Striving to Become a Major
Carbon Fiber Composite Production Base

CARBON FIBER / COMPOSITE PROJECT IN ISHIKAWA

Ishikawa Sunrise Industries Creation Organization

Striving to Become a Major Carbon Fiber Composite Production Base

"Carbon Fiber/Composite Project in Ishikawa" - Investigating Advanced Materials through Industry-academic-government Cooperation

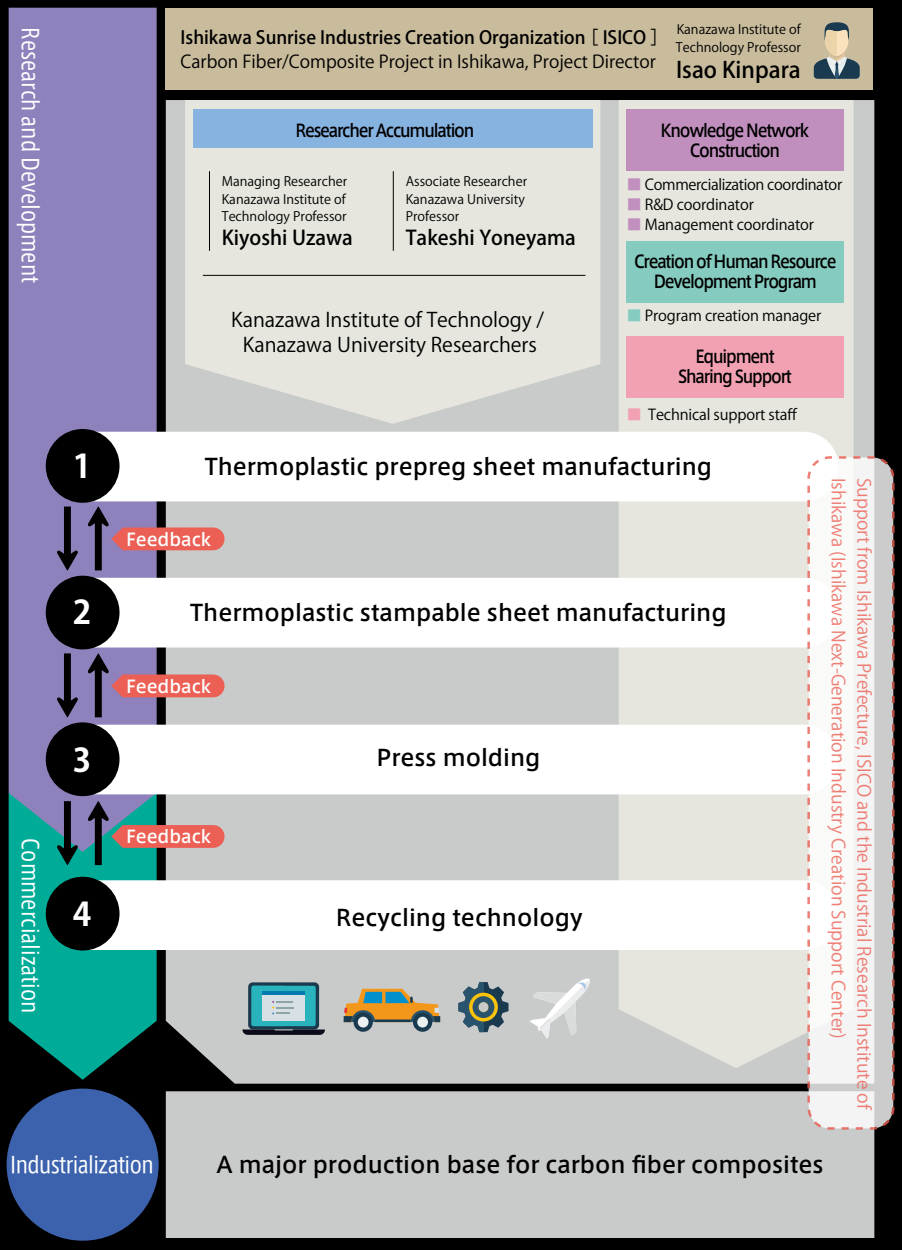
"Carbon fiber" is 10times stronger and 75% lighter than iron. Attention on "carbon fiber composites (resin-impregnated carbon fiber) "is increasing as a future key industry after the machinery, textile, foodstuff and IT industries that support Ishikawa Prefecture. "The Carbon Fiber/Composite Project in Ishikawa" was established allowing us to press forward with the creation of a new industry through industry-academic-government cooperation.

CARBON FIBER / COMPOSITE PROJ

Adopted as a MEXT Project for regional innovation

The Carbon Fiber/Composite Project in Ishikawa was launched in 2009 with Professor Isao Kinpara as Project Director, in order to turn Ishikawa into a major production base for carbon fiber composites, from development to the establishment of an integrated production system. In 2012, it was adopted as a "MEXT Project for regional innovation", and during the 5 years to 2016, initiatives including "researcher accumulation", "knowledge network construction", "human resource development" and "equipment sharing" were advanced. Effort has been poured into various areas, including inviting top-level domestic researchers and the placement of coordinators to connect universities and manufacturers.

In addition, the number of companies participating in the cluster has risen to 118. Several visible results nearing practical implementation have arisen from the cluster's initiatives, such as the commodification of thermoplastic stampable sheets (carbon composite sheets that are layered, heated and manufactured) and the development of an automatic laminating device for thermoplastic prepregs.



Agreement with the world-leading cluster, CFK Valley

In October 2015, a cooperation agreement was made between the major carbon fiber industry cluster "CFK Valley (CEO: Gunnar Merz) " of Lower Saxony in northern Germany and "the Innovative Composite Center (ICC) ", an R&D base for carbon fiber composites headed by Prof. Uzawa of Kanazawa Institute of Technology.

CFK Valley is a world-leading carbon fiber composite R&D base, featuring 120 participating organizations. It has been successful in a range of projects, including the mass production of Airbus aircraft parts. The exchange of technology and human resources is well underway, with synergies utilizing the strengths of the ICC and CFK Valley highly anticipated.

Ishikawa Prefectural Governor Masanori Tanimoto (far left) and the Lower Saxony Prime Minister Stephan Weil (far right) were also present for the agreement.

From upstream to downstream industry - Cooperation with the Tokai region

The December 2015 convention, held at Hokkoku Shimbun Akabane Hall. Approximately 400 guests were invited, who deepened their collective understanding of research trends and the market outlook.

The automobile and aircraft fields are driving the usage of carbon fiber composites. In regards to the development of automobiles and aircraft, the textile and machinery industries of Hokuriku are thriving as upstream and middlestream areas, with the Tokai region as the downstream area performing the final process of productization.

In order to link the two regions, from the upstream to downstream, "the Tokai-Hokuriku Composite Highway Plan" was developed. Various initiatives designed to deepen the cooperation between the Hokuriku and Tokai regions are ongoing; one of which was a convention held in Kanazawa during December 2015.

Research group launched for applications to the construction field

Lightweight, strong carbon fiber composites are also very appealing as building materials. In October 2015, "the Research Group for Construction Applications" was launched with members from textile, housing and construction companies, universities, and the government.

Within the research group, the broad use of composites as construction materials is envisioned, and a medium-to-long term roadmap based on arguments from a legislative perspective has been created. In 2017, materials developed by member companies are expected to be certified under the Japanese Industrial Standards (JIS) as seismic reinforcement materials (see page 8), and steady progress is being made.

A medium-to-long term strategy is being considered by the research group, which includes construction research institutes from around the country and related companies and government agencies.

Kanazawa Institute of Technology Innovative Composite Center［ICC］

INNOVATIVE COMPOSITE CENTER

Pursuing the Creation of New Markets through Combining Technology from Different Industries and Fields

Engineers and researchers from companies and universities gather here to work on practical applications for composites

There's a rich variety of large manufacturing equipment

Preparing R&D environments aiming for practical application

Despite the fact that domestic textile manufacturers have acquired approximately 60% of the global share of carbon fiber production, the productization of these composite materials is mainly performed in Europe and America. Thus in June 2014, "the Innovative Composite Center (ICC) " was opened at Kanazawa Institute of Technology's Yatsukaho Research Campus (Hakusan City), as a base for joint research for practical application through industry-academic-government cooperation, with the aim of developing the domestic composite material market.

The ICC features a large open space allowing for the construction and testing of large structural components, and a "knowledge corridor" allowing researchers to deepen collaboration. Various universities' and companies' researchers are gathered here, engaged in "market development", "material development" and "manufacturing technique development" in order to meet the specific needs of society, through combining the technologies of different industries and fields.

The nurturing of company engineers for industry expansion is also one of the ICC's important missions.

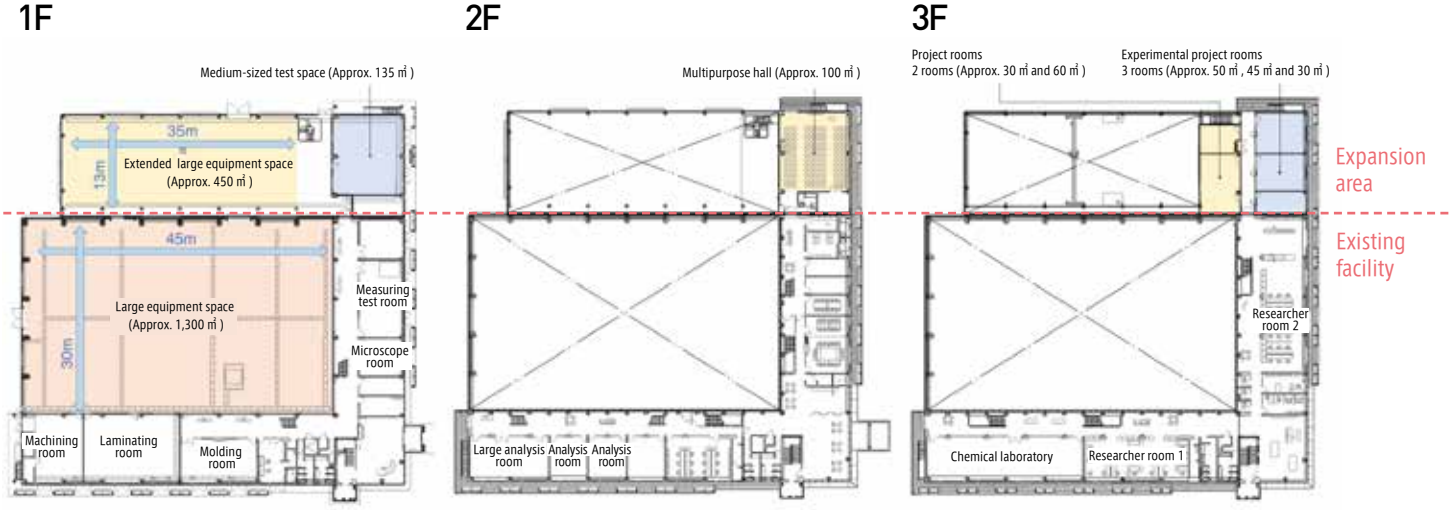
TOPICS

Expansion completed in fiscal 2017 Accelerating prototype development and empirical evaluation

1300㎡ expansion through government assistance

Expansion was completed at the ICC at the end of 2017. The outfitting includes a 3-floor steel-construction extension with approx. 1300 ㎡ of floorspace, containing a medium-sized test space, small laboratories, project rooms and a conference room.

Support via "the MEXT Regional Science and Technology Demonstration Base Establishment Project" received in December 2016 is being utilized for the expansion. Following completion, companies and research institutes from within and outside the prefecture will participate anew, and we plan to commence molding technology development and empirical evaluation projects for the use of composites in automobiles, aircraft, rolling stock, ships, civil engineering and wind power generation etc.



1F

Large Manufacturing Equipment / Molding / Test Evaluation Zone

"Enlargement" is an important part of composite innovation. With this in mind, a spacious area has been set up, allowing for composite forming and assembly, material test evaluation, etc.

[Installed equipment]

Double belt press, servo press, hydraulic press, HP-RTM molding system, vacuum chamber press, autoclave, film extrusion molding machine, laser machining device, multiaxial robot, micro x-ray CT, etc

2F

Analysis / Project Zone

A variety of analysis devices that would be difficult for a single company to acquire all of are installed here. There is also a project area where small / medium conferences can be held.

[Installed equipment]

NMR, FE-SEM, XPS, XRD, TGA, DSC, etc.

3F

Chemical Experiment / Research Lab Zone

A chemical experiment area and researcher lab area are located on the 3rd floor. The lab area has no internal walls, creating an open space with wide corridors, allowing researchers to deepen their communication easily.

[Installed equipment]

Gas chromatograph mass spectrometer, high - speed liquid chromatograph mass spectrometer, GeneChip Scanner, microchip next-generation sequencing system, etc.

Center of Innovation Science and Technology based Radical Innovation and Entrepreneurship Program

COI STREAM

Building Next-gen Infrastructure Systems, Looking 10 Years into the Future

Kanazawa Institute of Technology selected as a core location in 2013

"The MEXT COI STREAM" establishes research topics based on what society should look like 10 years from now, derived from the latent needs of today. The COI Program "Construction of next-generation infrastructure using innovative materials", based at Kanazawa Institute of Technology (Nonoichi City), is one of the 12 sites around Japan selected in the COI STREAM, which began in 2013.

It is the only site selected on the Japan Sea side of Japan, with participants from a range of universities, research institutions and companies within and outside of Ishikawa, including Kanazawa Institute of Technology, Kanazawa University, the Industrial Research Institute of Ishikawa, and machinery, textiles and housing manufacturers. In the 9 years to 2021, approximately 7 billion yen (US$63 million) of government financial support is estimated. Various R&D is underway in order to bring composites to the core of next-gen infrastructure, with the ICC as the research base.

Focusing on 3 types of infrastructure: "urban & residential infrastructure", "social infrastructure" and "marine infrastructure"

The practical applications targeted through the COI Program include infrastructure concerned with "urban & residential", "social works", and "the marine". Specifically, composite R&D is underway under the themes of high-rise buildings and next-gen housing for urban & residential; railroads, tunnels and bridges for social works; and large sail boats and offshore wind power for marine infrastructure.

In addition, the improvement of consolidation techniques of carbon fiber and resins, manufacturing processes such as the molding of long / large structural components, and the development of eco-friendly plant-based composites and future recycling techniques are also major themes. With a focus on environmental performance, cost-reduction and mass production, we are making progress in the challenges related to the realization of a safe and secure society pictured hundreds of years in the future.

● The COI mission, with Kanazawa Institute of Technology at its center

Research and development of innovative materials that are super lightweight, high strength and corrosion-resistant, to take the place of traditional iron materials etc.

Research and development of manufacturing processes for industrial goods making use of innovative materials

Achieve industrialization / mass production, with application to urban & residential, social and marine infrastructure

Three Types of Infrastructure Development through the COI Program

Urban & Residential Infrastructure

Responding to social change such as the increase in marginal settlements and single elderly person households. We aim to develop urban & residential that can be designed flexibly and easily relocated / recycled after construction.

Social Infrastructure

Super lightweight, high strength, corrosion-resistant composites for use in bridges and railroads. We are working to realize social infrastructure that is strong against natural disasters and keeps maintenance costs close to zero.

Marine Infrastructure

We are investigating the difficult problem of how to use carbon fiber composites for very long and large structures, such as the blades of offshore wind generators. We will make lightweight, strong, corrosion-resistant marine infrastructure a reality.

Reducing Environmental Burdon

- Realization of eco-friendly materials through biotechnology
- CO2 reduction through lightweight automobiles, aircraft and rolling stock

Reducing Social Costs

- Long life + lightweight + high strength
- Reduction of construction/ maintenance costs for infrastructure

Creation of New Value

- Realization of long and large structures
- Creation of sustainable energy

The key features of CABKOMA Strand Rods are that they do not rust due to rain or sea breeze, nor do they expand / contract due to temperature change

Innovative materials that will change the future of infrastructure are being created in succession at the ICC, as a base for R&D through the COI Program. Here we introduce some initiatives that are advancing towards practical application, with a focus on companies from Ishikawa.

Innovative Materials from COI Member Companies for Transforming Our Infrastructure

CASE 01

Towards JIS recognition as a seismic reinforcement material Anticipating use in architecture / public works

Komatsu Matere
[Head Office: Nomi City]

Visit the head office of textiles manufacturer Komatsu Matere, and you will be captivated by an elegant building that looks just like it is clad in a garment. This facility is the fabric laboratory "fa-bo", designed by the world-renowned architect Kengo Kuma. Over 4000 "CABKOMA Strand Rods" are strung from the roof to the ground around the building. These strand rods are a thermoplastic carbon fiber composite developed through the support of the COI Program.

The fabric laboratory "fa-bo" softly surrounded by seismic reinforcement material CABKOMA Strand Rods

This composite is lighter than iron, and each rod features a tensile strength of 9 tons. There's also no concern of rusting or condensation, with use as a seismic reinforcement material for wooden structures anticipated. It was used in preservation and repair work for "the scripture house of Zenkoji Temple" (Nagano City), an important cultural property of Japan. Japanese Industrial Standard (JIS) certification is anticipated in 2018 as a tension member for reinforcement of buildings - Carbon fiber composite strand wire.

The technology of the Ishikawa textile industry was applied in its development, with the carbon fiber braided with the glass fiber, using a method handed down within the prefecture. By twisting seven strands together into a rope shape, long carbon fiber composite, which is normally in the shape of a sheet, can be wound into a coil allowing easy transport. R&D for replacing current iron joints with carbon fiber is underway, which will greatly reduce weight and increase functionality, aiming to popularize carbon fiber as a building material in a wide range of construction and public works.

CASE 02

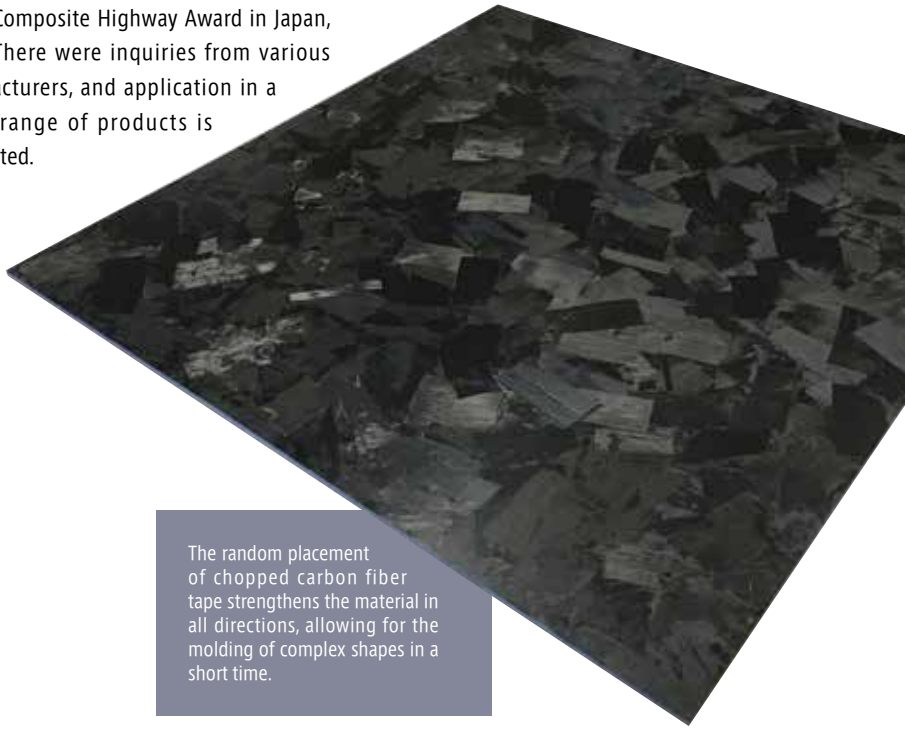
Enabling high-speed, complex shape molding through stampable sheets (Flexcarbon) made from laminated thin-layer chopped tape

Suncorona Oda
[Head Office: Komatsu City]

Suncorona Oda, which integrates production from yarn processing to sewing, worked with the Kanazawa Institute of Technology to develop the Flexcarbon stampable sheet. Flexcarbon is a reinforced sheet made by randomly arranging and laminating 20 layers of thin chopped carbon fiber tape impregnated with special resin, at a total thickness of 2 mm. It is isotropic, and therefore suitable for complex shape molding and high-speed press molding.

This characteristic makes it suitable for computer housing through the simultaneous molding of ribbed structures, and mass production of automobiles parts by means of short-cycle molding is also under consideration.

Flexcarbon was awarded the 1st Grand Prix of the Composite Highway Award in Japan, 2017. There were inquiries from various manufacturers, and application in a larger range of products is anticipated.



The random placement of chopped carbon fiber tape strengthens the material in all directions, allowing for the molding of complex shapes in a short time.

CASE 03

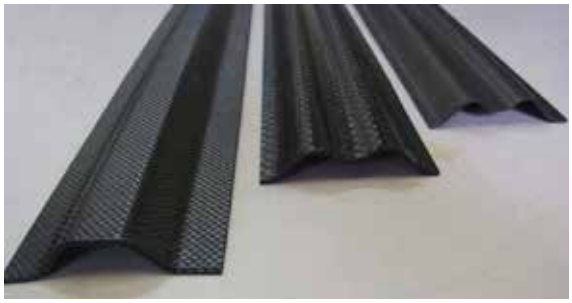
Roll forming technology solves long component molding difficulties

Daido Kogyo
[Head Office: Kaga City]

The molding of carbon fiber composites is performed mainly through presswork. However, there is a limit to the size of components that can be processed using this method, and the molding of long components such as the offshore wind generator blades and deepsea excavation pipes aimed for in the COI Program was difficult. To solve this problem, Daido Kogyo established a roll forming technique through joint research with the Kanazawa Institute of Technology.

Roll forming involves the passing of a thin sheet between several rollers, gradually creating the desired shape. It is used for the manufacture of rim wheels (used in motorcycle and agricultural equipment wheels), one of Daido Kogyo's main products. The processing line molds products without stopping feeding, making it ideal for the manufacture of long materials while also enabling excellent productivity. This technology, cultivated over many years by Daido Kogyo, formed the basis for the development of a continuous molding machine with enhanced heating, pressure and cooling capability for the processing of thermoplastic carbon fiber composite.

We are aiming to establish the first domestic mass production technology for the high-speed and low-cost molding of carbon fiber composites using roll forming, which excels in the processing of long parts with identical cross-sections.



Tackling Diverse Applications

Light, strong carbon fiber composites are anticipated to spur innovation in a wide variety of fields. Initiatives for the implementation of various products are also progressing at full speed in Ishikawa.

Automobile-Related Products

Development and sales of carbon fiber composites Supporting customers through material, design and processing proposals

Ichimura Sangyo [Head Office: Kanazawa City]

The development of thermoplastic CFRP is progressing in Ishikawa, and its application to automobiles is expected to increase due to its mass production capability.

Ichimura Sangyo has been developing thermoplastic CFRP sheets for seven years and has already provided them to over 100 customers in Japan.

Ichimura Sangyo supports customers' product development by supplying many kinds of CFRP and preparing mold testing equipment for customers.

Carbon fiber preform, ideal for complex-shape CFRP

TECONE [Head Office: Nomi City]

TECONE developed chopped carbon fiber tape sheets, used mainly in RTM mold preform. Adhesive-applied dry carbon fiber tape is cut into lengths in the dozens of millimeters and laminated at random orientations to produce chopped tape sheets, which are used to manufacture RTM mold preform.

This material 1) excels in formativeness for complex shapes, 2) simplifies the manufacture of preforms, 3) reduces loss through offcuts, 4) maintains resin flow channels through material hybridisation, thereby enabling compatibility with fast curing resins, and 5) exhibits bending strength comparable to high Vf values, thereby reducing costs.

Development of a molding system with appropriate temperature regulation and feeding

Hokuriku Press Kogyo [Head Office: Nonoichi City]

Due to the changing of resin's formability and physical properties according to temperature, the pressure and temperature control of dies and presses is a major issue in the short-time press molding of thermoplastic carbon fiber composites. Hokuriku Press Kogyo's molding system solves this problem.

Hokuriku Press Kyogo have built a system combining an infra-red heating device and an automated composite sheet feeder with a servo press. It is capable of press molding each piece in under 30 seconds, representing a large step toward the mass production of automobile body parts, and more.

※ Suncorona Oda (see page 9) is also engaged in the automobile field

Urban & Residential Infrastructure

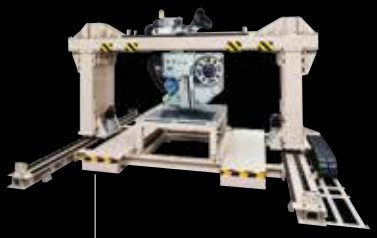
Komatsu Matere (see page 8)

Development of the automated tape layer for custom-made laminates

Tsudakoma Corp. [Head Office: Kanazawa City]

Following the thermoset prepreg automated tape layer, Tsudakoma Corp. developed the first thermoplastic prepreg automated tape layer in Japan. By laying several prepreg sheets (resin-impregnated carbon fiber), the machine makes the preform of molded objects according to the customer's purpose. Quality and productivity can be greatly increased compared to the traditional hand lay-up procedure.

Besides, there are various types of composite materials according to their usage, such as in aircrafts, automobiles and general industrial equipment. By developing and offering automated tape layer suitable for market demands, Tsudakoma Corp. is attempting to expand its sales in a wide range of fields, including aircraft.



Aircraft-Related Products

Sports & Leisure

Enabling high-speed press molding through increased impregnation

Ishikawa Jyushi Kogyo [Head Office: Kaga City]

Ishikawa Jyushi produces a variety of plastic products by leveraging many years of resin-related knowhow in the molding of carbon fiber composites.

For example, they established a high-precision processing method in which resin coating is performed concurrently with water jet cutting, and dispersed carbon fiber dust is contained so that there is no health hazard for workers. Dispersal is also prevented at the time of pressing by inserting the composite between resin sheets, and the need for deburring has also largely been removed. Complex shapes can also be processed efficiently, with intentions to develop various products including artificial limbs.

※ Suncorona Oda (see page 9) is also engaged in the sports & leisure field

Other Initiatives

Development of laser cutting technology that minimizes the effect of heat

SHIBUYA CORPORATION

[Head Office: Kanazawa City]

Laser processing, which allows non-contact dry machining, is becoming standard particularly within the sheet metal industry. However, traditional lasers cause fraying and burning of carbon fiber composites due to heat, making high quality cutting difficult.

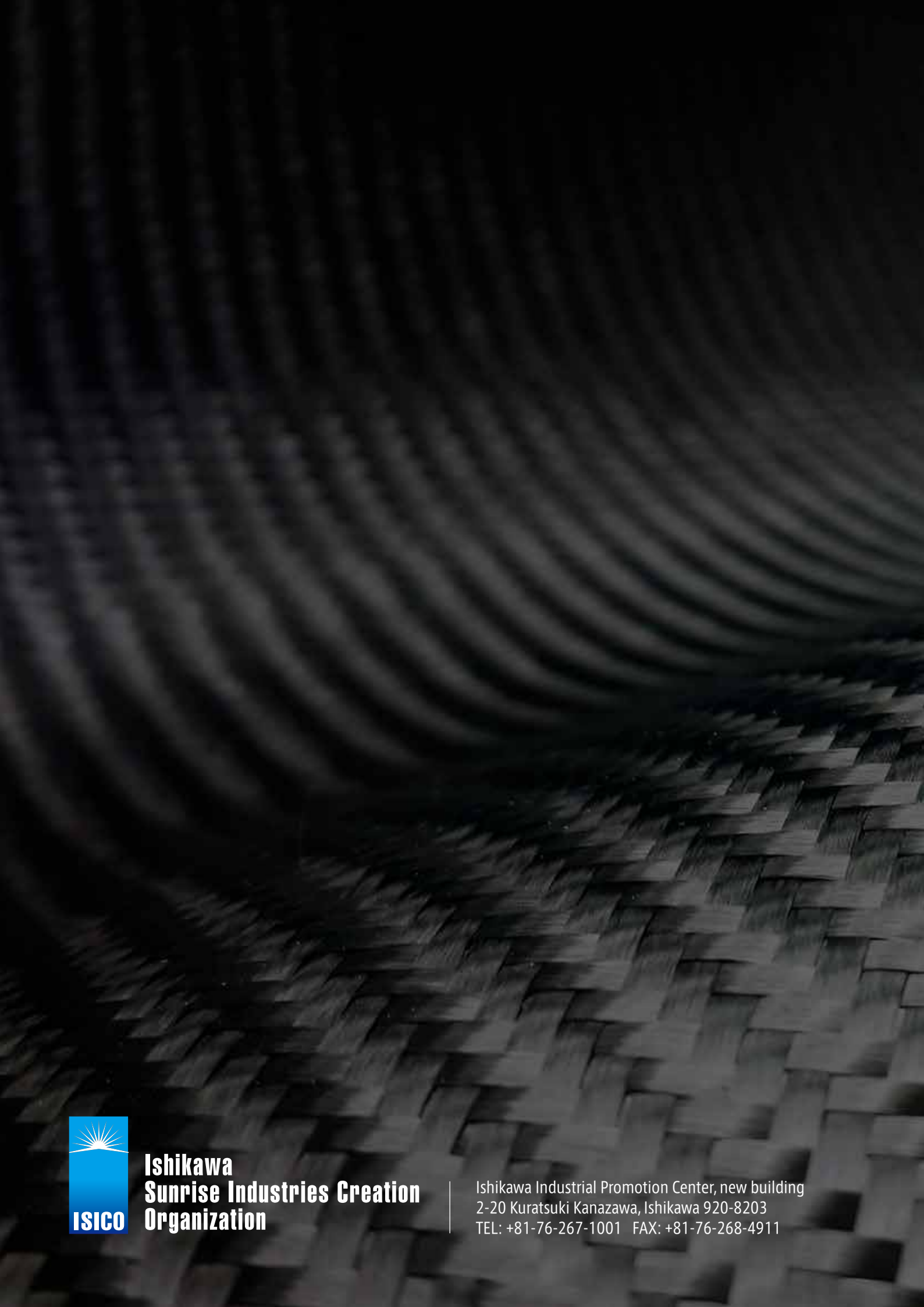
SHIBUYA CORPORATION have developed a laser ablation machine that combines a short-pulse laser with high-speed scanning, minimizing the effects of heat and allowing for high-quality, high precision laser cutting. SHIBUYA CORPORATION will continue development for high-speed cutting, thick sheet compatibility and three-dimensional processing, aiming to offer the latest laser processing technology.

Improving thermoplasticity issues through textile processing

Kajirene [Head Office: Kahoku City]

Kajirene developed commingled yarn, a material made from uniformly distributed carbon fiber and resin fiber. Textile processing is made possible using its fibrous characteristics, with the molding of complex shapes becoming easier. In addition, impregnation time is greatly reduced through the melting of resin fibers mixed in at the time of molding.

Kajirene also developed a semi-impregnated material that is impregnated in advance, while maintaining textile processability. They aim to use it for structural components of automobiles and artificial limb sockets.



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