

# Unlocking endless opportunities in carbon

Toyo Tanso was the first company in the world to mass produce isotropic graphite back in 1974 and today its high-quality graphite products are used across a wide range of industries. A vital cog in the ever-involving semi-conductor industry for over four decades, Toyo Tanso will remain at the forefront as the world embarks on a new era defined by fourth industrial revolution technologies such as robotics, IoT, smart devices and big data.



*"We can adapt our product to a wide range of applications. By mixing different materials such as metal and resin or ceramics, we can expand the range of our possibilities even further and address the market's needs"*

**MR. NAOTAKA KONDO,**  
Representative Director,  
Chairman & President, CEO,  
Toyo Tanso

Rapid advancements in technological products are often the result of rapid improvements in the materials and components that remain hidden to the naked eye of end consumers. Not only do these components or composite materials remain unseen, many of them remain unheard of by the general public, despite their profound impact on the development of the modern technologies that today sit in our pockets, assist us at work, power our homes and cars, and even save our lives.

People will talk about the invention of the wheel, the light bulb, the television and the internet, but perhaps few will have ever considered the invention of isotropic graphite, which is an essential component in hi-tech products and equipment. Compared to conventional graphite, which is anisotropic and has limited applications, isotropic graphite is much stronger due to its micro-particle structure, with higher reliability, ultra-high heat resistance, excellent chemical resistance and electrical conductivity, while also being lightweight and easy to machine.

Today isotropic graphite has an almost endless array of applications, from automobiles and semi-conductors, to the renewable energy industry and nuclear power plants. And with leading manufacturers improving the technology behind its production, the range of applications for isotropic graphite will continue to grow. Similarly, the global isotropic graphite market is expected to register revenue growth of 4.3% annually over the coming years, reaching \$1.3 billion by 2024, up from \$910 million in 2019.

Industrial use of this groundbreaking material can be traced back to Japan in 1974, when Toyo Tanso became the first company in the world to successfully mass produce large-size isotropic graphite. Since then the company has constantly invested in R&D and innovation to meet the

needs of a constantly developing market. From automobiles, home appliances and consumer electronics, to medical devices, solar panels, aerospace and medical care, Toyo Tanso's isotropic graphite products are found across the industrial spectrum, and are highly regarded for their excellent performance, quality and reliability.

The company's operations span the globe, and in the U.S. it has been servicing the semiconductor industry for over 25 years. One of the top-three manufacturers worldwide, Toyo Tanso has remained at the forefront of the graphite industry by providing innovative materials and solutions to help both the company and its customers to stay ahead of their competition.

So while other Japanese companies have fallen behind competitors in China, the U.S., Europe and South Korea, how has Toyo Tanso managed to maintain a competitive edge over its rivals? For company president, Naotaka Kondo, it's about the diligence and care that goes into every step of the production, from procurement of raw materials to the creation of the final product.

"We select the appropriate raw materials to start; we design the product, study the technical requirements such as coefficient thermal extension, bending strengths or heat resistance, and we go all the way to the fabrication itself. We always need to keep in mind our customer's desire and adapt our development accordingly. It is a continuous learning process as we always search for new applications for our products," he explains.

"With graphite for example, the higher the temperature of the

our possibilities even further and address the market's needs."

### Toyo Tanso's groundbreaking technologies

While isotropic graphite's unique properties make it suitable for multiple applications, the constantly evolving demands of customers in hi-tech industries compelled Toyo Tanso to develop C/C composite. Just as it did 46 years ago when it introduced isotropic graphite onto the market, Toyo Tanso changed the game with this groundbreaking carbon-carbon composite material. Reinforced by high strength carbon fiber, C/C has superior properties that make it lighter, stronger, more elastic, more heat resistant and easier to handle than isotropic graphite.

"In the semiconductor industry, manufacturing equipment for semiconductors is becoming bigger in size to increase the volume of production. According to this trend, our graphite products, which are used in manufacturing equipment for semiconductors, are also getting heavier and bigger in size," explains Mr. Kondo.

"Therefore, semiconductor customers are adopting lighter C/C composite products. Trends in size, upgrading equipment and lightweight requirements of equipment parts are not only seen in the semiconductor industry but also in other industries, so we are looking towards more expansion of this product." C/C is also being used in astero-probes developed by the Japan Aerospace Exploration Agency and plasma testing equipment for nuclear fusion reactors. To enhance the performance of its

coming from these industries, in 2018 Toyo Tanso announced a JPY 2.5 billion investment in its Technology Center in the Kagawa Prefecture to ramp up production of its SiC-coated carbon graphite products.

Today, manufacturers of power semiconductors are using silicon carbide (SiC), gallium nitride (GaN), aluminum nitride (AlN), and zinc oxide (ZnO), with these mono-crystalline manufacturing processes involving high temperatures and harsh environments using corrosive gases such as ammonia and hydrogen chloride – thus requiring even stronger and more resistant graphite materials. This led Toyo Tanso to develop EVEREDKOTE, a high-purity isotropic graphite substrate covered with dense tantalum carbide (TaC). With a melting point of approximately 4,000°C, this TaC coating provides ultra-high thermal durability. Moreover, it is crack-free and has excellent thermal shock resistance.

Another of Toyo Tanso's coating innovations is GLASTIX KOTE, a material coated with glass-like carbon on a graphite surface. Offering enhanced durability against scratching and other friction, as well as reducing the generation of dust, GLASTIX KOTE's applications include: parts for silicon single crystal pulling devices; parts for epitaxial growth; dies for continuous casting; and glass sealing jigs.

"GLASTIX KOTE is a product that can be used for applications other than semiconductor processes and combines resin coating technology and graphite conversion technology pioneered by Toyo Tanso," Mr. Kondo explains.



SiC-TaC-coated hybrid susceptor, manufactured with Toyo Tanso's unique technology, contributes to the evolution of SiC semi-conductor manufacturing.

"We believe that the silicone crystal and compound semiconductors markets are becoming very strong and will continue to grow at a fast pace as the use of computers and smart devices is becoming more important every day and in every aspect of our lives," says Mr. Kondo, who also points out growth opportunities in other industries in which Toyo Tanso is highly active, from transport and aerospace to renewable energies.

"Automobile is one of the sectors in which the application of our materials is growing the fastest, and the requirements are usually focused on better strength, improved light weight, and minimized costs. The train industry also requires compound semi-conductors with higher resistance to speed, heat and voltage. The opportunities are also significant in the making of the next generation of medical equipment.

"In the aircraft industry, we provide materials for furnaces. We are even active in the aerospace industry, where our products are used by engine manufacturers. Solar energy is indeed becoming prominent for us also since we contribute to making carbon-fiber panels."

From a geographical perspective, Toyo Tanso aims to continue expanding its presence on the international market, which already accounts for 60% of its sales. The company has established production and sales bases in more than 10 countries across the globe, including China, America, Europe and Asia.

The USA is one region where the company sees ample opportunity to bring its high-quality graphite products to a wider customer base. With its U.S. headquarters situated in Troutdale, Oregon, Toyo Tanso recently established a sales office in Washington DC in order to strengthen sales and marketing activities in the eastern region of the country.

China, naturally, is another big focus area, where many manufacturers have opted for high-quality, high-performing components made by Japanese companies over cheaper versions offered by domestic suppliers. The Dragon economy, therefore, offers ample opportunities for internationally reputable Japanese firms like Toyo Tanso, which already has four subsidiaries around Shanghai and recently inaugurated a new manufacturing facility in Chengdu.

"We are expanding in China and our future plan is to continue increasing our presence there since

it is the most populated country in the world with endless possibilities," says Mr. Kondo.

Through the establishment of its new Chengdu subsidiary, Toyo Tanso aims to further expand sales of its carbon brushes in the Chinese market. Another high-quality product which forms part of the company's rich portfolio, carbon brushes play an important part role in the flow of electric current between stationary and rotary parts in motors and generators. Toyo Tanso's brushes are used in a broad range of industries, but mainly for home appliances and power tools.

"The countries that have the biggest growth potential are undeniably China and the USA, followed by Germany, France and Italy," adds Mr. Kondo. "The reason behind this is because our main segments are the semiconductor and the automotive industries, which are all rapidly increasing in these countries. In addition, we are currently putting a big effort into trains; we are noticing that the train industry is experiencing rapid growth and utilizes our products."

### Inspiration for innovation

With such a wide global base, Toyo Tanso strives to ensure that its long-standing culture of innovation and creativity is adopted by its 16 overseas subsidiaries; while also offering regular evaluation and recognition of its international employees as a form of constant encouragement and motivation. This strong corporate culture ultimately ensures that Toyo Tanso's reputation for high-quality and the spirit of innovation are maintained across its international bases.

"We recently established a new division, the 'corporate planning division', which ensures that our philosophy is shared all around the world. We want our employees to be excited, to be proud and to be keen on constantly innovating. We also put a big effort into the appraisal of employees, into recognition of their efforts and we keep track of their performance records," says Mr. Kondo.

"Another thing we are putting a lot of effort into is the different checks put in place to make sure we maintain high quality uniformly across all the companies and one way in which we are doing so is by monitoring defects – recognizing what has happened, why it happened and then sharing that information as fast as possible with all of the other plants. As a result, we are improving our efficiency, performance and transparency across the world."



Toyo Tanso has a global network made up of 16 subsidiaries in 12 countries and aims to continue expanding its presence on the international market, which already accounts for 60% of its sales.

usage environment, the stronger the product will be. It can withstand use in high temperatures due to its high manufacturing process temperature and has unique properties that increase strength at 1,000°C to 2,000°C.

"The temperature resistance of silicon carbide can go up to 1,400°C, whereas with graphite, it can go up as high as 2,500°C. As a consequence, we can adapt our product to a wide range of applications. By mixing different materials such as metal and resin or ceramics, we can expand the range of

graphite products, Toyo Tanso has also developed a series of Chemical Vapor Deposition (CVD) coating technologies used to make the latest state-of-the-art semi-conductors that require highly purified components with higher resistance to heat, oxidation and chemicals.

PERMA KOTE™, for example, is a graphite product coated with silicon carbide (SiC), which serves as a susceptor in the manufacturing process for semi-conductors used in smart sensors, LED lighting, IoT and big data technologies, as well as automotive electronic systems. In order to meet the growing demand

### Eyeing global growth in a range of industries

Toyo Tanso has been a vital cog in the ever-involving semi-conductor industry for over four decades. And through its constant development of the most high-performing composite graphite products, it will remain at the forefront as the world embarks on a new era defined by fourth industrial revolution technologies such as robotics, IoT, smart devices and big data – technologies for which high performing semi-conductors form the building blocks.

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## TOYO TANSO

# Inspiration for Innovation

Toyo Tanso contributes to the world through the pursuit of the possibilities in carbon

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