufacturing leaders who can take calculated risks and develop the crucial technologies that will propel humanity into a new manufacturing revolution. Contrary to the narrative, Japan is thriving, leading in advanced manufacturing materials and processes.

Konoshima Chemical Advances Sustainable Material Solutions

Konoshima Chemical pioneers transparent ceramics and CO₂ recycling technologies, facilitating global research and development of future technologies and providing materials for a more sustainable industry.



By Daniel de Bomford and Arthur Menkes



"We are a company that delivers solutions to society through CO₂ reduction, clean energy and transparent ceramics."

Akira Fukawa, president,
Konoshima Chemical Co. Ltd.

The world is racing toward a greener future, and the materials of tomorrow are being created today. For industries such as energy, high-tech manufacturing and construction to reach greater heights in advanced research and manufacturing, they require cutting-edge solutions. For over a century, Konoshima Chemical has been a leading Japanese company in materials and chemical research, development and manufacturing. More recently, its efforts in CO₂ reduction, clean energy and transparent ceramics have garnered international attention.

The company is pioneering transparent ceramics, particularly yttrium aluminum garnet (YAG), which is being adopted across industries. YAG ceramics fill a variety of niches, including scientific research, medical, defense, industrial, fusion ener-

gy and high-intensity laser systems. In particular, the ceramics' high transparency enables stable, high-output lasers required for fusion research and advanced physics, as its large size and superior thermal and mechanical durability outperform those typically employed in single crystals. Konoshima Chemical's ceramics are being evaluated as critical components in high-powered laser assemblies critical for experimental fusion reactors. Laser fusion energy systems utilize extremely powerful laser pulses to rapidly compress and heat fuel, creating the extreme temperatures and pressures necessary to ignite a controlled thermonuclear reaction that releases vast amounts of clean energy, much like stars.



Takuma Factory, (Kagawa, Japan)

Konoshima Chemical ensures stable quality and can customize the dopant concentration levels to user requirements. The company's transparent ceramics have been well-received internationally, as evidenced by the ceramics' adoption by NASA and the Lawrence Livermore National Laboratory in the United States. He sees the 10 to 20-centimeter segment as having the greatest potential for Konoshima Chemical's global expansion, as the company is the



Transparent YAG ceramics for various applications

only producer capable of achieving quality higher than that of a crystal. There is considerable potential in autonomous vehicles; however, production costs remain relatively high for the consumer market.

Konoshima Chemical's ceramics have a wide variety of applications across industries and scientific disciplines. Its Bonded LuAG Ceramic Scintillators are a key component in ultra-high-resolution X-Ray imaging. Developed with Japan's RIKEN and the High Luminance Photon Science Institute, this technology enables 200 nm resolution—nearing the theoretical limit of X-ray imaging. The detector uses LuAG:Ce ceramics, bonded with precision for unmatched clarity. It's applied in advanced imaging systems for detailed biological and material studies.

Konoshima Chemical has been recognized for advancing material performance and efficiency, reducing carbon emissions and promoting a safer, more human-centric work environment. "Our factory emits a significant amount of CO₂, and we recognized that this isn't sustainable for the future. That led us to consider what actions we could take," Fukawa says. When the company began exploring CO₂ recycling, synergies within the company emerged. Konoshima Chemical has developed an innovative technology that can convert emissions into a valuable material. The company is in the early stages of its long-term plan to establish a system that utilizes the carbonization technology it developed for producing carbonate compounds as a raw material, achieving factory-level net-zero CO₂ emissions—a first in Japan. "Our system has potential applications

beyond our own operations and could be adopted by other companies and industries," he says. The company was awarded the Good Design Award, which has led to enquiries within Japan. Fukawa says that the company plans to promote it globally, as it is well-suited for international use. While there are theoretical alternatives, Konoshima Chemical's solution is already available. "If the right conditions are in place, it can be deployed anywhere in the world right away," he says.



Bonded ceramics for Q-switch applications

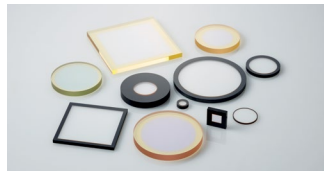
With 108 years of operation under its belt, Konoshima continues to innovate, push boundaries and find solutions for tomorrow's challenges. As its transparent ceramics enable breakthroughs in energy and science, its CO₂ recycling is turning emissions into building materials. The company is reshaping advanced manufacturing and positioning itself as an innovative leader as global industries seek sustainable, high-performance materials. Speaking on ceramics, Fukawa, the company's goals, "Moving forward, we hope to expand our reach into the private sector and generate sales in those areas."



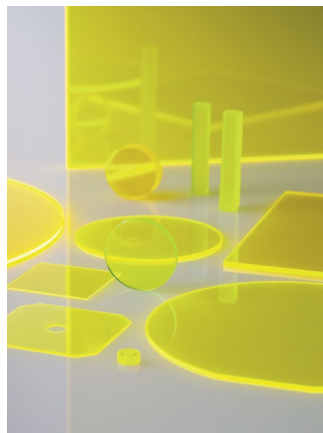
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Examples of various colors by changing dopant ions in YAG



Bonded ceramics for nuclear fusion applications



Scintillators and phosphors

"Happiness to people around the world": Happy Japan's brand designs

Having launched an original brand of sewing machines, Happy Japan is targeting global growth—with the U.S. and Europe in its sights. *By Arthur Menkes*

A company on a mission to "lead the development of advanced technologies that bring happiness to people around the world," Happy Japan stands out as a shining example of Japanese manufacturing excellence.

The Yamagata-based firm, whose origins date back to 1923, boasts an ever-growing portfolio of expertly crafted products that offer a superior user experience.



Such traits are evident across Happy Japan's catalogue of creations: from the company's seamlessly smooth home sewing machines to its standard-setting industrial embroidery equipment and its leading-edge microchip testing technology.

Key to reaching these world-class standards is a dedication to *monozukuri*: a Japanese manufacturing philosophy that revolves around the pursuit of outstanding craftsmanship.

"The greatest strength of Japanese *monozukuri* lies in manufacturers' ability to create products that precisely meet the detailed needs of their customers, ensuring a high level of satisfaction," explains Happy Japan's CEO, Keitaro Harada.

"Achieving this is about producing goods of the highest quality while also reducing costs to make them more accessible. Equally important is the standardization of processes for more efficient production workflows. The power of *monozukuri* comes from the combination of quality, cost-efficiency and operational excellence."

Happy Japan's sewing machines are emblematic of this commitment to ensuring the cus-

tomers is left reaping the rewards of a product with a difference.

"What sets our machines apart is their exceptionally quiet operation, designed for a more user-friendly and comfortable sewing experience," Harada says. "While machines typically operate in the upper 60-decibel range, ours function in the lower 60s—and we're investing in research and development to bring that below 60."

"Another key differentiator is our advanced fabric feed technology, which enables smooth, consistent stitching, regardless of material thickness. Whether working with ultra-thin fabrics or heavier textiles, our machines handle the material effortlessly."

In 2021, the company launched the Happy Japan original brand of sewing machines, shifting its focus from supplying products as an original equipment manufacturer to bolstering its reputation among international consumers.

"Domestic demand for home sewing machines in Japan is extremely low," Harada reveals. "In contrast, overseas markets, particularly the U.S. and Europe, continue to show strong demand, so we're focusing on expanding exports to these regions."

Meanwhile, Happy Japan's state-of-the-art industrial equipment is also integral to the company's designs on continued business growth.

Anchored by exquisitely intuitive control panels, the firm's durable, vibration-free embroidery machines are kitted out with motors of industry-leading strength.

Like the company's sewing machines, Happy Japan's embroidery equipment is the subject of constant innovation in the enterprise's research and development department. So, too, are Happy Japan's integrated circuit (IC) handlers, which are at the heart of the manufacturer's venture into the microchip industry.

The company's IC handlers are a blend of speed, accuracy and lightness of touch, all qualities

that are crucial when dealing with delicate microchips.

"Our IC handlers, which conduct the final tests to determine whether each IC is functional or defective, are the fastest in the world," Harada says. "Despite this, they are engineered with gentle mechanisms to prevent any damage to ICs. And, while some IC handlers on the market mistakenly identify functional ICs as defective, our machines ensure that functional chips are correctly identified and approved."

Thanks to the IC handlers' straightforward automated design, a single operator can comfortably monitor several dozen machines at the same time. "With minimal switching time and zero downtime, our systems ensure seamless operation, maximum efficiency and high throughput," Harada declares.



"The power of *monozukuri* comes from the combination of quality, cost-efficiency and operational excellence."

Keitaro Harada,
CEO, Happy Japan Inc.

Given microchips' pivotal role in powering growth technologies such as artificial intelligence and electric vehicles, Happy Japan is intent on doubling down on its investment in IC handlers. "We plan to further strengthen this business as a core pillar of our company," the CEO concludes.



Green Science Alliance Powers Sustainable EV Innovation

GS Alliance is developing next-generation material solutions for everything from EVs and agriculture to fuel cells and even beauty to address climate change. *By Daniel de Bomford, Cian O'Neill and Paul Mannion*

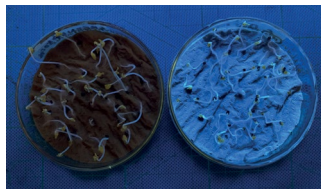


"In everything I do, the common factor is always material engineering."

Ryohei Mori, president,
Green Science Alliance Co., Ltd.

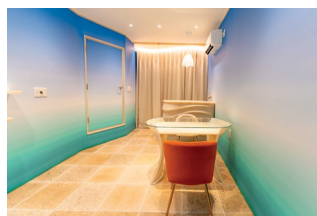
Developing new, sustainable technology is critical in meeting the environmental and economic challenges that humanity faces. Green Science Alliance is laser-focused on developing new technologies, and President Ryohei Mori states that the company aims to reduce CO₂ and plastic pollution. The company has devel-

oped a simpler process to recycle lithium-ion batteries that doesn't rely on toxic chemicals. Then, from the "black mass," it creates the world's first recycled, rechargeable lithium-ion batteries.



Quantum Dot-based nano fertilizer

GS Alliance has recently established a new subsidiary, e-Gle Tech Co., in collaboration with professor Hiroshi Shimizu of Keio University, a visionary who developed functional, groundbreaking electric vehicle prototypes, such as the Eliica, over 20 years ago, before Tesla. The company is developing and manufacturing EVs that combine professor Shimizu's in-wheel electric motors and GS Alliance's next-generation batteries, including recycled lithium-ion



3D-printed plant-based bioplastic furniture and décor

batteries. It is also developing new perovskite solar cells, platinum-free fuel cells and plant-based cellulose nanofibers that could be integrated into its EVs.



"Eliica" next-generation in-wheel motor-based EV

While GS Alliance's lofty ambition to create the world's most advanced EV in Japan is well underway, the company is also re-

searching a myriad of other environmentally conscious products, from biochemical products to CO₂ conversion to fuel and quantum dot-based fertilizers and pesticides.



Black mass-based recycled lithium-ion battery

Mori says, "Everything is based on the purpose for CO₂ reduction and plastic pollution reduction, so I'm always chasing the same goal with different materials."



Green Science Alliance
www.gsalliance.co.jp



Heat Energy Tech Powers Green Growth

The company aims to provide unparalleled heat treatment solutions in pursuit of carbon neutrality. *By Daniel de Bomford and Arthur Menkes*



"Our products represent the highest quality available to customers, especially those manufactured in Japan"

Yoichi Murata, president,
Heat Energy Tech Co. Ltd.

Industries worldwide are undergoing a significant transformation to reduce carbon emissions. Heat treatment plays a crucial role across many sectors, particularly in manufacturing, and Heat Energy Tech is leading the way with environmentally sustainable innovations.

According to President Yoichi Murata, the company's technologies rest on two main pillars. The first is high-temperature systems, operating above 500°C, mainly

used in the automotive industry. The second is low-temperature heat treatment equipment, operating at around 200 C, which serves industries such as coatings, paints, food and pharmaceuticals. Heat Energy Tech's strength lies in its ability to design and manufacture equipment that operates over a wide range of temperatures.

The company has proactively advanced its decarbonization technologies, including the development of hydrogen co-firing burners. This system significantly reduces CO₂ emissions by combining traditional energy sources with hydrogen. Additionally, the company is enhancing its heat cascade technology, a system that reuses waste heat in stages within the same unit, delivering high efficiency and substantial energy savings.



Katsura Group's new factory in Vietnam

Through these systems, Heat Energy Tech is accelerating its proposals for energy



Hydrogen co-firing burner

conservation and carbon neutrality to all users of thermal energy.

The company is also actively expanding its manufacturing operations in the ASEAN region. In addition to its Chinese factories, it is promoting manufacturing with a view to global expansion at its newly established factory in Vietnam. Murata emphasizes, "Our products are unmatched in quality, and that same high standard is upheld at our overseas facilities."

"We see this era of change as an opportunity," Murata concludes. "By evolving and adapting our technologies for new applications, we aim to build a truly sustainable growth model."



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