### Technical seeds of CFRP in Japan - Contents

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**IHI Corporation**

**Subject**
Improving production efficiency for isotropic matrix by automatic lamination of thermoplastic prepreg

**Keyword(s)**
Automation, mass production, quality stabilization

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### Point of the proposed technology

- Achieving mass production by automatic production of isotropic matrix which was mainly performed by manual in the past.

### Effect(s)

- Achievement of continuous production
- Stabilization of quality

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### Development stage

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### Conventional technology

- Prepreg cutting and lamination by manual
- Quality variation and productivity difference among
- With the existing laminating machine (patent information), it is difficult to respond to change in lamination angle or sequence

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### Example of application of this technology

- Mass production of isotropic matrix for aircraft/automobile CFRP parts

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### Technological challenge, constraints, business plan

- **Constraints**: Limited to lamination of thermoplastic prepreg sheets (thermosetting has not been addressed.)
- **Business plan**: Design and sales of prepreg laminating equipment

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### Collaborator needed to improve this technology or develop a new technology

- End users/individual equipment manufacturers considering mass production

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### Company outline

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<tr>
<th>Location</th>
<th>Toyosu IHI Building, 1-1 Toyosu 3-chome, Koto-ku, Tokyo 135-8710 Japan</th>
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<tr>
<td>Capital/No. of employees</td>
<td>107.1 billion yen / 8,311</td>
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<td>Overseas base(s)</td>
<td>Europe, Asia, etc.</td>
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<td>Major customers</td>
<td>Aviation, space, defense and industrial systems, general-purpose machinery, etc.</td>
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### Inquiries

- **Contact**
  - TEL: +81-3-6204-7286
  - E-mail: takahiro_oniwa@ihi.co.jp

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**Homepage**
http://www.ihi.co.jp/
### IHI Corporation

**Subject**: Automatic laminating machine for thermoplastic CFRP preform (form cutting and laminating machine)

**Keyword(s)**: Automation, mass production, quality stabilization

#### Point of the proposed technology

- Achieving mass production by automatic preform fabrication work (prepreg laminating work) which was mainly performed by manual in the past to enable stable-quality supply.
- Achievement of continuous production
- Stabilization of quality

#### Development stage

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<td>2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)</td>
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<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
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<tr>
<td>Commercialization completed (already delivered ☑ / ☐)</td>
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#### Conventional technology

- Prepreg cutting and lamination by manual
- Quality variation and productivity difference among workers

#### New technology

- Mass production of preform for thermoplastic CFRP forming

**Technological challenge, constraints, business plan**

- Limited to thermoplastic prepreg (currently not applicable to thermosetting)

**Collaborator needed to improve this technology or develop a new technology**

- Manufacturers knowledgeable of mass production of thermoplastic CFRP products (for cases applying to thermoplastic CFRP)

#### Example of application of this technology

- Mass production of preform for thermoplastic CFRP forming

#### Collaborator

- Name: Takahiro Oniwa
- Position: Manager, Takahiro Oniwa, Development Group, Logistic systems & Industrial Machinery FA Center, Machinery & Logistics Systems Operations
- Contact: TEL +81-3-6204-7286, E-mail takahiro_oniwa@ihi.co.jp
- Website: [http://www.ihi.co.jp/](http://www.ihi.co.jp/)

### Company outline

- **Location**: Toyosu IHI Building, 1-1 Toyosu 3-chome, Koto-ku, Tokyo 135-8710 Japan
- **Capital/No. of employees**: 107.1 billion yen / 8,311 employees
- **Product line**: Aviation, space, defense and industrial systems, general-purpose machinery, etc.
- **Overseas base(s)**: Europe, Asia, etc.
- **Major customers**: Aviation, power, infrastructure, automobile-related manufacturers, etc.
- **Certification**:

<table>
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<th>Company/organization name</th>
<th>Effect(s)</th>
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<tr>
<td>IHI Corporation</td>
<td>Yes</td>
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### Effect(s)

- Achievement of continuous production
- Stabilization of quality

### Joint researcher(s) and their role

- Yes

### Motivation

- None

### Development stage

- 1. Idea stage (to be completed in [month] [year]; progress: %)
- 2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
- 3. Development completion stage (to be completed in [month] [year]; progress: %)
- Commercialization completed (already delivered ☑ / ☐)

### Collaborator needed to improve this technology or develop a new technology

- Manufacturers knowledgeable of mass production of thermoplastic CFRP products (for cases applying to thermoplastic CFRP)

### Example of application of this technology

- Mass production of preform for thermoplastic CFRP forming
Subject: Thermoplastic mold forming system

Keyword(s): Automation of manufacture of thermoplastic CFRP parts

Point of the proposed technology: Provision of an integrated line that manufactures CFRP parts from thermoplastic UD prepreg

Effect(s): Achievement of integrated production, Mass production, Stabilization of quality

Development stage:
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)

Joint researcher(s) and their role:
None

New technology:
- Prepreg cutting and lamination and preform insertion by manual
  - or
- Cell production system using stand-alone equipment

Example of application of this technology: Mass production of thermoplastic CFRP parts

Technological challenge, constraints, business plan:
- Constraints: Poor availability (not distributed) of thermoplastic CFRP prepreg as material
- Business plan: Providing a manufacturing line through tie-up with a material manufacturer

Collaborator needed to improve this technology or develop a new technology: End users/individual equipment manufacturers considering mass production

Company/organization name: IHI Corporation

Location: Toyosu IHI Building, 1-1 Toyosu 3-chome, Koto-ku, Tokyo 135-8710 Japan

Capital/No. of employees: 107.1 billion yen, 8,311 employees

Overseas base(s): Europe, Asia, etc.

Product line: Aviation, space, defense and industrial systems, general-purpose machinery, etc.

Major customers: Aviation, power, infrastructure, automobile-related manufacturers, etc.

Inquiries:
- Dept./personnel: Manager, Takahiro Oniwa, Development Group, Logistic systems & Industrial Machinery FA Center, Machinery & Logistics Systems Operations
- Contact: TEL +81-3-6204-7286, E-mail takahiro_ooniwa@ihi.co.jp
- Homepage: http://www.ihi.co.jp/
IHI Corporation

Subject: Stampable sheet forming (high-cycle forming) system
Keyword(s): High-temperature, flexible, adhesive materials transfer, heat management

Point of the proposed technology:
Aiming at realizing a high-cycle forming system based on the heated stampable sheet transfer technology.

Effect(s):
Achievement of mass production through high-cycle forming

Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in March, 2015; progress: 30%)’
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes/no)

Joint researcher(s) and their role
None

Collaborator needed to improve this technology or develop a new technology:
Stampable sheet manufacturers, transfer grip (equipment) manufacturers

Company/organization name:
IHI Corporation

Location: Toyosu IHI Building, 1-1 Toyosu 3-chome, Koto-ku, Tokyo 135-8710 Japan
Capital/No. of employees: 107.1 billion yen, 8,311 Overseas base(s): Europe, Asia, etc.
Product line: Aviation, space, defense and industrial systems, general-purpose machinery, etc.
Major customers: Aviation, electricity, infrastructure, automobile-related manufacturers, etc.
Inquiries:
Contact: TEL +81-3-6204-7286, E-mail: takahiro_ooniwa@ihi.co.jp

Keyword(s):
High-temperature, flexible, adhesive materials transfer, heat management

Example of application of this technology:
Mass production of thermoplastic CFRP parts

Technological challenge, constraints, business plan:
Technological challenge: Temperature management during transfer of the heated base material, selection of equipment taking into account continuous production (mass production).
Business plan: Providing a thermoplastic CFRP forming system using a stampable sheet, supporting high-cycle forming

Collaborator needed to improve this technology or develop a new technology:
Stampable sheet manufacturers, transfer grip (equipment) manufacturers

Location: Toyosu IHI Building, 1-1 Toyosu 3-chome, Koto-ku, Tokyo 135-8710 Japan
Capital/No. of employees: 107.1 billion yen, 8,311 Overseas base(s): Europe, Asia, etc.
Product line: Aviation, space, defense and industrial systems, general-purpose machinery, etc.
Major customers: Aviation, electricity, infrastructure, automobile-related manufacturers, etc.
Inquiries:
Contact: TEL +81-3-6204-7286, E-mail: takahiro_ooniwa@ihi.co.jp

Homepage: http://www.ihi.co.jp/
ARKEMA K.K.

Subject: Unprecedented new carbon fiber composite with Arkema new matrix resins, and Arkema new filler

Keyword(s): (1) PEKK (polyether ketone ketone) resin, (2) Elium resin, (3) CNT (carbon nano tube)

Point of the proposed technology:
Thermoplastic resin CFRTP can be produced by using (1) PEKK (polyether ketone ketone) resin and also (2) Elium resin, against the conventional thermosetting resins.
(1) High heat resistant, high compressive strength CFRTP can be produced from PEKK resin, while (2) by using Elium resin, inexpensive, general-purpose CFRTP can be produced.
(3) With addition of CNT, Conductive CFRTP can be made.

Effect(s):
Creating new CFRTP useful for the manufacturing industry

Development stage:
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered Yes/ no)

Joint researcher(s) and their role:
Companies producing fiber from (1)
Companies producing films or sheets from (1)
Companies using (1), (2) and/or (3)

Company outline:
Location: Fukoku-Seimei Bldg., 15F, 2-2-2, Uchisaiwaicho, Chiyoda-ku, Tokyo 100-0011 Japan

Capital/No. of employees: 1 billion yen 14,000 (group employees)
Overseas base(s): 90 bases

Product line: Fluorine resin (PVDF), special polyamide, acrylic polymer
Major customers: A number of companies listed on the 1st section (of the Tokyo Stock Exchange)

Certification: ISO9001, ISO14001. This technology has no problem under the Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc.

Collaborator needed to improve this technology or develop a new technology:
For the manufacturing of CFRTP, the possible forms of matrix material include powder, fiber, film and sheet. We are looking for a partner that will process our material (1) into these forms. We are also looking for a partner that will use these forms of material (1).

Technological challenge, constraints, business plan:
(1) For CFRTP production, the processing method of PEKK to optimize low price, high efficiency this new matrix material is under way. Arkema intends to supply not only limited to current powder and pellet forms.
(2) Basically Elium resin is developed for RTM. We hope to co-develop with manufacturers using RTM.

Conventional technology:
(1) PEKK (polyether ketone ketone) resin
A unique PAEK polymer with controllable crystallizability
A thermoplastic resin with excellent thermal property (+ 20°C vs PEEK)
Mechanical strength (+ 20% vs PEEK)
Low residual stress
Adhesiveness to metal
Chemical resistance
Flame-retardance

Thermosetting resin (epoxy resin) as the matrix resin
(2) Elium resin
Good compatibility with conventional RTM technology
Multifunctional and lightweight
Easily manufacturable, high performance
High cost-performance effect
Recyclable
To make the same component, 30 to 50% lighter than steel
Demonstrates the same capability.

(3) CNT (carbon nano tube)
Powder and various master batches
Colored filler

Example of application of this technology:
(1) Aircraft parts
(2) Truck body
(3) Antistatic wheels

Joint researcher(s) and their role:

Owns any intellectual property right:

Point of the proposed technology:

Effect(s):
**Industrial Research Institute of Ishikawa**

**Subject**
Manufacturing technology for CFRTP stampable sheet by using extrusion lamination method

**Keyword(s)**
CFRTP, resin impregnating ability, void fraction

<table>
<thead>
<tr>
<th>Point of the proposed technology</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology for laminating a thermostropic resin film on carbon fiber fabric, by using extrusion lamination method.</td>
<td>Improved impregnation</td>
</tr>
<tr>
<td>Achieving improvement of the resin impregnation and reduction of the void fraction by molding a CFRTP plate by the laminate sheets.</td>
<td>Reduced void fraction</td>
</tr>
</tbody>
</table>

**Development stage**

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in March, 2014; progress: 100%)
4. Commercialization completed (already delivered: yes / no)

**Conventional technology**

**New technology**

**Comparison between methods for manufacturing CFRTP stampable sheet**

**Film method**
(method of alternately stacking carbon fiber fabric and a film)

Since the middle layer is sandwiched from both sides, air is trapped.

**Extrusion lamination method**
(method of laminated carbon fiber fabric and melted film together)

Air is squeezed out when the layers are pressed by rollers.

**Example of application of this technology**
Stampable sheet (intermediate matrix)

**Technological challenge, constraints, business plan**
- Use of a thermostropic resin that can be molded into a film and fabric-form carbon fiber
- Prototyping conditions: width 500 mm or less, molding temperature 450°C or below

**Collaborator needed to improve this technology or develop a new technology**
Material developing manufacturers, press molding firms, Research and development institutions such as universities that conduct research and development related to CFRTP

**Company outline**

- **Location**: 2-1 Kuratsuki, Kanazawa-shi, Ishikawa, 920-8203 Japan
- **Capital/No. of employees**
- **Overseas base(s)**
- **Product line**
- **Major customers**
- **Certification**

**Inquiries**

- **Dept./Personnel**: Mitsugu Kimizu, Researcher, Planning/Consultation Department/CFRP Development Office
- **Contact**
  - TEL: +81-76-267-8089
  - E-mail: jisedai@iri.jp
- **Homepage**: http://www.irii.jp
CFRTP materials show ductile behavior in a drilling process in contrast with CFRP with thermosetting resin, and it causes a problem of large burr remaining at the drilled hole end using a conventional twist drill. In order to prevent large burr growing, we have proposed "a step drill" that distributes the cutting force for the work plate in drilling.

**Development stage**

| Idea stage (to be completed in [month] [year]; progress: %) |
| Prototyping/experimental stage (to be completed in March, 2014; progress: 100%) |
| Development completion stage (to be completed in [month] [year]; progress: %) |
| Commercialization completed (already delivered: yes / no) |

**Joint researcher(s) and their role**

None

**Conventional technology**

**New technology**

**Improvement of the hole quality in drilling of a CFRTP material**

**Comparison of cutting force**

**Comparison of cutting temperature**

**Example of application of this technology**

Drilling process of CFRTP molding parts

**Technological challenge, constraints, business plan**

Evaluation of the tool life, and extension of tool life

**Collaborator needed to improve this technology or develop a new technology**

Cutting tool manufacturer
Ishikawa Metal Stamping Association

Subject: Press forming technique for CFRTP sheet
Keyword(s): Carbon fiber composite, thermoplastic resin, press forming, metal die technique

Point of the proposed technology
- Press forming system for CFRTP sheet capable of forming the work in short time by servo press control
- Heating/transfer equipment capable of automatically performing the process from CFRTP heating to feeding into the metal die
- Forming technique for efficiently performing the stamping and trimming of CFRTP

Effect(s)
- Forming time: within 1 minute

Development stage
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in March, 2015; progress: 80%)
4. Commercialization completed (already delivered: yes / no)

Joint researcher(s) and their role
- Hokuriku Press Industry (role: press control technique)
- Kita Iron Works, Ltd. (role: metal die design technique)
- Industrial Research Institute of Ishikawa (role: evaluating characteristics of forming part)
- Yes

Conventional technology

New technology

Example of application to automobile parts

1. Pressing forming of steel sheet
   - Multi forming process, and enormous die cost
   - Large amount of CO₂ occur in manufacturing, assembly, etc.
   - Lightweighting with the limit because of large specific gravity.

2. Molding of thermoplastic CFRP

[Expected effects]
- Production by one process
- Lightweight and high-strength part
- Replacement of steel parts for preventing rust
- Production of rigid body assembled by adhesive

Example of application to automobile parts

- Parts for which higher strength and lighter weight are expected (automobile parts, baggage, OA equipment enclosures)

Technological challenge, constraints, business plan
- For automatic feeding of CFRTP into the metal die, it is necessary to build a transfer system according to the shape and size of the forming.
- The forming size depends on the pressing capacity and the CFRTP sheet size.
- Joint order taking in the Ishikawa Metal Stamping Association

Collaborator needed to improve this technology or develop a new technology
- Automobile manufacturer, consumer-electronics manufacturer
- Testing and research institute having evaluation method and equipment

Outline of the association

<table>
<thead>
<tr>
<th>Location</th>
<th>2-3 Kuratsuki, Kanazawa, Ishikawa, Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment/member companies</td>
<td>87.3 million yen</td>
</tr>
<tr>
<td>67 companies</td>
<td>Overseas base(s)</td>
</tr>
<tr>
<td>Product line</td>
<td>Metal product manufacturers, general machinery and appliances manufacturers, etc.</td>
</tr>
<tr>
<td>Certification</td>
<td>Major customers</td>
</tr>
<tr>
<td>Inquiries</td>
<td>Dept./personnel</td>
</tr>
<tr>
<td></td>
<td>Contact</td>
</tr>
<tr>
<td></td>
<td>E-mail</td>
</tr>
<tr>
<td>Homepage</td>
<td><a href="http://press.ishikawa-kumiai.jp/">http://press.ishikawa-kumiai.jp/</a></td>
</tr>
</tbody>
</table>
**Ise Mold Industry Co., Ltd**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Weight-saving using a carbon fiber composite thermoplastic resin (CFRTP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyword(s)</td>
<td>Weight-saving, thermoplastic molding</td>
</tr>
</tbody>
</table>

### Point of the proposed technology

<table>
<thead>
<tr>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight reduced by 30%</td>
</tr>
<tr>
<td>Molding time: 50 sec.</td>
</tr>
</tbody>
</table>

#### Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

#### Conventional technology

- Using steel, and heavy.
- Low productivity due to use of many pressed parts.
- Thermosetting carbon fiber composites involve processes such as heating, and are less productive.
- Difficult to handle complex shapes.

#### New technology

- Greater weight-saving than iron or steel.
- Good production efficiency due to injection molding.
- Capable of handling complex shapes.

#### Example of application of this technology

- Automobile pedal parts
- Aircraft truck rail parts

#### Technological challenge, constraints, business plan

- Since molding using a carbon fiber composite thermoplastic resin involves problems such as deformation and weld (lines), it is necessary to improve the structure of the metal die. If these problems were improved, weight-saving and production efficiency increase would be achieved.
- Would like to sell automobile and aircraft parts that we currently produce, by metal molding and assembling them.
- Material manufacturers that develop carbon fiber composite thermoplastic resins
- Research institutes such as universities having resin flow analysis technology, material strength evaluation technology and equipment

#### Collaborator needed to improve this technology or develop a new technology

- The photo is a sample image of a product made of a glass fiber reinforced resin. Our company has produced such products.

<table>
<thead>
<tr>
<th>Company outline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
</tr>
<tr>
<td><strong>Capital/No. of employees</strong></td>
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<tr>
<td><strong>Product line</strong></td>
</tr>
<tr>
<td><strong>Overseas base(s)</strong></td>
</tr>
<tr>
<td><strong>Major customers</strong></td>
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<td><strong>Certification</strong></td>
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<tr>
<td><strong>Contact</strong></td>
</tr>
<tr>
<td><strong>Homepage</strong></td>
</tr>
</tbody>
</table>
**ICHIMURA SANGYO CO., LTD.**

**Subject**: Long thermoplastic CFRP sheet

**Keyword(s)**: Special press molding, industry’s most advanced technology

### Point of the proposed technology

<table>
<thead>
<tr>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cost reduction</td>
</tr>
<tr>
<td>• Quality/performance improvement</td>
</tr>
<tr>
<td>• Mass reduction</td>
</tr>
<tr>
<td>• Productivity (workability) improvement</td>
</tr>
</tbody>
</table>

### Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in March, 2015; progress: 80%)
4. Commercialization completed (already delivered: yes / no)

### Joint researcher(s) and their role

- TEC ONE CO., LTD. (resin processing technology)
- Yusui Chemical Industries Co., Ltd. (molding technology)
- Kanazawa Institute of Technology (evaluation, analysis)
- Industrial Research Institute of Ishikawa (evaluation, analysis)

---

### Conventional technology

**Manufacturing method for thermosetting resin carbon fiber composite**

- **Carbon fiber feeding**
- **Resin impregnation**
- **Release paper application**
- **Drying (half-curing)**
- **Refrigerated storage (-40°C)**
- **Release paper removal**
- **Laminated/prepreg plate is produced**

**Example of application of this technology**

- Vehicle parts
- Machine parts

**Technological challenge, constraints, business plan**

- Improvement of the roll press
- Improvement of the loom to support large tow

**Collaborator needed to improve this technology or develop a new technology**

- Press manufacturer, loom manufacturer

### New technology

**Manufacturing method for thermoplastic resin carbon fiber composite**

- **Pellet feeding**
- **Film resin**
- **Carbon fiber**
- **Roll press**
- **Thermoplastic resin stampable sheet**
- **Laminated-prepreg plate is produced**
- **Can support various types by using a metal die that can be easily cut.**

**Example of application of this technology**

- Vehicle parts
- Machine parts

**Technological challenge, constraints, business plan**

- Improvement of the roll press
- Improvement of the loom to support large tow

**Collaborator needed to improve this technology or develop a new technology**

- Press manufacturer, loom manufacturer

---

**Company/organization name**

- Location: 5-20, Minamicho, Kanazawa-shi, Ishikawa, 920-8633 Japan
- Capital/No. of employees: 1 billion yen 120
- Overseas bases: Shanghai
- Product line: Synthetic fabric, carbon fiber fabric, EPS molding
- Major customers: Toyoy, Sekisui Plastics
- Certification: ISO14001

**Inquiries**

- Dept./personnel: Mineaki Matsumura, Director
- Contact: TEL +81-76-263-1177
- E-mail: mineaki_matsumura@ichimura.co.jp
# INOAC CORPORATION

<table>
<thead>
<tr>
<th>Company/organization name</th>
<th>INOAC CORPORATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subject</strong></td>
<td>Achieving weight-saving and cost reduction by combining carbon and foam products</td>
</tr>
<tr>
<td><strong>Keyword(s)</strong></td>
<td>Weight-saving, cost reduction, CFRP</td>
</tr>
</tbody>
</table>

## Point of the proposed technology

Achieving weight-saving and cost reduction by changing to a foam material in the middle layer of the laminate, instead of the conventional all-carbon product.

## Effect(s)

- Reduced carbon consumption
- Thickness can be freely changed.

## Development stage

| 1. Idea stage (to be completed in [month] [year]; progress: %) | The company’s own technology |
| 2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %) | |
| 3. Development completion stage (to be completed in [month] [year]; progress: %) | |
| ☑ Commercialization completed (already delivered: yes / no) | Yes |

## Conventional technology

**Features of “RL-C”**

“High workability” and “cost reduction” are achieved in addition to “light weight” and “strength” by combining carbon and foam product.

**RL-C (thermoset)**

- Hot press molding
- Foam material
- Thermoset prepreg

## Technological challenge, constraints, business plan

**Products commercially available**

## Collaborator needed to improve this technology or develop a new technology

**Automobile parts manufacturer**

## Example of application of this technology

- Personal computer case
- Industrial products

## Company outline

<table>
<thead>
<tr>
<th>Location</th>
<th>1-36 Imaike 3-chome, Anjo-shi, Aichi, 446-8504 Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>720 million yen / 1,513</td>
</tr>
<tr>
<td>Product line</td>
<td>Urethane, rubber, plastics, composites</td>
</tr>
<tr>
<td>Certification</td>
<td>Certified with ISO 9001 14000</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td>North America, Europe, China, South Korea, Southeast Asia</td>
</tr>
<tr>
<td>Major customers</td>
<td>Industrial materials, automobile</td>
</tr>
</tbody>
</table>

## Inquiries

**Masanori Nagai**, Director, Finetec Dept., Composite Div.

**Contact**

- TEL: +81-50-3135-8728
- E-mail: NGI@inoac.co.jp

**Homepage**

[http://www.inoac.co.jp/](http://www.inoac.co.jp/)
### Point of the proposed technology

| Effect(s) | Hybrid molding combining continuous fiber and discontinuous fiber. Previously, multiple manufacturing processes were required due to press molding and injection molding. Now, one-shot molding through hot pressing is possible. This technology provides a CFRTP molding with high strength, light weight and good design that has discontinuous fibers in the inner material and continuous fibers in the outer material. | Molding time: 90 min → 45 min (reference value) |

### Development stage

| 1. Idea stage (to be completed in [month] [year]; progress: %) | No actual record so far. | None |
| 2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %) |  |
| 3. Development completion stage (to be completed in [month] [year]; progress: %) |  |
| 4. Commercialization completed (already delivered: yes / no) |  |

### Conventional technology

| 1) This cycle time is very long. Three more manufacturing steps are required.  
2) A pressing machine and an injection molding machine are required.  
3) Formability of rib and boss is bad. They can be molded only simple form. | 1) This cycle time is very short. Only one manufacturing step is required.  
2) The work is molded with a pressing machine. Any other machine is not needed.  
3) Formability of rib and boss is good. The complex form can be molded with this molding process. |

### Technological challenge, constraints, business plan

Higher strength, weight-saving, high cycle, mass production

### Collaborator needed to improve this technology or develop a new technology

1. Thermoplastic resin composite supplier  
2. Equipment/system manufacturer

### Example of application of this technology

Automobiles, aircraft, home electronics, etc.
Subject: Development of a metal die with low thermal strain that enables highly accurate and highly efficient molding of CFRP three-dimensional large-shape products through hot pressing

Keyword(s):
- Welding time for the metal die is 22% of the conventional method!
- Low heat input, low strain laser-arc hybrid welding method

Point of the proposed technology:
Establishing a laser-arc hybrid welding method with low heat input and low strain and no weld defect. Additionally, developing a method for removing the residual stress using low-frequency vibrations.

Development stage:
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

Joint researcher(s) and their role:
- Providing advice on the groove shape, setting of laser-arc hybrid welding conditions, etc., and making judgment of the welding result, based on a great deal of knowledge on welding technology
- None

Conventional technology

Example of application to a metal die for CFRP molding

Conventional method

Hybrid vibration welding

Maximum + 2.84 mm Minimum ≈ 11.02 mm Deformation: 13.86 mm

Maximum + 1.25 mm Minimum + 0.10 mm Deformation: 1.15 mm

Example of application of this technology
Partly because we have received inquiries not only from downstream companies in the aircraft industry, but also from the heavy electric industry, we are conducting sales activity for getting orders for low-strain welded parts using the vibration-arc-laser hybrid welding method, which we have developed.

Technological challenge, constraints, business plan
In the welding method with the inner material, which is a low thermal expansion alloy, a phenomenon in which the welding base metal is subject to heat accumulation and the penetration becomes deeper with the welding time because the thermal conductivity is low occurs, and this will be a problem to be solved in the future.

Collaborator needed to improve this technology or develop a new technology
None

Company outline
- Location: 128 Kinzudanchi, Kakamigahara-shi, Gifu, 504-0957 Japan
- Capital/No. of employees: 96 million yen / 186
- Overseas base(s): Malaysia, Thailand, Vietnam
- Major customers: Aircraft manufacturers, fuselage manufacturers, etc.

Inquiries
- Dept./personnel: Atsushi Hayashi, Group Leader, Production
- Contact: TEL +81-58-389-2011 E-mail: hayashi@imaiaero.co.jp
- Homepage: http://www.imai-aero.co.jp

Certification: JIS Q 9100 (AS9100/EN9100)

Collaborator needed to improve this technology or develop a new technology
None

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<th>Oji Holdings Corporation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject</td>
<td>Thermoplastic composite material in non-woven format for hot press molding</td>
</tr>
<tr>
<td>Keyword(s)</td>
<td>Thermal plasticity, hot pressing, non-woven CFRTP materials, moldability</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Point of the proposed technology</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Thermoplastic composite material supplied in non-woven format.</td>
<td>Moldable into deep drawn shapes</td>
</tr>
<tr>
<td>• Prepared by paper making technology</td>
<td>Uniform and smooth surface.</td>
</tr>
<tr>
<td>• By adjusting the layering # of the material, very thin or thick parts can be produced form the same material.</td>
<td>Enables high-speed heating-and-cooling molding and stamping molding</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Conventional technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in [month] [year]; progress: %)</td>
<td>The company’s own technology</td>
</tr>
<tr>
<td>2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)</td>
<td>Yes</td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
</tr>
<tr>
<td>Commercialization completed (already delivered: yes / no)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>New technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermoplastic FRP material that is, nonwovens consist of reinforcement fiber (carbon fiber, glass fiber) and plastic fiber has been developed by utilizing the “papermaking” technique.</td>
</tr>
</tbody>
</table>

- Reinforcement fiber nonwovens, prepared by conventional technology such as needle punch or card machines are inferior in uniformity.
- Thermoset CFRP material needs autoclave to cure, long molding time and low temp preservation.
- Continuous fiber CFRP, such as UD or fabric CFRP materials are difficult to be molded into 3D shapes.
- CFRTP material for injection molding: Due to its short fiber length, the strength is relatively low.

Example of application of this technology
Mobile device shells, flame-retardant members for railway and aircraft interior, automotive parts

Technological challenge, constraints, business plan
Setting up supply chain by collaborating with converters and molders

Collaborator needed to improve this technology or develop a new technology
Molder capable of conducting heating-and-cooling molding and stamping molding
Converter capable of handling carbonfiber containing non-woven materials

<table>
<thead>
<tr>
<th>Company outline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Capital/No. of employees</td>
</tr>
<tr>
<td>Overseas base(s)</td>
</tr>
<tr>
<td>Product line</td>
</tr>
<tr>
<td>Major customers</td>
</tr>
<tr>
<td>Certification</td>
</tr>
<tr>
<td>Company/organization name</td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Capital/No. of employees</td>
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<tr>
<td>Overseas base(s)</td>
</tr>
<tr>
<td>Product line</td>
</tr>
<tr>
<td>Major customers</td>
</tr>
<tr>
<td>Certification</td>
</tr>
<tr>
<td>Inquiries</td>
</tr>
<tr>
<td>Contact</td>
</tr>
<tr>
<td>Homepage</td>
</tr>
</tbody>
</table>
### Kajirene Inc.

**Subject**
Development of commingled yarn as intermediate material for high-cycle molding of CFRTP

**Keyword(s)**
FRTP, Fibrous intermediate material, Thermoplastic resin

#### Point of the proposed technology
- Achievement of high impregnation property through high dispersion of matrix resin fiber and carbon fiber
- It has high textile workability because of its fibrous shape.
- Reduction of the environmental burden by using thermoplastic resin as the matrix to provide recyclability

#### Effect(s)
- Strength: approx. 2 GPa (using PA, UD reinforcement)
- Molding time: 5 min or less (1 mm thick molding)

#### Development stage
<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage</td>
<td>to be completed in [month] [year]; progress: %</td>
<td></td>
</tr>
<tr>
<td>2. Prototyping/experimental stage</td>
<td>to be completed in April, 2015; progress: 90%</td>
<td></td>
</tr>
<tr>
<td>3. Development completion stage</td>
<td>to be completed in [month] [year]; progress: %</td>
<td></td>
</tr>
<tr>
<td>4. Commercialization completed</td>
<td>already delivered: yes / no</td>
<td></td>
</tr>
</tbody>
</table>

#### Joint researcher(s) and their role
- Mitsubishi Gas Chemical Company, Inc. (role: resin fiber development and evaluation)
- Gifu University (role: molding method development and evaluation)

#### Conventional technology
- Replacement of the thermosetting resin with thermoplastic resin by commingled yarn in the matrix of FRP

### Problems of CFRP (Thermosetting)
- Use of prepreg requires high cost
- Molding time is long (low cycle).
- Recycling or secondary processing is not possible.

### Problems of CFRTP (Thermoplastic)
- Thermoplastic resin has high melt viscosity and hard to be impregnated.
- Only woven or UD composite can be molded because impregnation of matrix is difficult.

### Example of application of this technology
- Primary and secondary structural members of automobiles
- Structural members of lightweight attache case

### Technological challenge, constraints, business plan
- Currently, the fiber commingling machine is a test machine, and therefore, we can produce a volume at the sample provision level.
- Available in the form of mixed commingled yarn.
- Other types of matrix resin fiber can be combined with a reinforcement fiber.

### Collaborator needed to improve this technology or develop a new technology
- Company related to press, etc. having knowledge on molding technology
- Textile-related company capable of producing a preform

### Company outline
- **Location**: NO-75-2 Takamatsu Kahoku-city Ishikawa 929-1215 Japan
- **Capital/No. of employees**: 25 million yen / 82
- **Overseas base(s)**: None
- **Product line**: Synthetic fabric for clothing, fabric for industrial materials
- **Major customers**: Asahi Kasei Fibers Corp.

### Inquiries
- **CONTACT**: TEL +81-76-281-0118
- **E-mail**: m.takagi@kajigroup.co.jp
- **Homepage**: [http://www.kajigroup.co.jp/](http://www.kajigroup.co.jp/)
Point of the proposed technology

- A material with the best combination of performance and cost achieved by combining a general industrial grade low-cost carbon fiber and a toughened epoxy resin
- A user-friendly material combining a unidirectional material and a fabric material

Effect(s)

- Can be adopted to commercial aircraft parts (Civil Aviation Bureau’s approval already obtained)

Conventional technology

- High-cost high-performance fiber dedicated for aircraft
- High-cost resin with high heat-resistance and high toughness

New technology

- Cost reduction by adopting large-low fiber, mass-produced for general industrial use
- Adoption of a resin with a good balance between heat resistance, toughness and cost
- Use of a self-adhesive resin enables the manufacture of honeycomb sandwich parts without using an adhesive

Example of application of this technology

- Aircraft horizontal/vertical tails, flaps, engine nacelle, landing gear door, winglets, etc.

Technological challenge, constraints, business plan

- Adoption to a commercial aircraft part requires a type certification by the Civil Aviation Bureau.
- While the unidirectional material has a standard thickness (0.19 mm/layer), the fabric material has a double thickness (0.38 mm/layer), which poses a design constraint. If a low-cost fabric material with a standard thickness is developed, the design flexibility will be increased, and its adoption may be expanded.

Collaborator needed to improve this technology or develop a new technology

- Company having knowledge on carbon fiber, weaving and prepreg
- University or research/testing institute having composite evaluation technology

Company outline

- Location: 1, Kawasaki-cho, Kakamigahara-shi, Gifu, 504-8710 Japan
- Capital/No. of employees: 104.484 billion yen / 34,620
- Overseas base(s): United States, Europe, Asia, etc.
- Product line: Composite system, aircraft parts, honeycomb panel, composite aircraft materials, commercial transport, guidance equipment, etc.
- Certification: JIS Q 9100 (AS/EN9100), JIS Q 9001 (ISO 9001), and ISO 14001, which is an international standard for environmental management system
- Major customers: Ground, marine, air and space transport machinery related manufacturers, etc.
- Dept./personnel: Katsuya Saito, Senior Manager, Engineering Division, Engineering Planning & Control Dept.
- Contact: +81-58-382-5722 E-mail: saito_katsuya@khi.co.jp
- Homepage: http://www.khi.co.jp/aero/index.html
- Inquiries: TEL

- Low-cost composite “KMS-6115”
The wide range (speedup) molding speed of molding equipment and molding data logging

**Keyword(s)**
- Control equipment organization, control technology, data logging system

**Point of the proposed technology**
- The wide range (high-speed range, in particular) molding speed makes it possible to respond to various resin material characteristics. In addition, a molding data logging system facilitates the grasp of the equipment’s movement in the molding range, and it is possible to study the molding conditions promptly.

**Effect(s)**
- Speedup: twice or more
- The molding data can be promptly checked on the operation screen.

---

**Development stage**

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)

**Joint researcher(s) and their role**

- No joint research was conducted.
- The hydraulic and control systems are both products with the company’s own technology.

**Conventional technology**

- By the wide molding speed range of the pressing machine, to 80 mm/s from 0.05 mm/s, the molding conditions for various base resins can be set.

**New technology**

- By checking (on the operation screen) the equipment's movement using the data logging function on the operation screen, it can be promptly compared with the intended molding conditions.

**Example of application of this technology**
- Automobile parts, aircraft parts

---

**Technological challenge, constraints, business plan**

- If the molding speed range is expanded (speedup, in particular), large energy will be required in the high-speed range. It is necessary to achieve appropriate energy and cost effectiveness to avoid excessive specifications through studying the equipment’s specifications (e.g., speed, stroke) by grasping details of the actual molding.

---

**Collaborator needed to improve this technology or develop a new technology**

- Information exchange with molders and material manufacturers

---

**Company outline**

<table>
<thead>
<tr>
<th>Location</th>
<th>15-1, Minamifutami, Futami-cho, Akashi-shi, Hyogo, 674-0093 Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>436 million yen 160</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td>Shanghai office</td>
</tr>
<tr>
<td>Product line</td>
<td>Hydraulic presses in general</td>
</tr>
<tr>
<td>Major customers</td>
<td>A large number of metal and plastic processing manufacturers</td>
</tr>
<tr>
<td>Certification</td>
<td>ISO 9001, ISO 14001</td>
</tr>
</tbody>
</table>

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**Inquiries**

<table>
<thead>
<tr>
<th>Dept/personnel</th>
<th>Nobuyuki Nagayasu, Director, Engineering Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact</td>
<td>TEL +81-78-941-3333 E-mail <a href="mailto:nagayasu.n@khm.co.jp">nagayasu.n@khm.co.jp</a></td>
</tr>
<tr>
<td>Homepage</td>
<td><a href="http://www.khm.co.jp">http://www.khm.co.jp</a></td>
</tr>
</tbody>
</table>
### Company/organization name
Giken Co., Ltd.

**Subject**
Achievement of the effects of shortening the process and reducing the cost by using a drill generating little CFRP burr

**Keyword(s)**
Drill for CFRP, burr reduction, process shortening, high processing quality

**Point of the proposed technology**

<table>
<thead>
<tr>
<th>Effect(s)</th>
<th>Point of the proposed technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burr reduction and tool life extension are achieved by using a compound hybrid structure consisting of a drill + tapered end mill + reamer.</td>
<td>・Burr reduction and tool life extension are achieved by using a compound hybrid structure consisting of a drill + tapered end mill + reamer.</td>
</tr>
<tr>
<td>Since burr is reduced, the deburring process can be eliminated.</td>
<td>・Since burr is reduced, the deburring process can be eliminated.</td>
</tr>
</tbody>
</table>

**Development stage**

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

**Joint researcher(s) and their role**

Industrial Technology Center of Fukui Prefecture (role: prototyping/manufacture of the drill designed by the Center)

**Conventional technology**

**Example of application of this technology**
- Aircraft fuselage
- Automobile body, fuel tank

**Technological challenge, constraints, business plan**
- The challenge is to increase the drilling speed (present: φ6 4-bladed drill feed speed F 400 mm/min --- drilling time per hole 3.3 sec/φ5)
- A drill that corresponding CFRTP (thermoplastic resin) is being developed. CFRTP (thermoplastic resin) in the corresponding drill current development
- Sale through both OEM and the company’s own brand

**Collaborator needed to improve this technology or develop a new technology**
- Universities, research institutes such as public testing facilities, manufacturers and users that can conduct service life and performance tests

**Company outline**

<table>
<thead>
<tr>
<th>Capital/No. of employees</th>
<th>1 million yen</th>
<th>% (incl. its parent company Ishiakawa-Kenmas S.S.)</th>
<th>Overseas base(s)</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certification</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Inquiries**

<table>
<thead>
<tr>
<th>Dept/personnel</th>
<th>Yoshikazu Ishikawa, Representative Director</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact</td>
<td>TEL +81-776-66-2200 FAX +81-776-66-2227 E-mail <a href="mailto:giken-fuku@hotmail.co.jp">giken-fuku@hotmail.co.jp</a></td>
</tr>
<tr>
<td>Homepage</td>
<td><a href="http://www.ik-giken.com">http://www.ik-giken.com</a></td>
</tr>
</tbody>
</table>

**Comparison of through surface**

- Even a drill with a diamond coat can drilling only approximately 40 holes per drill, therefore it is high cost. (Number of drilling holes per aircraft fuselage: 100,000)
- Burr is generated and delamination occurs, and deburring takes time.
- The side face of a CFRP plate cannot drilled (the plate would be torn during the drilling).
- Regrinding of the drill is not allowed (previously, only a drill with diamond coat was available)

- Drill with nano diamond coat can drilling 2000 holes or more (non-coated drill can drilling 500 holes).
- No burr generation or delamination
- Possible perforation of the CFRP plate side (burr, no occurrence of delamination)
- Drill can be regrinding (non-coated drill).

- Even a drill with a diamond coat can drilling only approximately 40 holes per drill, therefore it is high cost. (Number of drilling holes per aircraft fuselage: 100,000)
- Burr is generated and delamination occurs, and deburring takes time.
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- Possible perforation of the CFRP plate side (burr, no occurrence of delamination)
- Drill can be regrinding (non-coated drill).

**Location**
9-3-1 Furapose, Maruoka-cho, Sakai-shi, Fukui, 910-9381, Japan

**Note**
This description is a translation and may not be perfectly accurate. Please refer to the original document for detailed information.
If a probe integrated with diamond shaft is used, it becomes possible to perform continuous plane measurement, and measurement while working can also be performed. Measurement accuracy is improved, and the time can be shortened.

Example of application of this technology:
- Aircraft-related parts
- Automobile-related parts
- Digital home electronics-related parts
- Semiconductor-related parts

Technological challenge, constraints, business plan:
- Challenges: (1) further extension of the tool life; (2) reduction of tool unit price
- Business plans: (1) seek life extension by developing an innovative tool shape; (2) pursue price reduction by seeking mass production through market penetration

Collaborator needed to improve this technology or develop a new technology:
- Company developing new materials with interest in diamond tools
- Research institutes such as university that has knowledge on diamond tools and can conduct evaluation.
Gifu Prefectural Industrial Research Institute

### Subject
3D molding technology for CFRTP

### Keyword(s)
CFRTP, 3D molding technology, press molding

### Point of the proposed technology
- Basic data on methods for molding (press molding) CFRTP in a 3D shape in place of the conventional CFRTS (autoclave molding), setting conditions and molding evaluation method have been accumulated.
- The institute can provide support based on accumulated data for technological development at companies considering commercialization of CFRTP.

### Development stage
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in March, 2016; progress: 30%)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

### Joint researcher(s) and their role
Industrial Technology Center, Gifu Prefectural Government (role: development of CFRTP sheet material)

### Joint researcher(s) and their role
None

### Conventional technology

#### CFRTP molding technology

- The molding technology has been established, and products have been commercialized for aircraft, automobiles, etc.
- Data on the molding technology and various property evaluations have been accumulated.
- There are many molding processes.
- Special equipment (autoclave) is required, and the molding time is long.
  → High cost

### New technology

#### CFRP molding technology

- Molding can be completed through material heating (for several to 10 minutes) and pressing/cooling (for one minute).
  → The working processes and the molding time are shortened.
- Since molding conditions suitable for the material and the product shape are required, molding data serving as the basis for them are currently being accumulated.

### Example of application of this technology
- Automobile parts
- Parts of various transport machines
- Blades for wind power generation
- Sporting goods
- Home electronic products
- Commodities

### Technological challenge, constraints, business plan
- Basic technologies on 3D molding of CFRTP are being accumulated. Will enlist cooperation with related companies considering commercialization, and provide technological support to them.
- Currently, the molding data are only for limited on-the-shelf materials. Therefore, any other available materials will be added to the accumulated data in the future.

### Collaborator needed to improve this technology or develop a new technology
- Research institutes such as universities having evaluation technology and equipment for moldings' residual stress and product strength

### Company outline

#### Location
1288 Oze, Seki-shi Gifu, 501-3265 Japan

#### Capital/No. of employees
--- 38

#### Product line
---

#### Overseas base(s)
---

#### Major customers
---

#### Certification
---

### Inquiries

#### Dept./personnel
Joji Sato, Division Chief, Composite Materials Division

#### Contact
TEL +81-575-22-0147
E-mail sato-joji@pref.gifu.lg.jp

### Homepage
http://www.metit-rt.pref.gifu.jp

### Effect(s)

#### Point of the proposed technology

- • Technology support to companies newly working on commercialization of CFRTP
- • Spreading of the CFRTP molding technology

#### Collaborator needed to improve this technology or develop a new technology

- Research institutes such as universities having evaluation technology and equipment for moldings' residual stress and product strength

#### Example of application of this technology

- Molding can be completed through material heating (for several to 10 minutes) and pressing/cooling (for one minute).
  → The working processes and the molding time are shortened.
- Since molding conditions suitable for the material and the product shape are required, molding data serving as the basis for them are currently being accumulated.

#### Example of molding

- The molding technology has been established, and products have been commercialized for aircraft, automobiles, etc.
- Data on the molding technology and various property evaluations have been accumulated.
- There are many molding processes.
- Special equipment (autoclave) is required, and the molding time is long.
  → High cost

#### Table: CFRP molding technology

<table>
<thead>
<tr>
<th>Material (sheet material)</th>
<th>Heating (several to 10 min)</th>
<th>Pressing/cooling (for one minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IR heater</td>
<td>Press</td>
<td>Molding process</td>
</tr>
</tbody>
</table>

#### Diagram: CFRP molding technology

- Molding process:
  - Heating (several to 10 minutes)
  - Pressing/cooling (for one minute)

- Molding process:
  - Heating (several to 10 minutes)
  - Pressing/cooling (for one minute)
Previously, in 3D molding a thermoplastic CFRP laminate, there was a problem that a laminate using fabric material as the base material is subject to creasing because of lack of elasticity. By developing a laminate using knitted material as the base material, a CFRP laminate with excellent forming capabilities can be acquired.

- **Development stage**
  1. Idea stage (to be completed in [month] [year]; progress: %)
  2. Prototyping/experimental stage (to be completed in March, 2016; progress: %)
  3. Development completion stage (to be completed in [month] [year]; progress: %)
  4. Commercialization completed (already delivered: yes / no)

- **Conventional technology**
  - Creasing occurs during 3D molding.

- **New technology**
  - A CFRP laminate using carbon fiber knitted material as the base
  - Point: Since the base fabric has elasticity, the material is less subject to creasing during molding.
  - However, it is difficult to produce knitted material using carbon fiber. Carbon fiber intermediate material that can be easily knitted must be developed.

**Example of application of this technology**
- Healthcare goods
- Sporting goods
- Automobile members, etc.

**Technological challenge, constraints, business plan**
- Knitting technology for carbon fiber
- Improved adhesiveness of carbon fiber and thermoplastic resin

**Collaborator needed to improve this technology or develop a new technology**
- Company that will work on the development of a 3D molding technology for CFRP laminates using knitted material as the base in cooperation with the center

**Company outline**
- Location: 47 Kasamatsu-cho, Hashima-gun, Gifu, 501-0604 Japan
- Capital/No. of employees: -- / 35
- Overseas base(s): --
- Product line: --
- Major customers: --
- Certification: --

**Inquiries**
- Dept./personnel: Koji Hayashi, Senior Research Specialist
- Contact: TEL +81-58-388-3151
- E-mail: hayashi-koji@pref.gifu.lg.jp
**Point of the proposed technology**

There is a trend toward replacing the metal insert of molded resin parts with CFRP in terms of weight-saving or due to the ease of waste disposal. The methods for this purpose include hybrid molding and hot pressing. However, since they require multiple processes, the cost is high. If injection press molding in which the injection molding die has a pressing function is performed, a process such as cutting or drilling process can be performed simultaneously with the injection molding. Therefore, the number of processes can be reduced, and the cost will also be drastically reduced.

**Effect(s)**

- Process reduction
- High-accuracy working is achieved. (approx. ±0.02)

**Development stage**

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

- None

**Joint researcher(s) and their role**

- Yes

**Conventional technology**

- Some moldings require after processing of a gate formed with a ring gate or the like.

**New technology**

- We succeeded in punching a 1 mm thick CFRP sheet using an injection press die.
- The cut plane is clean.
- The technology can be applied also to hot pressing and hybrid molding of CFRP.

**Example of application of this technology**

- Air flow control plate of automobile air-conditioner

**Technological challenge, constraints, business plan**

- As for CFRP punching, the technology only has a record with a 1 mm thickness.

**Collaborator needed to improve this technology or develop a new technology**

- CFRP punching technology (over 3 mm)

---

**Company outline**

<table>
<thead>
<tr>
<th>Location</th>
<th>83 Tsuruta, Higashi-kaiden, Gifu, 501-1143 Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>55 million yen / 96</td>
</tr>
<tr>
<td>Product line</td>
<td>Metal dies for plastic molding, metal dies for die casting</td>
</tr>
<tr>
<td>Certification</td>
<td>None</td>
</tr>
<tr>
<td>Major customers</td>
<td>ASIN SEIKI, Tokai Rika, DENSO, LIXIL, etc.</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td>None</td>
</tr>
<tr>
<td>Inquiries</td>
<td>Dept./personnel: Masaaki Hori, Vice President</td>
</tr>
<tr>
<td></td>
<td>Contact: TEL: +81-58-230-2231, E-mail: <a href="mailto:hori@tada.co.jp">hori@tada.co.jp</a></td>
</tr>
<tr>
<td></td>
<td>Homepage: <a href="http://www.tada.co.jp/">http://www.tada.co.jp/</a></td>
</tr>
</tbody>
</table>
## Point of the proposed technology

<table>
<thead>
<tr>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Productivity: increased by 10 times</td>
</tr>
<tr>
<td>- Stabilization of the molding load</td>
</tr>
<tr>
<td>- Molding is achievable with the conventional metal molding press and something extra</td>
</tr>
</tbody>
</table>

## Productivity: increased by 10 times

- Enabled by the control of the slide position and speed, which was difficult with the conventional servo press.
- Load control is achieved with a constant pressing force.

## Stabilization of the molding load

- Ensures consistent molding load, even with resin shrinkage.
- Press molding is achievable with a constant pressing force.

## Molding is achievable with the conventional metal molding press and something extra

- Compared to the conventional metal molding press.
- Example of application to a hat section (assuming an automobile part): Impact absorbing member of automotive.
<table>
<thead>
<tr>
<th>Company/organization name</th>
<th>KOMATSU SEIREN CO., LTD.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject</td>
<td>New thermoplastic carbon fiber strand rod</td>
</tr>
<tr>
<td>Keyword(s)</td>
<td>Carbon fiber composite, reactive thermoplastic epoxy resin</td>
</tr>
</tbody>
</table>

**Point of the proposed technology**

It is a carbon fiber rod that uses a thermoplastic resin. With this rod, end-part fixing, which was previously difficult, is easily performed, and processing such as on-site bending is allowed. Utilizing its features of being light and strong, the product is expected to improve the workability of the conventional work and increase the productivity at the plant.

**Effect(s)**

Workability improvement, weight-saving of the whole work, cost reduction through elimination of heavy machinery, and long lifecycle

**Development stage**

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: 100%)
4. Commercialization completed (already delivered: yes / no)

**Joint researcher(s) and their role**

Kanazawa Institute of Technology: technical guidance, basic performance evaluation
Industrial Research Institute of Ishikawa: technical guidance, property measurement
Taniguchi Seityu K.K.: carbon fiber braid manufacturing (wire manufacturing)
Komatsu Seiren Co., Ltd.: resin impregnation, twisted wire total manufacturing/development, sales

**Conventional technology**

Developed as a substitute for steel (brace material) used for seismic strengthening material of building structures, etc.!

**New technology**

Features

(1) Lightweight (specific gravity: 1/4 of steel)
(2) High strength (tensile strength: approx. 10 times higher than iron)
(3) Not rusted
(4) A small thermal expansion coefficient, and excellent dimensional stability
(5) Can be wound, allowing long-size transfer
(6) Not magnetized
(7) Improvement of flexural cutting performance, which is a disadvantage of the existing bracing material
(8) Increase in site productivity of construction, civil engineering, etc.

Utilizing its features of being light and strong, improve the workability of the conventional work and increase the productivity at the plant.

**Disadvantages**

(1) Heavy
(2) Easily rusted
(3) Has a limit in transportable length
(4) Magnetized (inducing radio wave interference due to electromagnetic induction)

The shape and thickness vary with uses and required strengths. Since its own weight is heavy, it is not suitable for high-rise buildings or the like. In addition, problems such as the fact that the strength cannot be maintained due to corrosion of reinforcements in an environment with much salt such as coastal regions are also pointed out.

**Example of application of this technology**

Seismic retrofitting of buildings, repair and reinforcement of bridges and roads

**Technological challenge, constraints, business plan**

Since it is not included in the items of designated materials under Article 37-2 of the Building Standards Act, it cannot be adopted to newly constructed buildings. Only repair and seismic strengthening of existing buildings are covered. Cannot be used for civil engineering applications.

**Collaborator needed to improve this technology or develop a new technology**

General construction contractors

**Company outline**

<table>
<thead>
<tr>
<th>Location</th>
<th>Nu-167 Hama-machi, Nomu-cho, Ishikawa, 929-0124 Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>4.66042 billion yen / Approx. 1,280</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td>Has overseas bases</td>
</tr>
<tr>
<td>Product line</td>
<td>Fiber business (clothing/materials, etc.)</td>
</tr>
<tr>
<td>Certification</td>
<td>Major customers</td>
</tr>
</tbody>
</table>

**Inquiries**

<table>
<thead>
<tr>
<th>Contact</th>
<th>TEL +81-3-3549-3880</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-mail</td>
<td><a href="mailto:at_yamatake@komatsuseiren.co.jp">at_yamatake@komatsuseiren.co.jp</a></td>
</tr>
</tbody>
</table>

**Homepage**

http://www.komatsuseiren.co.jp/
**KOMATSU SEIREN CO., LTD.**

**Subject**: Thick plate using a new thermoplastic carbon fiber tow tip

**Keyword(s)**: Carbon fiber composite, reactive thermoplastic epoxy resin, high Vf value

<table>
<thead>
<tr>
<th>Point of the proposed technology</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The thermoplastic resin to be used is a reactive thermoplastic epoxy resin. The original yarn (tow) of carbon fiber is directly impregnated with thermoplastic epoxy resin, and after being cured, it is cut into approx. 10 to 50 mm pieces (tips), and then they are randomly oriented in a 3D manner to form a thick plate. Since this product is strong against compression, highly rigid, lightweight and resistant to rust, its use as a substitute for steel in fields such as civil engineering is expected.</td>
<td>Workability improvement, weight-saving of the whole work, cost reduction through elimination of heavy machinery, long lifecycle</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Joint researcher(s) and their role</th>
<th>Owns any intellectual property right</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in December, 2012; progress: 100%)</td>
<td>Kanazawa Institute of Technology: structural design of a thick plate, development of a metal die</td>
<td>Yes</td>
</tr>
<tr>
<td>2. Prototyping/experimental stage (to be completed in October, 2014; progress: 75%)</td>
<td>Industrial Research Institute of Ishikawa: technical guidance on property measurement, etc.</td>
<td></td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td>Taniguchi Seityu K.K.: carbon fiber tow tip resin impregnation, tipping</td>
<td></td>
</tr>
<tr>
<td>4. Commercialization completed (already delivered: yes / no)</td>
<td>Komatsu Seiren Co., Ltd.: pressed molding production, sales</td>
<td></td>
</tr>
</tbody>
</table>

### Conventional technology vs. New technology

**Application to an anchor plate (substitute for steel material) with the new thermoplastic carbon fiber tow tip**

**Disadvantages**

1. Heavy
2. Easily rusted
3. Poor workability
4. Durability (deterioration due to rust, etc.)

In addition, problems such as the fact that the strength cannot be maintained due to corrosion of steel in an environment with a lot of salt such as coastal regions are also pointed out.

**Features**

1. Lightweight (specific gravity: 1/4 of iron)
2. High strength (tensile strength: approx. 10 times higher than iron)
3. Not rusted
4. Not magnetized
5. Increase in site productivity in the field of civil engineering
6. Strong against compression
7. Can be tapped
8. Easily impregnated with resin

Utilizing its features of being light and of not being rusted, improve the workability of the conventional work and increase the site productivity.

**Example of application of this technology**

Anchor plate for ground anchor (substitute for steel material), etc.

**Technological challenge, constraints, business plan**

Since it is a high-rigidity thermoplastic carbon fiber thick plate that is lightweight, will not be rusted and can provide a high Vf value, its use as a substitute for steel material (iron sheet) is expected.

**Collaborator needed to improve this technology or develop a new technology**

Construction and civil engineering industry

---

**Company outline**

- **Location**: N-167 Hama-machi, Nomu-cho, Ishikawa, 929-0124 Japan
- **Capital/No. of employees**: 4,680,424 billion yen / Approx. 1280
- **Product line**: Fiber business (clothing/materials, etc.)
- **Certification**: Major customers
- **Inquiries**
  - **Dept./Personnel**: Yutaka Hayashi, Manager
  - **Contact**: TEL +81-3-3549-3880, E-mail at_yamatake@komatsuseiren.co.jp
  - **Homepage**: http://www.komatsuseiren.co.jp/
## KOMATSU SEIREN CO., LTD.

### Company/organization name

<table>
<thead>
<tr>
<th>Subject</th>
<th>New thermoplastic carbon fiber sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyword(s)</td>
<td>Carbon fiber composite, reactive thermoplastic epoxy resin</td>
</tr>
</tbody>
</table>

### Point of the proposed technology

This is a prepreg fabric sheet using a thermoplastic resin. The resin used is a reactive thermoplastic epoxy resin. Since it is durable, lightweight and will not be rusted, its use as a substitute for various industrial steel materials is expected.

### Effect(s)

Workability improvement, weight-saving of the whole work, cost reduction through elimination of heavy machinery, long lifecycle

### Development stage

1. Idea stage (to be completed in November, 2013; progress: 100%)
2. Prototyping/experimental stage (to be completed in September, 2014; progress: 100%)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

### Joint researcher(s) and their role

Komatsu Seiren Co., Ltd.: integrated manufacturing from resin impregnation to prototyping and sales

Yes

### Conventional technology

#### Substituting CFRP for metal

- Traffic light enclosure
- New thermoplastic carbon fiber sheet

### New technology

- Specifications
  - No. of layers: 1
  - Width: 480 mm
  - Length: continuous production allowed
  - Weave: plain weave, twill weave
  - (carbon fiber 3K, 6K, 12K)

- Features
  1. Lightweight (specific gravity of carbon fiber: 1/4 of steel)
  2. High strength (strength of carbon fiber: approx. 10 times higher than steel)
  3. Not rusted
  4. Excels in weather resistance, and durable for 50 years or more
  5. Strong against alkali
  6. Lightweight, improved site installation workability
  7. Being thermoplastic, it can be easily reheated and molded
  8. Easily recyclable
  9. Excels in impact resistance
  10. Allows CFRTP integrated molding decoration

### Example of application of this technology

Suitcase, helmet, safety shoes, etc.

### Technological challenge, constraints, business plan

Being lightweight, resistant to rust, highly durable and easily recyclable, its use as a substitute for steel material (steel plate) is expected.

### Collaborator needed to improve this technology or develop a new technology

Molders
Protective equipment/safety goods manufacturers

### Company outline

<table>
<thead>
<tr>
<th>Location</th>
<th>Nu-167 Hama-machi, Nomi-shi, Ishikawa, 929-0124 Japan</th>
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<td>4.68042 billion yen / Approx. 1280</td>
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</table>
### Point of the proposed technology

<table>
<thead>
<tr>
<th>Conventional technology</th>
<th>New technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Conventionally, it was necessary to transfer the products to a painting shop to coat it after it is molded. Transportation cost, coating cost, etc. are separately required.</td>
<td>(1) Decoration is completed when the molding has been completed. Even without special coating skills, the molder can provide decoration. Transferring for coating is unnecessary.</td>
</tr>
<tr>
<td>(2) To provide a retro-reflection function, a method of applying a reflective tape or sheet is available. However, it is difficult to freely apply the tape or sheet to a 3D curved surface. Unlike integrated bonding, the method was subject to exfoliation and less durable.</td>
<td>(2) Integrated with CFRP, the product allows decoration on its curved surface, has no exfoliation, and is robust.</td>
</tr>
<tr>
<td>(3) For coating with design such as a pattern, it is necessary to perform coating several times while providing masking and drying the work every time coating is done. Thus, it is extremely inefficient.</td>
<td>(3) Decoration with design such as a pattern is extremely easy. Decoration without retro-reflection can also be provided as necessary.</td>
</tr>
<tr>
<td>(4) Decoration with retro-reflective function can be easily achieved. Decoration without retro-reflection can also be provided as necessary.</td>
<td>(4) Decoration with retro-reflective function can be easily achieved.</td>
</tr>
</tbody>
</table>

### Example of application of this technology

Our company’s flash sign, school bag decoration

### Technological challenge, constraints, business plan

Development of a sheet transferrable at temperature suitable for thermoplastic CFRP molding, development of a sheet allowing molding and decoration at the same time

### Collaborator needed to improve this technology or develop a new technology

Public testing research institutes

### Company outline

| Location | 150-1, Nu, Nama-machi, Nomi-shi, Ishikawa, 929-0124, Japan |
| Capital/No. of employees | 20 million yen / 18 |
| Product line | Dyes, retro-reflective inks, paints, coating, fine particle dispersion |
| Certification | ISO9001 |
| Inquiries | Shinichi Ohmachi, Executive Director, Technical Development Department |
| Contact | TEL +81-761-55-2220 |
| Homepage | http://www.komatsuprocess.co.jp/ |
In the supporting industry project for fiscal 2009 to 2011, the center developed a prototype system, specifically laser-processed CFRP members with thickness up to 10 mm, and examined the cutting quality and processing accuracy of the processed planes. The center asked the Tanabe lab and the Saso lab of the Nagoya University to study the cutting and bonding conditions. The Taira lab of the Daido University examined the effect of ozone. The Aichi Center for Industry and Science Technology even examined the fatigue strength. Saito Industry also tried to manufacture a battery case by hot pressing.

If CFRP composite materials are extensively adopted in the transport equipment industry in the future, it will substantially advance the weight-saving and fuel efficiency improvement of aircraft and automobiles and the solution to the CO2 gas emission problem. However, since the CFRP material processing currently uses an expensive diamond cutter or water jet cutter, CFRP products are inevitably expensive. Therefore, using ultrashort pulsed-laser will achieve high-quality processing.

Conventional laser cutting methods for CFRP:
1) Cutting using a diamond tool
2) Water jet cutting
Characteristics: fiber is subject to exfoliation. The diamond tool is easily worn, and straight line cutting is the mainstay in expensive diamond cutting. Difficult in fine cutting and drilling. Flying of carbon powder is hazardous to the human body. Separation of garnet from carbon powder has a problem. Manufacturing cost is high.

New technology
Cut and drill carbon fiber by transforming it into plasma with temperature approx. 10,000°C using nano-second pulse laser.
Since it is free from wear of the optical system, high accuracy can be maintained. End face quality is good, allowing flexible processing. Fine cutting and drilling is easily achievable. Carbon powder can be absorbed and treated during the process. Unnecessary to separate abrasive from carbon powder. Use of a mosaic joint or the like enables butt welding. High-speed processing can be performed, and the processing cost can be reduced.

Example of application of this technology
Aircraft skin panel, jet engine acoustic liner, automobile battery case

Technological challenge, constraints, business plan
The technological challenge is to increase the processing speed with keeping the cut quality. With a thick CFRP material, in particular. In our business plan, we project to complete a hybrid laser processing system for CFRP material and sell it in fiscal 2015.

Collaborator needed to improve this technology or develop a new technology
The companies to which we desire to sell this technology include the aircraft equipment industry, automobile industry, industrial machinery manufacturers, and energy (e.g., wind generation) industry.

Company outline
Location 40-7 Hironi, Anjo-sho, Anjo-shi, Aichi, 446-0026 Japan
Capital/No. of employees 5 million yen 4
Overseas base(s) Dalian and Shenyang in China
Product line Laser peening systems, long-life power supply tips
Major customers BINTOKUGI LTD., ART METAL MFG., ASIN AIR, Toyota Motor
Certification None
Inquiries Dept./personnel Dr. Prof. Muneharu Kutsuna, President
Contact TEL +81-566-91-2281
E-mail altrec-kutsuna@nifty.com
Homepage http://homepage3.nifty.com/altrec/
Cybernet Systems Co., Ltd.

Subject: Simulation of CFRP molding achieved in an integrated CAE environment (injection, impregnation, pressing)

Keyword(s): Injection molding, impregnation molding, press molding, numerical material test, continuous/discontinuous fiber

Point of the proposed technology

- Operation of analyzing complex and different physical phenomena in the molding process can be achieved in an integrated environment in a simplified manner.
- By using a numerical material test simulation, repetition of design and trial and error are effectively and efficiently achieved.

Effect(s)

- Prototyping-free Shortening of the development period through design variable (parameter) study

Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in March, 2015; progress: 70%)
3. Development completion stage (to be completed in December, 2014; progress: 90%)
4. Commercialization completed (already delivered: yes / no)

Joint researcher(s) and their role

The company’s own technology

Collaborator needed to improve this technology or develop a new technology

- Companies interested in shortening and streamlining the development period for CFRP product design and material design by utilizing the CAE simulation

Material design feasible in an integrated environment & CFRP molding simulation

Example of application of this technology

- Molding simulation for FRP products
- Design of composite materials

Technological challenge, constraints, business plan

- Accuracy improvement and operability improvement for the real machine product

Collaborator needed to improve this technology or develop a new technology

- Companies interested in shortening and streamlining the development period for CFRP product design and material design by utilizing the CAE simulation

Company outline

Location: Fujisoft Bldg. 3 Kanda-nieribecho, Chiyoda-ku, Tokyo 101-0022 Japan

Capital/No. of employees: 955 million yen 534 (consolidated)

Overseas base(s): China, South Korea, Taiwan, United Stated, Canada, Europe

Product line: Computer software, solution service

Major customers: Not disclosed

Certification: ISO 27001

Website: [http://www.cybernet.co.jp/](http://www.cybernet.co.jp/)

Contact: TEL +81-3-5297-3244

E-mail: makoto13@cybernet.co.jp
Saekisogokensetsu

### Subject
Development of a high-function quake-resistant construction method for steel-frame buildings that uses the fastening of high-strength fiber material and metal terminal

### Keyword(s)
Technology for connecting high-strength fiber with metal terminal

### Point of the proposed technology
By using the fastening of high-strength fiber material and metal terminal, it can be attached to a steel-frame building as the seismic reinforcement member. This enables the achievement of a seismic reinforcing construction method with low cost, high strength and short construction period, and ensures seismic performance of steel-frame buildings (factories, warehouses) owned by private companies, which support the bottom of Japan as a 'manufacturing power.'

### Development stage
1. Idea stage (to be completed in August, 2015; progress: 100%)
2. Prototyping/experimental stage (to be completed in December, 2015; progress: 30%)
3. Development completion stage (to be completed in March, 2017; progress: 0%)
4. Commercialization completed (already delivered Yes)

### Conventional technology

### New technology

[Problems]
- Since flame is generated through welding for installation, protection is required.
- Since the members are made of iron, they are heavy and substantial reinforcements are required.
- Since these are heavy articles, it is difficult to handle them by human power, and equipment for loading and installation is required.
- Since there are many site works, considerable construction days are required.
- Equipment for working is required, and it is difficult to conduct the work while operating the factory.

[Features]
- High strength → reinforcement member with tensile strength 5.5 times as high as that of iron
- Weight-saving → since the weight is 1/6 of iron, it can be installed by human power
- Low cost → construction cost is reduced by 33% from the conventional construction method

### Example of application of this technology
Seismic reinforcement members for existing buildings (steel frame structure)
Civil engineering buildings (bridge main wire, earth-retaining wall earth anchor)

### Technological challenge, constraints, business plan
Seismic reinforcement of private buildings has not spread due to factors such as high cost and temporary closure of factories. To increase the ratio of seismic reinforcement, low cost and short construction period are prerequisites. In addition, if a 'non-welding method' that enables the work to be conducted while the building is used is developed, it will lead to promotion of seismic reinforcement.

### Collaborator needed to improve this technology or develop a new technology
- Companies related to resin processing having knowledge on technology for the development of terminals using high-strength fiber material
- Bolt manufacturers having knowledge on technology for non-welding connections of seismic reinforcement members to existing steel frames

### Company outline

#### Inquiries
- **Contact**
  - TEL: +81-574-83-1155
  - E-mail: hts@saekisogo.co.jp
- **Homepage**
  - http://www.saekisogo.com

#### Development stage
Joint researcher(s) and their role: Acts Institute of Technology (provision of experiment equipment, provision of advice on the experiment method, and observation of the result)

#### Conventional technology

#### New technology

#### Example of application of this technology
Seismic reinforcement members for existing buildings (steel frame structure)
Civil engineering buildings (bridge main wire, earth-retaining wall earth anchor)

#### Technological challenge, constraints, business plan
- Seismic reinforcement of private buildings has not spread due to factors such as high cost and temporary closure of factories. To increase the ratio of seismic reinforcement, low cost and short construction period are prerequisites. In addition, if a "non-welding method" that enables the work to be conducted while the building is used is developed, it will lead to promotion of seismic reinforcement.

#### Collaborator needed to improve this technology or develop a new technology
- Companies related to resin processing having knowledge on technology for the development of terminals using high-strength fiber material
- Bolt manufacturers having knowledge on technology for non-welding connections of seismic reinforcement members to existing steel frames
**SAKAI OVEX Co., Ltd.**

**Subject**
Strength increase, weight saving, and molding time shortening using spread tow carbon fiber prepreg impregnated with a thermoplastic resin

**Keyword(s)**
Carbon fiber, Spread tow, carbon fiber reinforced thermoplastic plastics (CFRTP), weight saving, high-speed molding

<table>
<thead>
<tr>
<th>Point of the proposed technology</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- By &quot;Spread tow&quot; carbon fiber, a thermoplastic resin impregnated sheet with &quot;thick and weight&quot; 1/2 or less of the conventional sheet can be manufactured.</td>
<td></td>
</tr>
<tr>
<td>- Since the layer is thinned through the opening, the strength will increase.</td>
<td></td>
</tr>
<tr>
<td>- Use of a thin sheet can make the product thinner and lighter.</td>
<td></td>
</tr>
<tr>
<td>- Since the resin impregnating ability is improved through fiber opening, a sheet impregnated with a highly viscous resin, which was previously difficult to produce, can be manufactured.</td>
<td></td>
</tr>
<tr>
<td>- Since CFRTP does not require curing time, the molding time can be drastically shortened from the conventional CFRP.</td>
<td></td>
</tr>
</tbody>
</table>

**Development stage**

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Company/university, etc. with which joint research is conducted</th>
<th>Owns any intellectual property right</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in [month] [year]; progress: %)</td>
<td>University of Fukui</td>
<td>Yes</td>
</tr>
<tr>
<td>2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Commercialization completed (already delivered: yes / no)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Conventional technology**

**New technology**

**Company outline**

<table>
<thead>
<tr>
<th>Location</th>
<th>2-15-1, Hanamidob Naka, Fukui-shi, 919-8530 Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>4.65504 billion yen, 488</td>
</tr>
<tr>
<td>Product line</td>
<td>Fiber related products</td>
</tr>
<tr>
<td>Major customers</td>
<td></td>
</tr>
<tr>
<td>Certification</td>
<td>ISO9001, ISO14001</td>
</tr>
<tr>
<td>Dept/personnel</td>
<td>Hiroki Kono, Manager, Advanced Composite Materials Department</td>
</tr>
<tr>
<td>Contact</td>
<td>TEL +81-778-34-8680, E-mail <a href="mailto:h.kono@sakaiovex.co.jp">h.kono@sakaiovex.co.jp</a></td>
</tr>
<tr>
<td>Homepage</td>
<td><a href="http://www.sakaiovex.co.jp/">http://www.sakaiovex.co.jp/</a></td>
</tr>
</tbody>
</table>

**Example of application of this technology**
- Exterior panel members for automobiles
- Structural members for aircraft

**Technological challenge, constraints, business plan**
- Increasing productivity of thick products
- Selection of thermoplastic resins

**Collaborator needed to improve this technology or develop a new technology**
- Companies/universities having equipment for molding/processing our company’s material
- Thermoplastic resin manufacturers

**Effect(s)**
- By “Spread tow” carbon fiber, a thermoplastic resin impregnated sheet with “thick and weight” 1/2 or less of the conventional sheet can be manufactured.
- Since the layer is thinned through the opening, the strength will increase.
- Use of a thin sheet can make the product thinner and lighter.
- Since the resin impregnating ability is improved through fiber opening, a sheet impregnated with a highly viscous resin, which was previously difficult to produce, can be manufactured.
- Since CFRTP does not require curing time, the molding time can be drastically shortened from the conventional CFRP.

**We supply molding material impregnated with thermoplastic resin**

**Sectional photo of an ordinary resin impregnated sheet made of carbon fiber fabric**

Having a resin-rich part and a fiber-dense part, the sheet is uneven as a material, and fiber that may be easily broken undulates. Stress is concentrated at the intersection of warp and woof, and the theoretical strength is not achieved.

**Sectional photo of a resin impregnated sheet made of “spread tow” carbon fiber fabric**

Since it is woven with an opened yarn, it has little fiber undulation, shows little stress concentration at the intersection, and achieves strength close to the theoretical strength.

**Development of CFRP and CFRTP**

<table>
<thead>
<tr>
<th>(1) Material setting</th>
<th>(2) Pressurization</th>
<th>(3) Heating</th>
<th>(4) Cooling</th>
<th>(5) Releasing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Molding of CFRP</strong></td>
<td><strong>0° direction</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(1) Material setting</th>
<th>(2) Pressurization</th>
<th>(3) Heating</th>
<th>(4) Cooling</th>
<th>(5) Releasing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Molding of CFRTP</strong></td>
<td><strong>0° direction</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Point of the proposed technology**

**Conventional technology**

**New technology**
### Subject
System that performs rapid heating and rapid cooling by instantaneously switching the temperature of the medium circulating into the metal die between high and low temperature

### Keyword(s)
Metal die, temperature control, heating, cooling

### Point of the proposed technology
- Shortening of the molding cycle time by rapid heating and rapid cooling
- Raising the metal die temperature during the filling to a level at which the transferability can be increased.
- After the filling, cooling the die as rapidly as possible to achieve a high-quality molding.

### Effect(s)
- Increased product strength
- Increased transferability
- Increased gloss

### Development stage
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

### Joint researcher(s) and their role
Not disclosed

### Conventional technology
- Silver streaks on the surface of the molding (floating of glass fiber)
- Low transferability and poor surface gloss

### New technology
- Free of silver streak
- Luxurious impression of the product is drastically improved.
- High transferability resulting in high gloss of the surface

### Example of application of this technology
- Temperature control for a metal die for hot press molding
- Thick and thin plastic molding products

### Technological challenge, constraints, business plan
- Survey on the necessary functions and needs for metal die temperature control systems for carbon fiber composites

### Collaborator needed to improve this technology or develop a new technology
- Companies that consider adopting temperature control (e.g., constant temperature, rapid heating, rapid cooling) for molding

### Company outline
- **Location**: 3-2-10 Minamitsumori, Nishi-ku, Osaka, 557-0063 Japan
- **Capital/No. of employees**: 33.4 million yen / 75
- **Overseas bases**: Has overseas bases
- **Product line**: Temperature controllers for metal dies for plastic molding
- **Major customers**: Not disclosed
- **Certification**: ISO 9001

### Inquiries
- **Dept./Personnel**: Takayuki Nakata, Engineering Department
- **Contact**: TEL +81-6-6659-1347  E-mail t-nakata@thermoteq.co.jp
- **Homepage**: http://www.thermoteq.co.jp/
**National Institute of Advanced Industrial Science and Technology (AIST)**

**Subject**
Application of the microwave process to CFRP molding

**Keyword(s)**
Microwave, High-speed molding, High-speed resin curing, Suppression of thermal degradation

### Development stage

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Joint researcher(s) and their role</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
</tr>
<tr>
<td>Prototype/experimental stage (to be completed in March, 2014; progress: 80%)</td>
<td></td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
</tr>
<tr>
<td>4. Commercialization completed (already delivered: yes / no)</td>
<td></td>
</tr>
</tbody>
</table>

### Conventional technology vs. New technology

**Application of the developed microwave process to CFRP molding**

- **Conventional CFRTP**
  - Thermally degradation

- **Developed CFRTP**
  - By the development of thermal conductive matrix, the thermal degradation of CFRTP during molding is suppressed.
  - High-speed molding of CFRTP is achieved by the developed microwave process.
  - In case of CFRTS, adhesion between fiber and resin and mechanical properties are improved by the developed microwave process.

### Example of application of this technology

- CFRTS: high-speed resin curing
- CFRTP: High-speed molding and suppression of thermal degradation

### Collaborator needed to improve this technology or develop a new technology

- Development of equipment for large-scale molding
- Development of resin matrix
- Development of die

### Company outline

**Location**
2265-98 Anagahora, Shimoshidami, Moriyama-ku, Nagoya 463-8560, Japan

**Capital/No. of employees**
- Capital:
- No. of employees: 150

**Product line**
- Major customers:
- Overseas base(s): —

**Certification**
- —

**Inquiries**

**Dept./personnel**
Yasuo Iida, Innovation Coordinator, Center for Industrial Relations

**Contact**
+81-52-736-7597

**E-mail**
y.iida@aist.go.jp

**Homepage**
https://unit.aist.go.jp/chubu/ci/
**Company/Organization name**  
SANKO GOSEI LTD.

**Subject**  
Carbon fiber molding technology, metal die production

**Keyword(s)**  
Carbon fiber (thermosetting, thermoplastic), molding, metal die

### Development stage

<table>
<thead>
<tr>
<th>Stage</th>
<th>Joint researcher(s) and their role</th>
<th>Joint researcher(s) and their role</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in [month] [year]; progress: %)</td>
<td>Ichimura Sangyo Co., Ltd. (role: development of thermoplastic prepreg)</td>
<td>Yes</td>
</tr>
<tr>
<td>2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Commercialization completed (already delivered: yes / no)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Conventional technology

- With use of carbon fiber instead of the conventional sheet metal, the strength is substantially increased and the weight can be reduced.
- Since thermoplastic carbon fiber material is used, the molding time is short.
- Since trimming of the periphery is unnecessary, a finishing process for the product is unnecessary.
- Since it is unnecessary to make holes for securing the molding, the product strength is not lowered.

### New technology

- Molding time: 30 min. ⇒ 5 min.
- Cost: reduced by 30%
- Trimming: unnecessary

### Point of the proposed technology

- Molding of carbon fiber (deep drawing)
- Deep drawing with a depth 20 mm and molding without trimming
- Integration of a carbon fiber molding with screw bosses
- Integration molding of insert bosses into a carbon fiber molding

### Technological challenge, constraints, business plan

- If the releasing resistance in deep drawing of carbon fiber is reduced, the burden on the ejection work will be lightened.
- If the metal die heating time is shortened and uniform cooling is achieved, the molding cycle will be shortened and the product quality will be stabilized.

### Collaborator needed to improve this technology or develop a new technology

- Company or research institute that can develop an automatic design program for preparing an expansion plan of prepreg based on the product shape.
- Company or research institute that can develop a technology and equipment for cutting prepreg.
- Company or research institute that can develop intermediate material for efficiently producing carbon fiber parts.

### Example of application of this technology

- Automobile goods
- Office automation equipment

### Company outline

- **Location**: 1200 Habushin, Nanto-shi, Toyama, 939-1698 Japan
- **Capital/No. of employees**: 1.8908 billion yen 801
- **Overseas base(s)**: China, Thailand, Malaysia, Indonesia, Singapore, U.K.
- **Product line**: Exterior and functional parts for automobiles, office automation equipment
- **Major customers**: Daihatsu Motor Co., Ltd., Honda Motor Co., Ltd., XEROX, Canon

### Inquiries

- **Dept/personnel**: Tsutomu Konishi, Chief Products Engineer Products Applied Technology Futuristic Technology Department
- **Contact**: TEL +81-763-62-3660  E-mail t.konishi@sankogosei.co.jp
- **Homepage**: [http://www.sankogosei.co.jp](http://www.sankogosei.co.jp)
Point of the proposed technology

<table>
<thead>
<tr>
<th>Effect(s)</th>
<th>I . Materials with isotropy and high strength (mechanical properties)</th>
</tr>
</thead>
<tbody>
<tr>
<td>II . High moldability enables to produce intricate-shaped moldings.</td>
<td></td>
</tr>
<tr>
<td>III . Short-cycle forming and low-pressure pressing are possible.</td>
<td></td>
</tr>
<tr>
<td>IV . A low porosity rate ensures high quality moldings.</td>
<td></td>
</tr>
<tr>
<td>V . Suitable for thin CFRP products</td>
<td></td>
</tr>
</tbody>
</table>

Total cost is reduced by shortening the forming time and simplifying the material handling.
Mass: 1/4 of iron or steel
Productivity/workability: high-cycle forming
Superior to conventional fabrics in formateness in deep grooves and small corner radius

Example of application of this technology

| Metallic parts, thermosetting resin parts. | Fabric-made parts that are Difficult to form. |

Technological challenge, constraints, business plan

| Developing a cold-pressing molding method and heat-and-cool molding method. |

Collaborator needed to improve this technology or develop a new technology

| Company that has a molding technology for carbon fiber composites and creates a new market by conducting molding as the end customer |

Company outline

<table>
<thead>
<tr>
<th>Location</th>
<th>Ka-81, Kiba-machi, Komatsu-shi, Ishikawa, 923-0311 Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>33 million yen 148</td>
</tr>
<tr>
<td>Product line</td>
<td>Manufactured fiber products</td>
</tr>
<tr>
<td>Major customers</td>
<td>Teijin, Toray, NITORI</td>
</tr>
<tr>
<td>Inquiries</td>
<td>Naoya Eguchi, Manager, New Business Development Department</td>
</tr>
<tr>
<td>Contact</td>
<td>TEL +81-761-43-2268</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:n-eguchi@sunoda.co.jp">n-eguchi@sunoda.co.jp</a></td>
</tr>
</tbody>
</table>

Homepage | http://www.sunoda.co.jp |
By adopting a drill with a cutting edge optimally shaped for micro pecking to the drilling of a laminated sheet of CFRP and Ti alloy, the quality was improved while reducing the number of processes and substantially improving the processing efficiency.

Effect(s)

* Reduction of the number of pieces of equipment and types of tools
* Reduction of the drilling cost and the tool room inventory cost
* Extension of the drill life
* Improvement of the hole diameter tolerance and surface roughness
* Reduction of delamination and burr

The conventional technology has various problems in the drilling of a laminated sheet of CFRP and Ti alloy.

# Conventional technology

- It is necessary to process different materials (CFRP and Ti alloy) using the same tool, making it necessary to set the cutting condition at a low level.
- The CFRP surface is damaged by chips of Ti alloy, making it difficult to secure quality of the processed surface.
- The demand for the drilling of larger-diameter holes is becoming stronger, it is urgent to make improvement.

# New technology

By adopting the micro-pecking process and a drill with a cutting edge optimally shaped for it to the drilling of a laminated sheet of CFRP and Ti alloy, it became possible to process the workpiece in a single step, and various effects were achieved.

## Features and advantages of the processing

- Micro-power processing is achievable.
- Lubricant is surely supplied to the cutting edge.
- Damage to the CFRP surface due to chips is reduced.
- In metal parts such as titanium and aluminum, fine chips are generated, and discharged.
- The processing may be unstable due to the matching between the power feeder and a fixing jig or suction equipment, and lack of maintenance.

## Shape of the conventional drill’s cutting edge

### State of chips

- Conventional process
- Micro-pecking process

---

**Example of application of this technology**

* Aircraft fuselage parts

---

**Technological challenge, constraints, business plan**

- The processing may be unstable due to the matching between the power feeder and a fixing jig or suction equipment, and lack of maintenance. The installation of the power feeder, which is the micro-pecking mechanism’s attachment, has partially limitations, and its application requires a separate special adapter, etc.
- We intend to contribute to highly efficient processing at customers by proposing a cutting tool and an application technology at the same time.

---

**Collaborator needed to improve this technology or develop a new technology**

- Companies that conduct composite processing or have such a plan in the future, and companies related to equipment
- Research institutes such as universities having evaluation technology/equipment for composite processing
**SANYO CHEMICAL INDUSTRIES, LTD**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Sizing agents for carbon fibers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyword(s)</td>
<td>Sizing agent</td>
</tr>
</tbody>
</table>

### Point of the proposed technology

**Effect(s)**

- Good compatibility with carbon fibers and matrix resins
- Molded articles excelling in strength can be obtained

### Development stage

<table>
<thead>
<tr>
<th>Stage</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage</td>
<td>%</td>
</tr>
<tr>
<td>2. Prototyping/experiment stage</td>
<td>%</td>
</tr>
<tr>
<td>3. Development completion stage</td>
<td>%</td>
</tr>
<tr>
<td>Commercialization completed</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Conventional technology

- Since the sizability is low, fuzzing occurs in carbon fiber.
- Low opening property
- Low compatibility between carbon fiber and resin

### Example of application of this technology

**Sizing agents for carbon fibers**

### Collaborator needed to improve this technology or develop a new technology

**Organization capable of evaluating CFRP mechanical property and CF/matrix interface adhesive strength**

### Company outline

- **Location**: 11-1, Ikkyo Nomoto-cho, Higashiyama-ku, Kyoto 605-0995, Japan
- **Capital/No. of employees**: 13.051 billion yen, 1,917
- **Overseas base(s)**: Has overseas bases
- **Product line**: Surfactants, raw material for polyurethane foams, etc.
- **ISO Certification**: ISO9001, ISO14001
- **Inquiries**: Unit Manager, Masahito Inoue, Surfactants Research Dept.
- **Contact**
  - TEL: +81-75-541-6245
  - E-mail: m.inoue@sanyo-chemical.com
- **Homepage**: [http://www.sanyo-chemical.co.jp](http://www.sanyo-chemical.co.jp)

---

**Image Description**

The image contains a text in Japanese, which translates to:

**Features**

- High compatibility with carbon fibers and matrix resins
- Molded articles excelling in strength can be obtained
- Low opening property
- Low compatibility between carbon fiber and resin

**Development stage**

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experiment stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: Yes / No)

- Yes

**Example of application of this technology**

Sizing agents for carbon fibers

**Collaborator needed to improve this technology or develop a new technology**

Organization capable of evaluating CFRP mechanical property and CF/matrix interface adhesive strength

---

The text is accompanied by a diagram illustrating the manufacturing process of carbon fiber.
Subject
CFRTP and GFRTP are continuous-fiber thermoplastic materials in which carbon or glass fiber is completely impregnated with thermoplastic resin
Keyword(s)
60-seconds hybrid molding

Point of the proposed technology
In Europe and the United States, continuous-fiber thermoplastic materials are adopted in mass-produced parts in various fields such as those of automobiles, aircrafts, sporting goods and mobile equipments. Weight reduced by 50% from metal. Molding cycle: 1 minute

Development stage
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

Joint researcher(s) and their role
Bond Laminates (Germany)
Lanxess (Germany)

None

Conventional technology
New technology

Short fiber, long fiber: CFRTP, GFRTP

Example of application of this technology
Automobiles, aircrafts, mobile equipments, sporting goods, etc.

Technological challenge, constraints, business plan
60-seconds hybrid molding technology

Collaborator needed to improve this technology or develop a new technology
Molders, metal die companies, equipment manufacturers, research institutes such as universities

Company outline
Location 3-204 Unuma-Kawasaki-Cho, Kakamigahara-cho, Gifu, 509-0147 Japan
Capital/No. of employees 10 million yen 16 Overseas base(s) None
Product line CFRTP, GFRTP Major customers Kawasaki Heavy Industries, Mitsubishi Heavy Industries, IHI, etc.
Certification JIS Q 9100

Inquiries
Dept./personnel Hoteli: Araya, Manager, Sales
Contact TEL +81-58-389-4511 E-mail stc003@sunwa-trading.co.jp
Homepage www.sunwa-trading.co.jp

Collaborator

Technological challenge, constraints, business plan
60-seconds hybrid molding technology

Example of application of this technology
Automobiles, aircrafts, mobile equipments, sporting goods, etc.

Collaborator needed to improve this technology or develop a new technology
Molders, metal die companies, equipment manufacturers, research institutes such as universities

Company

Location

Capital/No. of employees

Product line

Certification

Inquiries

Dept./personnel

Contact

Homepage
## CFC DESIGN Inc.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Improvement of anisotropic thermal conductivity and development of new C/C composite with lower porosity (FS320)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyword(s)</td>
<td>C/C composite, thermal conductivity, anisotropy, oil cooling, lower porosity</td>
</tr>
</tbody>
</table>

### Development stage

- **1. Idea stage** (to be completed in [month] [year]; progress: %)
- **2. Prototyping/experimental stage** (to be completed in [month] [year]; progress: %)
- **Development completion stage** (to be completed in January 2015; progress: 50%)
- **4. Commercialization completed** (already delivered: yes / no)

### Joint researcher(s) and their role

- None

### Point of the proposed technology

- In comparison with conventional C/C composites, anisotropic thermal conductivity will improve significantly.
- Lowering porosity enables the use of C/C composite for the heat treatment oil cooling process.

### Effect(s)

- Anisotropic thermal conductivity (XY plane : Z) 3:1 → 1:1
- Porosity: conventional 20% → 5%

### Collaborator needed to improve this technology or develop a new technology

- Companies which can test at the oil cooling process.
- Research institutes having technique and expertise to suppress reaction between carbon and metal, etc.

### Inquiries

- **Dept./personnel**: Hirotaka Nagao, Fellow, Sales & Marketing Department
- **Homepage**: [http://www.cfc-design.co.jp](http://www.cfc-design.co.jp)
- **Contact**
  - TEL: +81-778-42-5629
  - FAX: +81-778-51-2220
  - E-mail: h-nagao@cfc-design.co.jp

### Conventional technology

- **Tray using SUS310 at 1100°C**
  - Although cooling oil is not penetrated, deformation is severe under high-temperature because it is metal.
  - As it is heavy-weight, heating and cooling take time, leading to high energy consumption.

### New technology

- **Tray using C/C composite at 1100°C**
  - As porosity is low and cooling oil is not penetrated, it can be used for oil cooling process.
  - As it is made from carbon, it has greater heat resistance with no deformation.
  - As its density is 1.7 g/cm³ which is approximately a quarter of metal, it is light-weight with low energy consumption.

### Example of application for the oil cooling process using a tray for metal heat

**Example of application of this technology**

- Jigs for the heat treatment process such as tools and gears (oil cooling process in particular)
- C/C composite heater (substitute for graphite heater)

### Technological challenge, constraints, business plan

In recent years, heat treatment temperature for metal is becoming increasingly high, and the reaction between heat treated object and c/c has become a problem. Once surface treatment technique to suppress this reaction is established, further application will be expected.

### Collaborator needed to improve this technology or develop a new technology

- Companies which can test at the oil cooling process.
- Research institutes having technique and expertise to suppress reaction between carbon and metal, etc.

### Company outline

- **Location**: 1-4-11, Funatsu-cho, Sabae-shi, Fukui, 916-0054 Japan
- **Capital/No. of employees**: 100 million yen / 58 employees
- **Product line**: C/C composite
- **Major customers**: Shin-Etsu Chemical Co., Ltd., Daido Steel Co., Ltd. etc.
- **Certification**: ISO 9001
- **Across USA**

### Example of application for the oil cooling process using a tray for metal heat

**Example of application of this technology**

- Jigs for the heat treatment process such as tools and gears (oil cooling process in particular)
- C/C composite heater (substitute for graphite heater)
Integrated manufacturing of products ranging from formed and fabricated CFRTP materials to molded articles by utilizing the formed material (UD tape) processing and the TAM molding method

**Point of the proposed technology**

**Effect(s)**

- Reduction of capital investment to up to 1/5
- Molding time 60 min → 20 min
- In-house production of formed and fabricated material is possible

**Development stage**

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experiment stage (to be completed in March, 2015; progress: 80%)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

**Joint researcher(s) and their role**

Hamamatsu Region Society for CFRP Commercialization Study

- A company participating in the UD tape project (development of UD tape forming equipment)
- Cap Inc., (development of the high-frequency current conduction heating method (TAM method))

**New technology**

- Technology for manufacturing formed and fabricated CFRTP material (UD tape)

**Conventional technology**

- Building of an integrated production process covering material to product in the company
- Improved design of molded articles and forming technology using a UD tape or secondary-formed material (sheet, chop)
- Clarification of the UD tape manufacturing conditions and final forming conditions supporting various matrix resins
- Enclosure and structural parts of robot
- Forming of low-plasticity material such as Mg and Ti
- Forming with the high-temperature conduction heating method (TAM method)
- Supporting forming with the conventional equipment (pressing machine)
- Building of a short-time forming process with a small capital investment

**Example of application of this technology**

- Exterior parts such as automobile transmission case
- Parts such as screws of an outboard engine
- Forming of low-plasticity material such as Mg and Ti
- Enclosure and structural parts of robot
- To achieve uniform temperature, it is necessary to establish a forming technology applying the core material for the optimization of the heating simulation and for the uniformity of the applied pressure

**Technological challenge, constraints, business plan**

- Clarification of the UD tape manufacturing conditions and final forming conditions supporting various matrix resins
- Design of molded articles and forming technology using a UD tape or secondary-formed material (sheet, chop)
- TAM method is used to solve the problem of unevenness in metal die temperature and pressure distribution depending on the forming material and shape. However, a metal die with even pressure distribution and temperature distribution is being completed by reviewing the structure, mechanisms, etc., of the metal die.
- To achieve uniform temperature, it is necessary to establish a forming technology applying the core material for the optimization of the heating simulation and for the uniformity of the applied pressure

**Collaborator needed to improve this technology or develop a new technology**

- Contact us if there is any organization to which this technological seed can be applied.

**Company outline**

- Location: 1-3-3 Shinmyakado, Kita-ku, Hamamatsu city, Shizuoka, 431-2103 Japan
- Capital/No. of employees: —/—
- Product line: —
- Overseas base(s): —
- Major customers: —
- Certification: —
- Staff/personnel: Section Director, Kazuyuki Suzuki, Fiber and Polymeric Materials Section

**Inquiries**

- Contact: TEL +81-53-428-4154
- E-mail: kazuyuki3_suzuki@pref.shizuoka.jp
- Homepage: http://www.it.pref.shizuoka.jp/hamamatsu/index.html
**Company/organization name**: Hamamatsu Technical Support Center, Industrial Research Institute Of Shizuoka Prefecture

**Subject**: Vibration and rigidity control for fiber-reinforced plastic by weaving with two kinds of fibers

**Keyword(s)**: fiber-reinforced material, composite, weaving technique, vibration characteristic

---

### Point of the proposed technology

| Effect(s) | By using a combination of characteristics of fibers such as carbon and aramid fiber, and anisotropically controlled reinforced fiber material unique to weaving, required strength and vibration characteristics are given to fiber-reinforced plastic (FRP). |

---

### Development stage

<table>
<thead>
<tr>
<th>Idea stage (to be completed in [month] [year]; progress: %)</th>
<th>Prototyping/experimental stage (to be completed in March 2015; progress: 75%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td>4. Commercialization completed (already delivered: yes / no)</td>
</tr>
</tbody>
</table>

---

### Conventional technology

**Fiber-reinforced material for FRP by combining different kinds of fibers (fabrics)**

---

### New technology

**By controlling the mixture rate of carbon and aramid fiber, and the laminating ratio, control natural frequency loss coefficient etc.**

---

### Example of application of this technology

- A resonant board for musical instruments and acoustic equipment
- Design parts
- Transportation equipment parts

---

### Technological challenge, constraints, business plan

- Automation for three dimensional form weaving technique is difficult and there are issues regarding mass-production.
- Modifying weaving machines for reinforced fiber has enabled test weaving of difficult weaving material. However, there are still areas where manual operations are needed, leading to productivity issues.

---

### Collaborator needed to improve this technology or develop a new technology

- Please contact to discuss applicable deployment target of this technology seeds.

---

### Company outline

- **Location**: 1-3-3 Shinmyakoda, Kita-ku, Hamamatsu-shi, Shizuoka, 431-2103 Japan
- **Capital/No. of employees**: — / approx. 35 employees
- **Product line**: —
- **Overseas base(s)**: —
- **Major customers**: —
- **Certification**: —

---

### Inquiries

- **Dept/personnel**: Kazuyuki Suzuki, Section Director, Fiber and Polymeric Materials Section
- **Contact**: TEL +81-53-428-4154
- **E-mail**: kazuyuki3_suzuki@pref.shizuoka.lg.jp
### Hamamatsu Technical Support Center,
Industrial Research Institute Of Shizuoka Prefecture

**Subject**: Optimization of cutting conditions by evaluating CFRP cutting

**Keyword(s)**: Cutting, High speed camera, Cutting resistance, Optimization of cutting conditions

#### Point of the proposed technology

- Analyze cutting dynamics of equipment in actual use by using a high speed camera and a tool dynamometer.
- Analyze cutting surface and tools by using a roughness measuring device, three-dimensional measuring machine and a video microscope.
- Consider the most suitable cutting conditions by investigating the relevance of a various evaluation data.

#### Effect(s)

Optimization of CFRP cutting

#### Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)

#### Joint researcher(s) and their role

Not open to the public (Please inquire.)

None

#### Conventional technology

Example of application for cutting edge of delamination CFRP plate material

#### Issues regarding cutting CFRP

- Short tool life expectancy.
- The quality of cut surface deteriorates due to uncut, falling off of fibers and thermosetting.

#### Point of the proposed technology

- By using images from a high speed camera and cutting resistance measurement, conditions of uncut fiber occurrence were investigated and analyzed.
- It was found that more forces added to the vertical direction, when the amount of uncut fiber was large.

#### Example of application for cutting edge of delamination CFRP plate material

- You can evaluate the process by using equipment in actual use at the manufacturing site!
- We measure work materials after cutting and the observation of surface roughness and cutting tools and examine comprehensibly the most suitable conditions.

#### Collaborator needed to improve this technology or develop a new technology

- Please contact to discuss the possibility of applicability of this technology seeds.

#### Example of application of this technology

Support to optimize CFRP cutting conditions
Support for developing tools for CFRP cutting

---

**Company outline**

<table>
<thead>
<tr>
<th>Location</th>
<th>1-3-3 Shinniyakoda, Kita-ku, Hamamatsu-shi, Shizuoka, 431-2103 Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>Approx. 35 employees</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td>Major customers</td>
</tr>
<tr>
<td>Product line</td>
<td></td>
</tr>
<tr>
<td>Certification</td>
<td></td>
</tr>
</tbody>
</table>

**Inquiries**

- **Dept/personnel**: Hirofumi Ohsawa, Chief Researcher, Machinery Section
- **Contact**: TEL +81-53-428-4155, E-mail oosawa@iri.pref.shizuoka.jp
Subject: CFRP cutting technique using a high precision water jet processing machine and an ablation laser processing machine

Keyword(s): Cutting technique

Point of the proposed technology
- The proposed high-precision cut with a water jet machine
- The heat effects in a conventional laser cutting have been reduced significantly (an ablation laser processing machine)

Effect(s)
- Cutting with reduced heat effects

Development stage
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

High precision water jet processing machine
- Processing accuracy approximately ± 0.05 mm (conditions apply)
- Equipped with delamination reduced piercing function
- Cutting with reduced heat effects

Conventional technology
- Water jet processing machine
- Processing accuracy approximately ± 0.2 mm
- The delamination occurred during piercing

New technology
- High precision water jet processing machine
- Processing accuracy approximately ± 0.05 mm (conditions apply)
- Equipped with delamination reduced piercing function
- Cutting with reduced heat effects

Example of application of this technology: Use for CFRP parts cutting

Technological challenge, constraints, business plan:
- Ablation laser processing machine aim at cutting speed UP

Collaborator needed to improve this technology or develop a new technology:

Contact:
- TEL +81-76-268-2216
- E-mail se-nakamura@shibuya.co.jp  t-suwa@shibuya.co.jp

Company outline:
- Location: 2-232 Wakamiya, Kanazawa-shi, Ishikawa, 920-0054 Japan
- Capital/No. of employees: 11,39201 billion yen 3100 employees
- Overseas base(s): No
- Product line: Package plant, Mechatronics system business
- Major customers: 
- Certification: ISO9001, 14001 (Mechatronics Department)

Inquiries:
**Company/organization name**

<table>
<thead>
<tr>
<th>SHINDO Co., Ltd.</th>
</tr>
</thead>
</table>

**Subject**

Spreading non-crimp fabric (Spreading NCF)

**Keyword(s)**

Spreading, Multiaxial, Non-crimp fabric, Stitching, Preform

---

**Point of the proposed technology**

- Compared with fabrics, it is easier for the strength to develop (Non-crimp structure)
- Compared with fabrics, it is possible to reinforce in the diagonal direction.
- Compared with conventional non-crimp fabrics, thinner and more uniformed sheet can be manufactured.

**Effect(s)**

- Strength development: high
- Fiber content (Vf): high
- GAP less, thin layer sheet

---

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Joint researcher(s) and their role</th>
<th>Patent pending</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in [month] [year]: progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Prototyping/experimental stage (to be completed in [month] [year]: progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]: progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercialization completed (already delivered [✓] / [☐])</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Conventional technology**

<table>
<thead>
<tr>
<th>Example of application of this technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>• CFRP parts in the aerospace field, a large scale ship structure, automobile parts, general industrial parts</td>
</tr>
</tbody>
</table>

**Technological challenge, constraints, business plan**

Provision of low cost high quality sheet using large tow carbon fiber (under development)

**Collaborator needed to improve this technology or develop a new technology**

- Molder who are interested in CFRP where NCF is used and end users
- Machine manufacturers who can manufacture preform machines.

---

<table>
<thead>
<tr>
<th>Company/organization name</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHINDO Co., Ltd.</td>
</tr>
</tbody>
</table>

**Location**

11-1-1, Awara-shi, Fukui, 919-0614 Japan

**Capital/No. of employees**

30 million yen 244 employees

**Product line**

Auxiliary material of apparel, silicon resin, industrial material

**Certification**

ISO 14001

**Overseas base(s)**

Factories in China

**Major customers**

- Overseas base(s)

**Inquiries**

Contact: TEL +81-776-73-3111 FAX +81-776-73-4148 E-mail info@shindo.com

**Homepage**

http://www.shindo.com/jp/
**Development stage**

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

**Joint researcher(s) and their role**

- Our company's own technology
- None

### Conventional technology

<table>
<thead>
<tr>
<th>Individual-axis feed speed</th>
<th>Unit</th>
<th>Old model</th>
<th>New model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before and after gantry (X-axis)</td>
<td>m/min</td>
<td>30</td>
<td>80</td>
</tr>
<tr>
<td>Left and right lamb principal axis (Y-Axis)</td>
<td>m/min</td>
<td>30</td>
<td>80</td>
</tr>
<tr>
<td>Above and below lamb (Z-axis)</td>
<td>m/min</td>
<td>12</td>
<td>45</td>
</tr>
<tr>
<td>Left and right turning of lay-up head (A-axis)</td>
<td>degree</td>
<td>1200</td>
<td>2160</td>
</tr>
<tr>
<td>Rotation of lay-up head (C-axis)</td>
<td>degree</td>
<td>3600</td>
<td>7200</td>
</tr>
<tr>
<td>Movement of tape cutter (V-axis)</td>
<td>m/min</td>
<td>15</td>
<td>80</td>
</tr>
<tr>
<td>Acceleration (straight-axis)</td>
<td>G</td>
<td>0.1</td>
<td>0.3</td>
</tr>
</tbody>
</table>

**Effect(s)**

- Enables to keep the cost low with domestic technologies.
- Enables CFRP yield and cost reduction.
- Enables to change machines to be used according to the work shape.

### New technology

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

**Joint researcher(s) and their role**

- None

### Example of application of this technology

Large parts of an airplane (main wing, panel etc.), Structure parts Panel parts such as roof and bonnet of automobiles

### Technological challenge, constraints, business plan

Configuration of CAM software, collaboration and an efficient way to adhere using pre-cut tape. Manufacturers who can provide CFRP and review. Improvement in collaboration with leading domestic manufacturers and research institutes.

### Collaborator needed to improve this technology or develop a new technology

Hard system as a lay-up machine is close to completion. However, it is necessary to develop and tie-up CAM software and controlling software in order to stick prepreg tape along the shape without sagging (crease).

### Company outline

<table>
<thead>
<tr>
<th>Location</th>
<th>Hirokoji-izakae Building B1F, 2-4-1 Sakae, Naka-Ku, Nagoya 460-0008, Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>CapitalNo. of employees</td>
<td>100 million yen 650 employees</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td>Chicago, Germany, Korea, Beijing, Thailand, India, Indonesia</td>
</tr>
<tr>
<td>Product line</td>
<td>Machine tools, industrial machinery, measuring machine</td>
</tr>
<tr>
<td>Major customers</td>
<td>Toyota, Suzuki, Boeing, Airbus</td>
</tr>
<tr>
<td>Certification</td>
<td>ISO9001, 14001</td>
</tr>
<tr>
<td>Inquiries</td>
<td>Dept./personnel Kazuya Tanaka, General Manager, Nagoya Office</td>
</tr>
<tr>
<td>Contact</td>
<td>TEL +81-52-239-8698  E-mail <a href="mailto:k-tanaka@snkc.co.jp">k-tanaka@snkc.co.jp</a></td>
</tr>
<tr>
<td>Homepage</td>
<td><a href="http://www.snkc.co.jp">http://www.snkc.co.jp</a></td>
</tr>
</tbody>
</table>
**SUGINO MACHINE LIMITED**

Subject: Pneumatic drilling unit for composite materials such as CFRP

Keyword(s): Pneumatic, Drilling, Air Driven, Delamination prevention, CFRP, Composite materials

### Point of the proposed technology

- Built-in high torque and high durable air motor.
- Stable drilling due to high precision spindle structure.

**Effect(s)**

- Burrs and delamination reduced in drilling CFRP
- Weight reduction of the drilling unit

### Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

### Joint researcher(s) and their role

- Owns any intellectual property right: Yes

### Example of application of this technology

- Drilling of CFRP
- Drilling for the industries such as aerospace, shipbuilding, automobile and construction

### Conventional technology

- With conventional portable drilling unit, spindle precision was not enough. Therefore, when drilling CFRP, there were problems like burrs and delamination, and also shortening of tool life.
- With the structure of conventional portable drilling machines, it was not able to set drilling conditions suitable for different materials. As a result, laminated workpieces with different types of materials took longer time with poor efficiency.

### New technology

- With high precision spindle structure, high level run-out control is achieved. It can reduce burrs and delamination, and prolong tool life.
- Pneuconfeeder is a complete air driven unit equipped with air motor for spindle rotation and air cylinder for feeding forward and backward. Air driven unit can process the work in accordance with work load, thus enables efficient drilling even in case of composite material laminated with different types of materials.
- With two-step feed speed regulator equipped, it is possible to set pre-exit low feed which can reduce burrs and delamination.

### Example of application to CFRP

- Occurrence of burrs and delamination
- Burrs and delamination reduced

### Collaborator needed to improve this technology or develop a new technology

- Customers who employs various drilling with portable drilling unit.

### Company outline

- Location: 1800 Nakanocho, Namerikawa-cho, Toyama, 936-8588 Japan
- Capital/No. of employees: 2,324,677 billion yen / 1,350 employees
- Overseas base(s): USA, Mexico, France, Germany, China, Thailand, Singapore, Indonesia etc.
- Product line: Ultra high-pressure water cutting device, Wetdry type atomization unit, drilling unit etc.
- Major customers: Precision Machine Division
- Inquiries: TEL +81-76-475-5113 / E-mail mt@sugino.com
- Homepage: [http://www.sugino.com/index-e.html](http://www.sugino.com/index-e.html)
Subject: Cutting difficult-to-cut materials by water jet technology

Keywords: Water jet, Heat effects, Complex shape processing, Difficulty-to-cut materials Cutting (regardless of materials and shapes)

Point of the proposed technology
• As compared with conventional machine processing and laser cutting, water jet cutting can ensure contactless and high density processing and can help minimizing deformation and strain of the workpiece.

Effect(s)
• Prolongs tool life
• Improves precision of processed surface

Development stage
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
(Commercialization completed (already delivered) yes / no)

Joint researcher(s) and their role

Collaborator needed to improve this technology or develop a new technology
Companies which can manufacture and sell parts that can withstand high pressure in order to prolong the life of devices

Example of application to CFRP

Laser cutting
• Laser processing is not good for cutting CFRP. Because CFRP consists of resin parts and fiber parts and the resin parts melt by the heat of laser.

Water jet cutting
• Water jet processing does not cause resin dissolution by the heat and it can make stable surface.

Machine processing
• In processing composite materials such as CFRP, it is difficult to process fiber well and the tool life is very short. Moreover, if processing was carried out with the worn tool, the cutting surface of the workpiece deteriorate.

Material: CFRP
Thickness: 6 mm

Technological challenge, constraints, business plan
• Running costs of consumable goods such as abrasive materials, high-pressure water applicable parts.
• Improvement of processing speed and cutting ability by establishing technologies such as a pump with a high level of safety.

Example of application of this technology
• Piercing and cutting of CFRP and plastic molding etc.

Material: CFRP
Thickness: 6 mm

Collaborator needed to improve this technology or develop a new technology
Companies which can manufacture and sell parts that can withstand high pressure in order to prolong the life of devices
SUGINO MACHINE LIMITED

Subject: Development of "Biomass nano-fiber" composites using water jet technology
Keyword(s): Water jet, Biomass, Nano-fiber, BiNFi-s, Mixing, Filler, Nano-cellulose

Point of the proposed technology

- It can be developed new light-weight and environment friendly nano-composite materials by mixing "Biomass Nano-fiber" instead of conventional carbon and glass fiber.

Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototype/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

Joint researcher(s) and their role

- No joint research is needed.

Environmental impact

- Changes depending on the mixed quantity

Tensile strength

- Mixed into PVA, increase more than twofold.

Example of application

- It is difficult to recycle and dispose CFRP and GFRP, so that environment burden is high, and replacement of the carbon and glass fiber are required.
- BiNFi-s is biomass nano-fiber which is produced by our ultra high pressure water jet technology. It is made from biomass like cellulose, chitin and chitosan. The size is about 20 nm width and several μm length in average.
- BiNFi-s has low thermal expansion, high elasticity, transparency.
- BiNFi-s is difficult to mix with hydrophobic resin. Please consider applying our "BiNFi-s" to various materials.
- The tensile strength can be improved without losing.

Example of application of this technology

- Chemistry: Resin reinforcement, Transparent base material, Filter
- Cosmetics: Base agent, Moisturizing agent, Sunscreen

Technological challenge, constraints, business plan

- It is difficult to mix with hydrophobic resin.
- Companies with polymer mixing technology.
- Companies with technology for cellulose chemical modification.
- Companies with introducing our technology into various materials.

Collaborator needed to improve this technology or develop a new technology

- Companies with polymer mixing technology.
- Companies with technology for cellulose chemical modification.
- Companies with introducing our technology into various materials.

BiNFi-s

- BiNFi-s is biomass nano-fiber which is produced by our ultra high pressure water jet technology. It is made from biomass like cellulose, chitin and chitosan. The size is about 20 nm width and several μm length in average.
- BiNFi-s has low-thermal expansion, high elasticity, transparency.
- It enables to mix with generic hydrophilic resin and it can maintain smoothness.
- The tensile strength can be improved without losing.

Location

2410 Hongo, Uozu-shi, Toyama, 937-8511 Japan

Capital/No. of employees

2.32467 billion yen / 1350 employees

Overseas base(s)

USA, Mexico, France, Germany, China, Thailand, Singapore, Indonesia etc.

Major customers

- Companies with polymer mixing technology.
- Companies with technology for cellulose chemical modification.
- Companies with introducing our technology into various materials.

Collaborator needed to improve this technology or develop a new technology

- Companies with polymer mixing technology.
- Companies with technology for cellulose chemical modification.
- Companies with introducing our technology into various materials.

Homepage

http://www.sugino.com/index-e.html
<table>
<thead>
<tr>
<th>Company/organization name</th>
<th>SUGINO MACHINE LIMITED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subject</strong></td>
<td>Efficient mixing and deaeration of resin used for CFRP base materials</td>
</tr>
<tr>
<td><strong>Keyword(s)</strong></td>
<td>Mixing, Deaeration, Centrifugal force, Reduction in operation time, Reproducibility</td>
</tr>
</tbody>
</table>

**Point of the proposed technology**
- It can improve productivity and reproducibility more significantly by using rotation/revolution type mixing and deaeration machine than by hand or propeller mixing when mixing resin as a base material with hardening material etc.

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Joint researcher(s) and their role</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td>・Operation time: 1/10 (compared with hand mixing)</td>
</tr>
<tr>
<td>2. Prototype/ experiment stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td>・Consistent and highly reproducible processing regardless of operators</td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercialization completed (already delivered: Yes / no)</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

**Conventional technology**

**New technology**

**Example of application to materials such as resin**
- Hand mixing takes long operation time. Mixing high-viscosity materials is a large burden for operators.
- Among operators, processing state is not consistent.
- Foam will be produced through hand mixing and propeller mixing.
- Cleaning is not required for every lot with no contamination risk.
- Both rotation and revolution motors are controlled by inverter, so it is possible to perform highly reproducible mixing deaeration.
- Saves significantly operation time.

**Technological challenge, constraints, business plan**
- If processing continues for a long time, the temperature of raw materials and the device will increase.
- It can sometimes be difficult to deaerate foam from materials with high-viscosity.

**Collaborator needed to improve this technology or develop a new technology**
- Companies which want to mix and deaerate raw materials and can evaluate its state after processing.

**Company outline**
- **Location**: 2410 Hongo, Uozu-shi, Toyama, 937-8511 Japan
- **Capital/No. of employees**: 2.32467 billion yen / 1350 employees
- **Overseas base(s)**: USA, Mexico, France, Germany, China, Thailand, Singapore, Indonesia etc.
- **Product line**: Ultra high-pressure water cutting device, Wet/dry type mill unit, Drilling unit etc.
- **Major customers**: USA, Mexico, France, Germany, China, Thailand, Singapore, Indonesia etc.

**Inquiries**
- **Dept./personnel**: Tadashi Sugimori, Corporate Planning Division, New Development Department Project Section 2
- **Contact**: TEL +81-765-24-5111
- **E-mail**: t.sugimori@sugino.com
- **Homepage**: [http://www.sugino.com/index-e.html](http://www.sugino.com/index-e.html)
Subject: Development of new material using wet type jet mill

Keyword(s): Wet type, Emulsification, Dispersion, Fine grinding, Surface improvement

Point of the proposed technology:
- By pressurizing raw materials and making them colliding each other or against ball at high-pressure inside chamber of the unit, raw materials can be refined.

Effect(s):
- Improve dispersion function
- Simplify disjoining and cleaning

Development stage:
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

Joint researcher(s) and their role:
- Yes

Conventional technology
- Dispersion difficulty
  Depending on the manufacturing method, the diameter and the shape, characteristics of carbon nanotube are different. Therefore, it was difficult to loosen condensation and let it disperse in the aqueous solution.

- Use organic solvents In order to make carbon nanotube disperse, organic solvents is used but it is not good regarding operation environment.

New technology
- Enables dispersion
  Using wet type jet mill processing enables constant dispersion.

- Saves the use of organic solvent
  As the wet type jet mill processing loosens condensation of carbon nanotube by high-pressure jetting, it decreases the use of organic solvent.

- Disjoining and cleaning
  The desktop wet type jet mill unit is small and 100V power supply, so it can easily use and test, and particularly suits at the experiment stage.

Example of application to carbon nanotube
- Dispersion processing of carbon nanotube
- Wet type jet mill processing of resin, plastic, polymer, monomer, paint etc.

Technological challenge, constraints, business plan
- Wet type jet mill unit is suited for processing raw materials with fluidity.

Collaborator needed to improve this technology or develop a new technology
- Companies interested in refining raw materials

Example of application of this technology
- Carbon nanotube 0.1 wt%
  - pass: 20 times
  - pressure: 200MPa
  - before processing: 17μm
  - after processing: 0.15μm
  - precipitation and separation
  - constantly dispersed

Location: 2880 Kuriyama, Namerikawa-shi, Toyama, 936-8577, Japan

Company outline
- Capital/No. of employees: 2.32467 billion yen / 1350 employees
- Overseas base(s): USA, Mexico, France, Germany, China, Thailand, Singapore, Indonesia etc.

Product line
- Ultra high-pressure water cutting device, Wet dry type mill unit, drilling unit etc.

Contact: TEL +81-76-477-2581
E-mail o.oshio@sugino.com

Inquiries
- Dept./personnel: Takaharu Oshio, Plant Equipment Division

Homepage: http://www.sugino.com/index-e.html
Company/organization name: DAIICHI SYSTEM ENGINEERING CO., LTD.

Subject: Injection molding simulation using resin-flow analysis software Moldex3D

Keyword(s): CAE, Injection Molding, Molding condition optimization, resin

Point of the proposed technology:
- Simulate resin flow in 3D
- Grasp beforehand and improve the problems likely to occur (shrinkage, short shot, filling balance, etc.)
- Simulate the fiber orientation and length with high accuracy by our patented fiber orientation analysis
- Transfer the simulated result to structure analysis software using mapping function.

Effect(s):
- Optimization of molding conditions
- Reduced trials and errors in actual experiments
- Improvement of product-making cycle

Development stage:
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes

Joint researcher(s) and their role:
The customers' names are classified as confidential: they cooperated our benchmark. Yes

Conventional technology:
- Flow simulation
  - Simulates the flow of the model shape from within the runner
  - Prediction of temperature and pressure distribution as well as volume contraction ratio is possible

New technology:
- Fiber orientation prediction (Fiber in X-axis direction)
  - Predicts the orientation of the resin with fibers
  - The analysis for both long and short fibers is possible

Example of application of this technology:
The molded product with voids occurred was simulated, and the molding condition that reduces volume contraction ratio was found out in the simulation to improve the bad molding.

Technological challenge, constraints, business plan:
- RTM molding simulation is now under development.
- Select the resin material on Moldex3D database as an analysis condition or the material measurement result as a molding condition of a new material.

Collaborator needed to improve this technology or develop a new technology:
- Injection molding product development manufacturer
- Resin material manufacturer
- Research institutes (universities, etc.) having injection molding machine.

Company outline:
- Location: 5F Tokai Bldg. 1-16-30, Mekkominami, Nakamura-ku, Nagoya-shi, Aichi, 450-0003 Japan
- Capital No. of employees: 589 (2014/4/1)
  - Overseas base(s): Thailand
- Product line: Engineering staffing
  - Major customers: Toyota Motor Corporation, Mitsubishi Heavy Industries Ltd., etc.
- Inquiries:
  - Shohei Sawada, The Third Engineering Department Global Technologies Section
  - Contact TEL +81-52-569-5550 E-mail shohei-sawada@dse-corp.co.jp

Homepage: http://www.dse-corp.co.jp
**DAIICHI SYSTEM ENGINEERING CO., LTD.**

**Subject:** Compression molding simulation using resin-flow analysis software Moldex3D

**Keyword(s):** CAE, Compression molding, molding condition optimization, resin

<table>
<thead>
<tr>
<th>Point of the proposed technology</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>・Simulate resin flow in 3D</td>
<td>・Optimization of molding conditions</td>
</tr>
<tr>
<td>・Grasp beforehand and improve the problems likely to occur (shrinkage, short shot, filling balance, etc.)</td>
<td>・Reduced trials and errors in actual experiments</td>
</tr>
<tr>
<td>・Simulate the fiber orientation and length with high accuracy by our patented fiber orientation analysis</td>
<td>・Improve product-making cycle</td>
</tr>
<tr>
<td>・Transfer the simulated result to the structure analysis software using mapping function</td>
<td></td>
</tr>
</tbody>
</table>

**Development stage**

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

**Conventional technology**

**New technology**

**Flow simulation**

Set up the charging shape and simulate the flow for which the contraction plane is being pressed. Prediction of temperature and pressure distributions as well as volume contraction rate is possible.

**Fiber orientation prediction (Fiber in X-axis direction)**

Predict the orientation of the resin with fiber in it. Analysis for both long and short fibers is possible.

**Interface to structure analysis software**

Possible to map the Moldex3D analysis result and fiber orientation to structure-analyze with ANSYS.

**Example of application of this technology**

No previous example of application

**Technological challenge, constraints, business plan**

- RTM molding simulation is now under development
- Select the resin material on Moldex3D database as analysis condition or the new material from the material measurement result as molding condition

**Collaborator needed to improve this technology or develop a new technology**

- Compression molding product development manufacturers
- Resin material manufacturers
- Research institutes (universities, etc.) having compression molding machine

**Company outline**

<table>
<thead>
<tr>
<th>Location</th>
<th>SF Tokai Bldg. 1-16-30, Meikiminami, Nakamura-ku, Nagoya-shi, Aichi, 460-0003 Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>90 million yen  560 personnel (2014/4/1)</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td>Thailand</td>
</tr>
<tr>
<td>Product line</td>
<td>Engineering staffing  Major customers  Toyota Motor Corporation, Mitsubishi Heavy Industries, Ltd., etc.</td>
</tr>
</tbody>
</table>

**Inquiries**

<table>
<thead>
<tr>
<th>Dept./personnel</th>
<th>Shohei Sawada, The Third Engineering Department Global Technologies Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact</td>
<td>TEL +81-52-569-5550 E-mail <a href="mailto:shohei-sawada@dse-corp.co.jp">shohei-sawada@dse-corp.co.jp</a></td>
</tr>
</tbody>
</table>
Point of the proposed technology
This is a newly developed processing technology to recycle carbon fibers from the used CFRP (carbon fiber reinforced plastics) at minimum running cost by a continuous rotary kiln type apparatus. Used CFRP cut into certain sizes will be fed into the rotating cylinder where the plastics (resins) of the CFRP are decomposed by SHS (Superheated Steam) and the carbon fiber only is recovered. Resin decomposition gas is ejected from the cylinder and burnt in the outer kiln housing. Heat generated from combustion of the decomposition gas is used to heat the rotary cylinder and also to generate SHS so that fresh energy (fuel gas) consumption is minimized.

Development stage
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in March 2017; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

Joint researcher(s) and their role
Japan Fine Ceramics Center (Evaluation of the recycled fibers)
University of Tokyo (advisor)
Toyota Motor Corporation (advisor)
Fukui Fibertech Co., Ltd. (advisor)

Effect(s)
Cost (reduction): 30% or higher
Processing time: 480 min. -> within 60 min. (test phase)

Keyword(s)
CFRP (Carbon Fiber Reinforced Plastics), Recycle of Carbon Fiber, SHS (Superheated Steam)

Example of application of this technology
Various plastic materials of which strength can be improved by recycled carbon fibers

Technological challenge, constraints, business plan
Please contact Takasago Industry Co., Ltd. for any inquiries about the carbon fibers recycle from CFRP and/or the recycle apparatus.

Collaborator needed to improve this technology or develop a new technology
None
Tamagawa Seiki Co., Ltd.

**Subject:** Weight-saving of the rotating movable stable stand

**Keyword(s):** Rotating stand, monitoring equipment, weight-saving

### Point of the proposed technology

Parent mass is reduced by 40%.

However, due to some limitations in peripherally equipped parts' shapes etc., whole mass reduction is only 5%.

### Development stage

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Joint researcher(s) and their role</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in [month] [year]; progress: %)</td>
<td>Cannot be disclosed due to strict confidentiality</td>
</tr>
<tr>
<td>2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)</td>
<td>None</td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td>None</td>
</tr>
<tr>
<td>Commercialization completed (already delivered: yes / no)</td>
<td>None</td>
</tr>
</tbody>
</table>

### Conventional technology

- Mass: 429 g

### New technology

- Mass: 175 g

---

**Example of application of this technology**

Gimbal part of rotating stable stand for monitoring applications

**Technological challenge, constraints, business plan**

Can be extended to the movable stable stand for aircraft equipment and monitoring applications.

The design and evaluation methods are needed to be established.

**Collaborator needed to improve this technology or develop a new technology**

Institutions having knowledge about design considering manufacturing methods and optimized design

---

**Company outline**

- **Location:** 3174-22 Moto-Ohjima, Matsukawa, Shimoina-gun, Nagano, 399-3303 Japan
- **Capital/No. of employees:** 100 million yen, 650 employees
- **Overseas bases:** Hong Kong, China, Singapore, Germany
- **Product line:** Motor, angle detector, rate sensor and their applied products
- **Major customers:** MHI, KHI, FH, Mitsubishi Electric Corporation, NEC, Toshiba Corporation, etc.
- **Certification:** ISO/TS16949 (Automobile industry), JISQ9100 (Aerospace industry), ISO9001 (Quality management system), ISO14001 (Environmental management system), ISO17025 (Angle correction business)
- **Dept./personnel:** Hiroki Kitamura, Assistant Manager, ATLAS Development Center, Spacronics Laboratory
- **Contact:** TEL +81-265-34-7814, E-mail: hiroki-kitamura@tamagawa-seiki.co.jp
- **Homepage:** [http://www.tamagawa-seiki.co.jp/jpn/japan/index.html](http://www.tamagawa-seiki.co.jp/jpn/japan/index.html)
Chubu Electric Power Co., Inc.

Subject: Advanced local blower using active carbon fiber filter

Keyword(s): Nuclear power, radioactive iodine, radioactive cesium, active carbon fiber, local blower, positive pressure apparatus

Point of the proposed technology

Effect(s)
- Compact (improved mobility)
- Low cost (reduced apparatus price and maintenance cost)
- Simplified maintenance and operations

In Boiling Water Reactor (BWR), when in open inspection of the turbine and condenser, the radioactive iodine generated in the reactor on operation is likely to be dispersed throughout the turbine house and released into the air. So, protection measure against the remaining radioactive iodine is implemented. Conventionally, local blower using active carbon particle filter was used to eliminate the radioactive iodine. However, because the apparatus is too big to relocate, we decided to fabricate an advanced local blower excellent in mobility.

Development stage

Joint researcher(s) and their role
Japan Environment Research Co., Ltd. (Collaborator in development)

Yes

Conventional technology

New technology

Downsizing of local blower

- Downsizing
  (1/3 of the conventional product size)
- Cost lower than the conventional products

Example of application of this technology
- Elimination of remnant radioactive iodine in the nuclear power plant
- Air cleaner in the buildings such as temporary evacuation place in the case of nuclear facility accidents

Technological challenge, constraints, business plan
None

Collaborator needed to improve this technology or develop a new technology
None

Company outline

Location: Shizuoka, 437-1695 Japan
Capital/No. of employees: 430.777 million yen, 17,559 employees
Overseas base(s): Washington, London
Product line: Electric power
Major customers: None
Inquiries: Hirotsu Hiraishi, Ph.D Kazuhiro Ikedou, Nuclear Safety Research & Development Center
Contact: TEL +81-50-7772-8766
E-mail: ikedou.Kazuhiro@chuden.co.jp
Homepage: http://www.chuden.co.jp

Keyword(s)
Nuclear power, radioactive iodine, radioactive cesium, active carbon fiber, local blower, positive pressure apparatus

Performance
- Dust elimination efficiency
- Radioactive iodine gas elimination efficiency
- Processed air

Example of application of this technology
- Elimination of remnant radioactive iodine in the nuclear power plant
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Example of application of this technology
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- Air cleaner in the buildings such as temporary evacuation place in the case of nuclear facility accidents

Technological challenge, constraints, business plan
None

Collaborator needed to improve this technology or develop a new technology
None
1. Thanks to accurate lay-up quality by the auto lay-up machine, finished parts quality can be improved and stabilized compared with hand-lay-up process.
2. Manpower saving and higher productivity can be achieved by adopting full-automated processing system.

More than 80% running cost saving (compared to the manual processing)

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Joint researcher(s) and their role</th>
<th>New technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in [month] [year]; progress: %)</td>
<td>In-house development</td>
<td>Yes</td>
</tr>
<tr>
<td>2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conventional prepreg sheet processing

1. Cutting out the material
Cut out the material every single piece in the size and shape needed for the lay-up process, by hand or cutting machine.

2. Hand lay-up
Laying-up the cut-out sheets at the desired position one by one, after peeling it off from its backing-paper.

Mass production Lay-up process proposed by Tsudakoma

1. Slitting the material by dedicated slitter
Max mechanical speed: 30 m/min.
Max. operation speed: 15 m/min.
(Carbon UD prepreg)
Max. roll dia.: 25 inches
Slit width accuracy: ±0.1mm

The sheet is slitted in required width from the mother roll.

2. Automated lay-up
Machine dimension: 4000 mm (length)
3300 mm (width)
2000 mm (height)
Lay-up table dimension: 1200mm x 1200 mm
Lay-up speed: 40m/min.

The accurate slit tape prepared by the dedicated slitter is set in the automatic lay-up machine. It runs automatically based on the pre-input lay-up program. Backing paper is removed automatically.

Example of application of this technology
- CF prepreg process of aircraft structural parts and automobile's structure material as well as exterior sheet parts.
- SIT processing for new materials such as highly-functional film

Technological challenge, constraints, business plan
Depending on the lay-up pattern, material waste may be generated, but it can be minimized by an optimization of the tape width. For further material waste saving, we have been addressing machine development.

Collaborator needed to improve this technology or develop a new technology
CFRP product manufactures, companies with knowledge in material processing, research institutes such as universities, etc.

Company outline
- Location: 5-18-18 Nomachi, Kanazawa, Ishikawa, 921-8650 Japan
- Capital/No. of employees: 12.3 billion yen, 900 employees
- Overseas base(s): China, India
- Certification: ISO9001, ISO14001, JSQ9100
- Major customers: Domestic major heavy industry companies, etc.
- Domestic major heavy industry companies, etc.
- Contact: TEL +81-76-242-1116
- E-mail: composite@tsudakoma.co.jp
- Homepage: http://www.tsudakoma.co.jp/composite/english/index.html

Inquiries
- Industry: Composite machinery department / Sales, Service and Marketing Section
- Company: Tsudakoma Corp.

Subject: Carbon fiber composite material lay-up processing line
Keyword(s): Realizing the mass production lay-up process for the prepreg sheet

Effect(s)
1. Thanks to accurate lay-up quality by the auto lay-up machine, finished parts quality can be improved and stabilized compared with hand-lay-up process.
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More than 80% running cost saving (compared to the manual processing)

<table>
<thead>
<tr>
<th>Company/organization name</th>
<th>Tsudakoma Corp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject</td>
<td>Carbon fiber composite material lay-up processing line</td>
</tr>
<tr>
<td>Keyword(s)</td>
<td>Realizing the mass production lay-up process for the prepreg sheet</td>
</tr>
</tbody>
</table>

Development stage
- 1. Idea stage (to be completed in [month] [year]; progress: %)
- 2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
- 3. Development completion stage (to be completed in [month] [year]; progress: %)
- Commercialization completed (already delivered: yes  /  no): Yes

In-house development | New technology

Conventional technology

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Technological challenge, constraints, business plan
Depending on the lay-up pattern, material waste may be generated, but it can be minimized by an optimization of the tape width. For further material waste saving, we have been addressing machine development.

Collaborator needed to improve this technology or develop a new technology
CFRP product manufactures, companies with knowledge in material processing, research institutes such as universities, etc.

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- Homepage: http://www.tsudakoma.co.jp/composite/english/index.html

Inquiries
- Industry: Composite machinery department / Sales, Service and Marketing Section
- Company: Tsudakoma Corp.
### TEC ONE CO., LTD.

**Company/organization name**
Sub-micron carbon fibers

**Subject**
Application for Li-ion secondary battery conductive additive

**Keyword(s)**
Li-ion secondary battery, conductive additive

### Point of the proposed technology

<table>
<thead>
<tr>
<th>Effect(s)</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good dispersion due to larger fiber size</td>
<td>Reduced battery cost</td>
</tr>
<tr>
<td>Reduced risk of any metal mixed due to the manufacturing process without metal</td>
<td>Improved cycle characteristic</td>
</tr>
<tr>
<td>1/3 of the additive amount can achieve the equivalent battery performance.</td>
<td>Improved rate characteristic</td>
</tr>
<tr>
<td>Usable as negative electrode active material</td>
<td></td>
</tr>
</tbody>
</table>

### Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes

### Joint researcher(s) and their role

- TEC ONE Co., Ltd. (role: prototyping for mass production, battery performance evaluation)
- Prof. Okino, Faculty of Textile Science and Technology, Shinshu University (role: Analysis and evaluation of carbon material)
- Industrial Research Institute of Ishikawa (role: Spec evaluation of product intermediate and product)

### Conventional technology

- Dispersion is difficult.
- Metal catalysis is necessary -> Less mass production effect, high risk for metal inclusion

### New technology

- Good dispersion due to larger fiber size
- Low cost and reduced risk of metal mixture, due to the manufacturing method without using metal
- 1/3 of additive amount compared to the conventional, can achieve an equivalent battery performance.
- Usable as negative electrode active material

### Example of application of this technology

Li-ion secondary battery conductive additive

### Technological challenge, constraints, business plan

- Improving mass productivity and reducing cost by solving the bottleneck
- Negotiable if 20 YY or higher

### Collaborator needed to improve this technology or develop a new technology

Organizations having expertise on the evaluation of electrochemical devices such as fuel cell, redox flow battery, etc. (both companies and universities, etc.)

### Company outline

- **Location:** 151-4 Hama-machi, Nomi-shi, Ishikawa 929-0124 Japan
- **Capital/No. of employees:** 80 billion yen 151 employees
- **Product line:** Printing, dyeing, lamination and finishing on synthetic fabrics
- **Major customers:** Toyobo Co., Ltd., Teijin Limited, Toray Industries Inc.
- **Certification:** ISO9001

### Inquiries

- **Dept./personnel:** Takahiro Kitano, General Manager, R&D center
- **Contact:** TEL +81-90-4329-5099 E-mail tkitano@tecone.co.jp
- **Homepage:** [http://www.tecone.co.jp](http://www.tecone.co.jp)
Tokai Seiki Co., Ltd.

Subject: Dedicated C-SMC manufacturing machine (name at our company: SMC impregnating machine)

Keyword(s): C-SMC sheet manufacturing

Point of the proposed technology

- Speed increased by 20% from the conventional machine (comparison between our company’s machines)
- Continuous operation is achieved (with accumulator) 1) in film replacement, 2) in sheet cutting

Effect(s)

Production speed of 30 m/min
Continuous operation

Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/实验 stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered?): yes / no

Joint researcher(s) and their role

The company’s own technology
None

Conventional technology

Currently, there is no manufacturer that has introduced full-scale C-SMC manufacturing equipment. Small quantities are produced using G-SMC development machine.

New technology

A G-SMC manufacturing machine has been improved into a C-SMC manufacturing machine.

Improvements:
1) Roving cutter dedicated for carbon fibers
2) Device for preventing foreign material intrusion (depending on the place designated by the customer)
3) Device for preventing the sheet from meandering
4) Sheet folding device

Whole line of SMC impregnating machine

(model supporting G-SMC and C-SMC)

Example of application of this technology

Installation of manufacturing machine for product (C-SMC) delivered to automobile manufacturer (cutting part)

Technological challenge, constraints, business plan

Offering a lineup ranging from development machine to full production machine; production speed 5 m/min to 30 m/min

Collaborator needed to improve this technology or develop a new technology

SMC sheet manufacturers

Company outline

<table>
<thead>
<tr>
<th>Location</th>
<th>542 Gokanjima, Fuji-shi, Shizuoka, Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>20 million yen 23</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td>None</td>
</tr>
<tr>
<td>Product line</td>
<td>C-SMC sheet manufacturing machine</td>
</tr>
<tr>
<td>Major customers</td>
<td>C-SMC manufacturers</td>
</tr>
<tr>
<td>Certification</td>
<td>None</td>
</tr>
</tbody>
</table>

Inquiries

<table>
<thead>
<tr>
<th>Dept/personnel</th>
<th>Manager, Engineering, Katsuo Tsurufuji, Engineering unification department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact TEL</td>
<td>+81-545-61-7101</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="http://www.tokaiseiki.jp/">http://www.tokaiseiki.jp/</a></td>
</tr>
</tbody>
</table>

Keyword(s) C-SMC sheet manufacturing
### Work efficiency greatly improved by continuous sheet cutting before pressing and with loading apparatus

30% increase compared to our conventional

### Development stage

<table>
<thead>
<tr>
<th>1. Idea stage (to be completed in [month] [year]; progress: %)</th>
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<tbody>
<tr>
<td>Commercialization completed (already delivered)</td>
<td></td>
<td></td>
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</table>

### Conventional technology

<table>
<thead>
<tr>
<th>Cutting machine conventional: for G-SMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-SMC cutting machines are mostly used since C-SMC production line is in the development phase.</td>
</tr>
<tr>
<td>※ The cut surface is rough and a part of the carbon fibers cannot be cut at the cutting plane, likely to extrude outward.</td>
</tr>
</tbody>
</table>

### New technology

<table>
<thead>
<tr>
<th>Cutting machine new: for C-SMC</th>
</tr>
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<tbody>
<tr>
<td>※ Thermosets effect by the cutting machines generates resin heat hardening, so such machines cannot be used. However, this machine can be used even in the explosion-proof area since it uses a circular blade for cutting.</td>
</tr>
</tbody>
</table>

### Example of application of this technology

Sheet cutting machine equipped for C-SMC manufacturing machine

### Technological challenge, constraints, business plan

Reduced poor cutting and optimization of cutting & weighing

### Collaborator needed to improve this technology or develop a new technology

SMC sheet manufacturers

### Company outline

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<tr>
<td>Product line</td>
<td>C-SMC sheet manufacturing machine</td>
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<tr>
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<td>None</td>
</tr>
<tr>
<td>Major customers</td>
<td>C-SMC manufacturers</td>
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</table>
TOYO SENKO CO., LTD./HATTA TATEAMI CO., LTD.

Thermoplastic resin reinforced sheet material "Flexible UD Sheet"

Spread tow technology, warp knitting technology, adhesive processing technology

Point of the proposed technology

- An integrated reinforcing sheet with low weight per unit area is produced by combining spread carbon fiber tow with warp knitted fabric made from thermoplastic resin.
- Very thin semi-impregnated sheet is achieved by using spread carbon fiber tow.
- Use of warp knitted fabric with low weight per area (5-90 g/m²) makes it easier to support high Vf values.

Development progress

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experiment stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes) / no
5. Development completion stage (to be completed in [month] [year]; progress: %)

Joint research conductor and his/her/their role

Industrial Technology Center of Fukui Prefecture (role: disclosure of the spread tow technology)
Hotta Tateami Co., Ltd. (role: development of textiles such as warp knitted fabric)
Toyo Senko Co., Ltd. (role: development of bonding with textiles)

New technology

Examples of use

- Intermediate base material of carbon fiber reinforced thermoplastics (CFRTP)
- Flexible UD Sheet
- Warp knitted fabric + Adhesive resin
- Adhesive processing technology

Characterized by the fact that it is a very thin unidirectional sheet.
Very thin CFRTP/very thin sheet with high thermal and electric conductivity
(Examples) Electronic equipment susceptible to heat, snow melting sheet, electromagnetic wave shield

Technological challenge, constraints, business plan

Currently, patent pending

Collaborator needed to improve this technology or develop a new technology

We are looking for development partners for specific uses.
Manufacturers in the fields of civil engineering, construction, electricity/electronics, machinery, chemicals, etc.

Company outline

TOYO SENKO CO., LTD.

Location

45-15, TABATA HORI-CHO, SAKAI, SHI, FUKUI, JAPAN

Capitalize of employees

60 million yen

250

Overseas base(s)

None

Product line

Dyeing and finishing, raising, and coating of a wide variety fabric

Major customers

Toyobo Industries, Inc., Nitto Boseki Co., Ltd., TOYOCHI Corporations, Heiwadai Corporation, SHIMADZU, etc.

Certification


Inquiries

TOYO SENKO CO., LTD.

Contact

TEL +81-776-51-2223

E-mail hattateami@toyo-senko.com

Homepage http://www.toyosenko.co.jp

HATTA TATEAMI CO., LTD.

Location

5-10, TOYOKU-AWARA-SHI, FUKUI, JAPAN

Capitalize of employees

65 million yen

90

Overseas base(s)

Thailand

Product line

Development and manufacturing of knitted fabric (strocture, double weave)

Major customers

Sanyo Trading Co., Ltd., TOYOCHI Corporation, SEIEN Co., Ltd., SHIMADZU, etc.

Certification


Inquiries

HATTA TATEAMI CO., LTD.

Contact

TEL +81-776-73-1291

E-mail hattateami@ha.co.jp

Homepage http://www.fhs.co.jp

Effect(s)

- Very thin, and great mechanical property ability
- Increased productivity by side equipment
- Has flexibility and generates few cuts
- Good machinability
- Travel distance of sheet is short because of spread tow
- Suits for multi-calendering during molding
- Also useful for as a media material for VaRTM process
- Flexible to reduce the parts because of warp knitted fabric
<table>
<thead>
<tr>
<th>Company/organization name</th>
<th>Toray Industries, Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject</td>
<td>A-VaRTM technology for aircraft structure</td>
</tr>
<tr>
<td>Keyword(s)</td>
<td>VaRTM, aircraft structural parts, autoclaveless</td>
</tr>
<tr>
<td>Point of the proposed technology</td>
<td>Effect(s)</td>
</tr>
<tr>
<td>• Uni-directional fabric of carbon fiber fusion bonded with thermoplastic particle on its surface</td>
<td>• Mechanical property and quality stability as excellent as prepreg</td>
</tr>
<tr>
<td>• Low viscosity epoxy resin formulated with high-toughness nano-scale particles</td>
<td>• High drapability by dry fabric</td>
</tr>
<tr>
<td>• VaRTM technology for which sheet thickness is stably controlled and that can be applied to aircraft structural parts</td>
<td>• High cost competitiveness: autoclave and freezing storage are not needed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Joint researcher(s) and their role</th>
<th>Owns any intellectual property right</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in [month] [year]; progress: %)</td>
<td>Mitsubishi Heavy Industries Ltd. (Role: Collaborative development of molding technology)</td>
<td>Yes</td>
</tr>
<tr>
<td>2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□Commercialization completed (already delivered: yes / no)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conventional technology</th>
<th>New technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepreg/autoclave method</td>
<td>Energy saving, low cost, molding (A-VaRTM method)</td>
</tr>
<tr>
<td>Prepreg</td>
<td></td>
</tr>
<tr>
<td>Stacking</td>
<td></td>
</tr>
<tr>
<td>Baggin</td>
<td></td>
</tr>
<tr>
<td>Pressurizing, Curing</td>
<td></td>
</tr>
<tr>
<td>Demolding</td>
<td></td>
</tr>
<tr>
<td>Composite</td>
<td></td>
</tr>
<tr>
<td>Carbon fiber</td>
<td></td>
</tr>
<tr>
<td>Resin</td>
<td></td>
</tr>
<tr>
<td>Base material</td>
<td></td>
</tr>
</tbody>
</table>

Example of application of this technology: Aircraft primary structures (MRJ empennage)

Technological challenge, constraints, business plan: For molding technology, in collaboration with Mitsubishi Heavy Industries Ltd.

Collaborator needed to improve this technology or develop a new technology: None

Company outline:
- Location: Please refer to the Contact Us page on our website.
- Capital/No. of employees: 147,873 mil. Yen, 7123 employees
- Overseas base(s): Many
- Product line: Carbon fiber composite material business, Fiber business, etc.
- Major customers: Many
- Certification: JISQ9100, MSJ4000, etc.

Inquiries:
- Dept./personnel: Please refer to the Contact Us page on our website.
- Contact: TEL +81-52-613-5881
- E-mail: Masato_Furukawa@nts.toray.co.jp
- Homepage: [http://www.toray.com](http://www.toray.com)
## Tokuda Industries Co., Ltd.

**Subject**
Autoclaveless forming mold for carbon fiber composite material

**Keyword(s)**
Porous, forming mold, out-of-autoclave, integrated forming

---

### Point of the proposed technology

- Productivity greatly improved by employing out-of-autoclave forming method instead of conventional autoclave forming.
- Even the material generating reaction gas on forming can be formed in high quality due to porous aluminum alloy
- Sub-material wasted as industrial waste after forming is reduced

### Forming duration
8 hours or longer → within 2 hours

### Development stage

<table>
<thead>
<tr>
<th>Idea stage (to be completed in [month] [year]; progress: %)</th>
<th>Prototyping/experimental stage (to be completed in March 2016; progress: 50%)</th>
<th>Development completion stage (to be completed in [month] [year]; progress: %)</th>
<th>Commercialization completed (already delivered: yes / no)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TTS Co., Ltd. (Provision of information on porous aluminum alloys)</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

### Conventional technology

**Autoclave forming**

- Pressurizing
- Vacuuming
- Heating
- Forming
- Carbon fiber textile prepreg
- Backing film
- Temp. control piping
- Seal
- Base plate
- Vacuuming apparatus
- Autoclave apparatus (pressure vessel)

### New technology

**Autoclaveless forming**

- Facility cost lower than the conventionals
- Reduced sub-material for forming
- Short duration forming by rapid heating and cooling
- Reaction gas generated during the forming is sucked and exhausted from the formed surface through porous aluminum alloy

- Large-scale facility
- Long forming duration

- Low cost and high quality parts can be provided

---

**Example of application of this technology**

- Airplane's seat parts
- Train car’s seat parts
- Automobile body and seat parts
- Robot parts

**Technological challenge, constraints, business plan**

- Durability of the porous alloy on de-molding process is a challenge
- We hope to sell the parts formed in our company.

**Collaborator needed to improve this technology or develop a new technology**

- Companies with knowledge about demolding process technology for porous alloys
- Companies able to provide carbon fiber composite materials with lower forming temperature and high performance.

---

**Company outline**

<table>
<thead>
<tr>
<th>Location</th>
<th>209 Kinokudanchi, Kakamigahara-shi, Gifu, 504-0957 Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>30 mil. yen, 123 employees</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td>-</td>
</tr>
<tr>
<td>Product line</td>
<td>Airplane parts, various jigs</td>
</tr>
<tr>
<td>Major customers</td>
<td>Kawasaki Heavy Industries, Ltd.</td>
</tr>
<tr>
<td>Inquiries</td>
<td>Hiroshi Sawai, Manager, Sales Department</td>
</tr>
<tr>
<td>Contact</td>
<td>TEL: +81-58-380-8003 E-mail:</td>
</tr>
<tr>
<td>Homepage</td>
<td><a href="http://www.tokuda.co.jp/">http://www.tokuda.co.jp/</a></td>
</tr>
</tbody>
</table>
In the case of manufacturing 3D shape products from carbon fiber sheets, the product shape after sheet processing requires stacking and cutting, leading to higher cost. Also, adhesion using conventional resin when stacking may cause interlayer peel-off. Furthermore, sawing by machine thread may damage the carbon fiber. So, we manufacture the integral product shape from carbon fiber textile using 3D textile manufacturing technology, and obtain a great product cost down and ensure the product's strength.

Cost: 80% reduction

- Stacking is mostly by hand-work, leading to higher cost.
- Cutting into product shape requires forming step, leading to higher cost.

Example of application of this technology
Movable parts of industrial machines

Technological challenge, constraints, business plan
- By adding the mechanism to cut the textile at a product length after weaving, a perfect automation of the manufacturing machine is achieved.
- Product dimension: 100 mm wide, 70 mm thick, endless length.
- We manufacture and provide the carbon fiber 3D textile in-house, and we hope to form it in-house to provide the completed product in the future.

Collaborator needed to improve this technology or develop a new technology

Company/organization name
TOMI-TEX CO., LTD

Subject
Manufacture of the carbon fiber 3D textile

Keyword(s)
Textile processing

Point of the proposed technology

Conventional technology

New technology

Example of application to carbon fiber product by 3D textile manufacturing technology

Development stage

<table>
<thead>
<tr>
<th>Joint researcher(s) and their role</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
</tr>
</tbody>
</table>

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in March 2015; progress: 70%)
4. Commercialization completed (already delivered: yes / no)

Conventional technology

New technology

- 3D textile manufacturing technology requires no stacking and cutting, realizing cost reduction by 80%.
### Toyo Matelan Corporation

**Subject**
Cement composite material development using recycled carbon fiber

**Keyword(s)**
Recycled carbon fiber, cement composite material, toughness

<table>
<thead>
<tr>
<th>Point of the proposed technology</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of the composite material with mixing waste carbon fiber as short fiber into cement material to improve the strength and toughness</td>
<td>None, since it is still in idea phase.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Joint researcher(s) and their role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idea stage (to be completed in March 2015; progress: 60%)</td>
<td>None</td>
</tr>
<tr>
<td>2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)</td>
<td>Gifu University (fabrication of prototypes, organizing the project, proposing the extended applications, material development, performance evaluation)</td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td>Gifu National College of Technology (examining the manufacturing methods)</td>
</tr>
<tr>
<td>4. Commercialization completed (already delivered: yes / no)</td>
<td>Toyo Matelan Co., Ltd. (examining material evaluation methods)</td>
</tr>
</tbody>
</table>

#### Conventional technology
- Although the cement composite materials mixed with PE fiber, PVA fiber and steel fiber as short fibers are used in civil engineering and architecture, the cement composite material mixed with carbon fiber is used a little.

#### New technology
- Reduced environmental load by reducing waste carbon fiber amid CFRP prevalence.
- Development of the composite material with waste carbon fiber as short fiber mixed into cement material to improve additional value.
- Using the developed cement composite material mixed with waste carbon fiber for repairing and reinforcing materials in civil engineering and architecture field.

**Example of application of this technology**
Use as repairing and reinforcing materials in civil engineering and architecture field

**Technological challenge, constraints, business plan**
Establishing the way of collecting the recycled carbon fiber and reuse, and manufacture of the cement composite material making the most of the carbon fiber's characteristics.

**Collaborator needed to improve this technology or develop a new technology**
Now, collaborating with Gifu University, Gifu National College of Technology, and Takayasu Co., Ltd. as a mini-working group of Technological Innovation Center Gifu operation committee.

### Company outline

<table>
<thead>
<tr>
<th>Location</th>
<th>1512 Akechicho, Kasugai-shi, Aichi, 488-0303 Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>355 million yen / 95 employees</td>
</tr>
<tr>
<td>Product line</td>
<td>silica sand, premixed mortar, concrete secondary products, cast materials</td>
</tr>
<tr>
<td>Major customers</td>
<td>Mazda Motor Corporation, DIY store, Public agencies</td>
</tr>
</tbody>
</table>

**Inquiries**

| Contact | TEL +81-568-88-1101 | E-mail shine@matelan.co.jp |

**Homepage**
http://www.matelan.co.jp/
**NICCA CHEMICAL CO., LTD.**

**Subject**
Process Development of Electron Beam Cured Carbon Fiber Composite

**Keyword(s)**
Electron beam (EB), EB irradiation, Carbon fiber reinforced plastics (CFRP)

<table>
<thead>
<tr>
<th>Point of the proposed technology</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed EB curing resin for CFRP</td>
<td>Forming time: a few hours → a few seconds</td>
</tr>
<tr>
<td>Possible to rapidly set and form CFRP for a few seconds.</td>
<td>Pot-life: 6 months in refrigeration → 1 year at room temperature</td>
</tr>
<tr>
<td>Curing agents are not need, therefore the EB resin has long pot-life.</td>
<td></td>
</tr>
</tbody>
</table>

**Development stage**
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototype/experimental stage (to be completed in March 2014; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

**Joint researcher(s) and their role**
- NICCA CHEMICAL CO., LTD. (Resin development)
- KAIDOU KOUGYOU CO., LTD. (Forming)
- Kansai Electron Beam Co., Ltd. (EB irradiation)

**Conventional technology**

【Thermo-curing forming】
- Takes long forming time
- A few hours are need
- High temperature and high pressure vessel is required
- Autoclave forming
- Pot-life management of the resin including setting agent is required

【EB curing forming】
- Takes short forming time
- A few seconds only
- High temperature and high pressure vessel is not required.
- Enables to form under the ambient condition
- Pot-life is long due to no curing agent contained

**Example of application of this technology**
EB cured CFRP, EB cured prepreg yarn, EB cured braided pipe

**Technological challenge, constraints, business plan**
- Large-scale EB irradiator and irradiation facility are needed.
- We hope to develop market collaborating FRP forming and processing companies.

**Collaborator needed to improve this technology or develop a new technology**
- FRP forming and processing related companies with FRP forming technology (facility)
- Research institutes including universities having material property evaluation technology (facility) and expertise.

**Company outline**

<table>
<thead>
<tr>
<th>Location</th>
<th>23-1, 4-chome, Bunkyo, Fukui-shi, 910-8670 Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>2,898.545 m(^2) yen 1172 employees</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td>Yes</td>
</tr>
<tr>
<td>Product line</td>
<td>Chemical products manufacturing and sales</td>
</tr>
<tr>
<td>Major customers</td>
<td>Emori Group Holdings Co., Ltd., Nagase &amp; Co., Ltd.</td>
</tr>
<tr>
<td>Certification</td>
<td>ISO9001 ISO14001</td>
</tr>
</tbody>
</table>

**Inquiries**
Dept./personnel
Toshihide Tsukatani, Assistant Director, Corporate Research & Innovation Center
Contact
TEL +81-776-24-0213
E-mail tsukatani@niccachemical.com

**Homepage**
http://www.nicca.co.jp
NIHON POLYMER CO., LTD.

Subject Fluororesin release sheet for resin forming process
Keyword(s) Fluororesin, glass cloth, fluororesin coating, thermal resistance, non stick

Modify and improve fluororesin release sheet used in resin forming step to soft material with elasticity and flexibility, enabling the adhesion to the formed curve surface without wrinkles
Prevents release sheet from splitting
Enables to apply to curved surface (formed product) without wrinkles

Modify and improve fluororesin release sheet used in resin forming step to soft material with elasticity and flexibility, enabling the adhesion to the formed curve surface without wrinkles
Prevents release sheet from splitting
Enables to apply to curved surface (formed product) without wrinkles

Development stage Joint researcher(s) and their role

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

In-house technology
None

Conventional technology New technology

Release sheet in stacking, heating, pressurizing step of prepregs

Apply to plane surface only

Enables to apply to a curved surface

- The conventional product is hard with less elasticity and flexibility.
- Once folding wrinkles are made, it tends to split.
- Used for plane surface

- Soft material with elasticity and flexibility
- Improved strength
- Enables to apply to a curved surface

Example of application of this technology
Release sheet in stacking, heating, pressurizing to set hardened the prepreg

Technological challenge, constraints, business plan
We hope to improve the quality collaborating with CFRP forming and processing companies.

Collaborator needed to improve this technology or develop a new technology
CFRP forming companies, research institutes having autoclave and press facilities

Company/organization name
Subject Fluororesin release sheet for resin forming process
Keyword(s) Fluororesin, glass cloth, fluororesin coating, thermal resistance, non stick

Modify and improve fluororesin release sheet used in resin forming step to soft material with elasticity and flexibility, enabling the adhesion to the formed curve surface without wrinkles
Prevents release sheet from splitting
Enables to apply to curved surface (formed product) without wrinkles

Development stage Joint researcher(s) and their role

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

In-house technology
None

Conventional technology New technology

Release sheet in stacking, heating, pressurizing step of prepregs

Apply to plane surface only

Enables to apply to a curved surface

- The conventional product is hard with less elasticity and flexibility.
- Once folding wrinkles are made, it tends to split.
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- Soft material with elasticity and flexibility
- Improved strength
- Enables to apply to a curved surface

Example of application of this technology
Release sheet in stacking, heating, pressurizing to set hardened the prepreg

Technological challenge, constraints, business plan
We hope to improve the quality collaborating with CFRP forming and processing companies.

Collaborator needed to improve this technology or develop a new technology
CFRP forming companies, research institutes having autoclave and press facilities

Company outline

Location 69, 2-Chome, Hosokicho, Kasugai-shi, Aichi, 488-0937 Japan
Capital/No. of employees 20 million yen 15 employees Overseas base(s) China (Suzhou), Korea (Inchon)
Product line Fluororesin products Major customers Not disclosed
Certification None

Inquiries

Dept./personnel Kenji Yamada, Manager, Tsuishin Plant
Contact TEL +81-568-33-6575 (Tsuishin Plant) E-mail yamada@nihon-polymer.co.jp
Homepage http://www.nihon-polymer.co.jp
<table>
<thead>
<tr>
<th>Company/organization name</th>
<th>Hirose Mold Ltd.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subject</strong></td>
<td>Thickness-varying parts in SMC material press forming</td>
</tr>
<tr>
<td><strong>Keyword(s)</strong></td>
<td>Metal forming, press forming, painting</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Point of the proposed technology</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enables any cutting process for CFRP. Eliminates autoclave work to shorten the work time for CFRP forming</td>
<td>Reduced cutting and forming time and cost reduction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Joint researcher(s) and their role</th>
<th>Does any intellectual property right</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Takai Corporation Co., Ltd.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>

We have been working on processing new material, CFRP (carbon-fiber-reinforced plastic), generally termed as carbon, lighter than steel and excellent in strength and rigidity compared to steel and glass fibers. We take contracts of prototyping part manufacturing of thermosetting CFRP for blade products using cutting processing technology for CFRP (Photo 1), and manufacturing lever parts of thermosetting CFRP by simple press forming of sheet-shaped precursor material SMC (Sheet Molding Compound) of CFRP flexible prior to thermosetting (Photo 2: brake lever for bicycles, water lever, etc.). By doing these, we have been accumulating related technologies. For thermosetting CFRP part manufacturing, cutting-processed products and larger formed products are prevalent. So, we consider the forming smaller structural parts as a new and pioneering business field. CFRP material itself can be more recognized and production method and technologies for CFRP product can be established in the industry, leading to the expansion of the market for this new material replacing existing materials (aluminum, steel). Our main business is production and manufacturing of molds, and we have fabrication technology and knowledge of molds as well as production and fabrication methods and facility for the products using molds. So, we can extend new business making use the most of those technologies and knowhow as well as existing facilities.

<table>
<thead>
<tr>
<th>Example of application of this technology</th>
<th>General small structural parts (automobile, motor cycle, bicycle, commodity)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technological challenge, constraints, business plan</strong></td>
<td>Development of sales-channels for smaller structures by simple press forming of thermosetting CFRP</td>
</tr>
</tbody>
</table>

| Collaborator needed to improve this technology or develop a new technology | if you have information of any companies and institutes for our sales-channel development and technical collaboration, please let us know. |

<table>
<thead>
<tr>
<th>Company outline</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>1469-3 Inabeminarino, Kamono-cho, Minkamori-cho, Gifu, 505-0055 Japan</td>
</tr>
<tr>
<td><strong>Capital/No. of employees</strong></td>
<td>5 million yen 4 employees</td>
</tr>
<tr>
<td><strong>Overseas base(s)</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>Product line</strong></td>
<td>Die-cast molds Major customers Shin Tokai Die Casting Industry Ltd.</td>
</tr>
<tr>
<td><strong>Certification</strong></td>
<td>None</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inquiries</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dept./personnel</strong></td>
<td>Katsuke Yamane, CFRP Product Manager, Carbon Industrial Design</td>
</tr>
<tr>
<td><strong>Contact</strong></td>
<td>TEL: +81-574-25-0717 E-mail: <a href="mailto:info@hirose-mold.com">info@hirose-mold.com</a></td>
</tr>
<tr>
<td><strong>Homepage</strong></td>
<td><a href="http://hirose-mold.com">hirose-mold.com</a></td>
</tr>
</tbody>
</table>
Recycling of carbon fibers from CFRP and surface modification of the fibers using superheated steam

**Keyword(s)**
Recycle, superheated steam, fiber surface modification

**Development stage**

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in March 2014; progress: 70%)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

**Joint researcher(s) and their role**
Takasago Industry Co., Ltd. (role: development of low cost and mass processing system)

**New technology**

- Various lengths and states of carbon fiber can be recovered by SHS treatment.
- SHS treatment with process gas (N₂, etc) enables the surface modification of fibers (improvement in adhesion between fiber and resin).

**Example of application of this technology**
Fiber recycling from various CFRP and fiber surface modification

**Technological challenge, constraints, business plan**
- Processing capacity and cost are poor due to the current batch and electric heating type system.
- Continuous-type low cost processing system to be developed.
- Not sufficient in application development of the recycled carbon fiber.

**Collaborator needed to improve this technology or develop a new technology**
CFRP part manufacturers

**Company/organization name**
Japan Fine Ceramics Center

**Subject**
Recovery of carbon fibers from CFRP and surface modification of the fibers using superheated steam

**Keyword(s)**
Recycle, superheated steam, fiber surface modification

**Point of the proposed technology**
- Matrix resin of CFRP is decomposed and vaporized by superheated steam treatment, and various lengths and states of carbon fibers can be recovered.
- Superheated steam treatment with process gases (N₂, etc) enables the surface modification of fibers (improvement in adhesion between fiber and resin).

**Effect(s)**
Lowering of CFRP reproduction costs

**Conventional technology**

<table>
<thead>
<tr>
<th>Comparison of recovery process of carbon fiber from CFRP waste</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pyrolysis</strong></td>
</tr>
<tr>
<td><strong>Recovered materials</strong></td>
</tr>
<tr>
<td><strong>Temperature / °C</strong></td>
</tr>
<tr>
<td><strong>Pressure / MPa</strong></td>
</tr>
<tr>
<td><strong>Other conditions</strong></td>
</tr>
<tr>
<td><strong>Application is limited because of the focus on recovery of short fibers.</strong></td>
</tr>
</tbody>
</table>

**Development stage**

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in March 2014; progress: 70%)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

**Joint researcher(s) and their role**
Takasago Industry Co., Ltd. (role: development of low cost and mass processing system)

**New technology**

- Various lengths and states of carbon fiber can be recovered by SHS treatment.
- SHS treatment with process gas (N₂, etc) enables the surface modification of fibers (improvement in adhesion between fiber and resin).

**Example of application of this technology**
Fiber recycling from various CFRP and fiber surface modification

**Technological challenge, constraints, business plan**
- Processing capacity and cost are poor due to the current batch and electric heating type system.
- Continuous-type low cost processing system to be developed.
- Not sufficient in application development of the recycled carbon fiber.

**Collaborator needed to improve this technology or develop a new technology**
CFRP part manufacturers

**Company outline**

<table>
<thead>
<tr>
<th>Location</th>
<th>2-4-1 Mutsuno, Atsuta-ku, Nagoya, 456-8597 Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>— / 86 employees</td>
</tr>
<tr>
<td>Product line</td>
<td>R&amp;D</td>
</tr>
<tr>
<td>Certification</td>
<td>—</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td>—</td>
</tr>
</tbody>
</table>

**Inquiries**
Masashi Wada, Researcher, Materials Research and Development Laboratory, Reliable Materials Group

**Contact**
TEL +81-52-871-3500
E-mail m.wada@jfcc.or.jp

**Homepage**
http://www.jfcc.or.jp/
### Company/organization name

ITCF (Industrial Technology Center of FUKUI prefecture)

### Subject

FUKUI Technologies for carbon composites (Thin prepreg sheet)

### Keyword(s)

Carbon fiber, Tow-spreading technology (FUKUI method), Prepreg sheet

### Point of the proposed technology

Tow-spreading technology (Fukui method) which fiber-tow such as carbon fiber and glass fiber can be spread widely and thinly was developed in ITCF (Patented by Fukui prefecture). And then, the development of a thin prepreg sheet which is less than 0.05mm in thickness, the evaluation of new composite materials using this prepreg sheet, and so on, has been conducted.

A new laminated composite using thin prepreg sheets has a benefit which is tough as compared to a conventional laminated composite. The weight reduction of an apparatus for transportation such as an airplane and a car can be realized by these developments, and also the energy saving by an improvement in fuel efficiency can be realized.

### Effect(s)

- Possibility of delamination, which may cause fracture, is extremely low.
- High performance (e.g., tensile, compressive).
- Supports both thermosetting resins and thermoplastic resins.
- Thin prepreg sheets less than 0.05mm in thickness can be efficiently manufactured using a carbon large tow (15, 24, 50, 60K) of comparatively low-cost.
- Also supports other reinforced fiber tows (e.g., glass, aramid).

### Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experiment stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

### Joint researcher(s) and their role

- Owns any intellectual property right

### Company/organization name

ITCF (Industrial Technology Center of FUKUI prefecture)

### Subject

FUKUI Technologies for carbon composites (Thin prepreg sheet)

### Keyword(s)

Carbon fiber, Tow-spreading technology (FUKUI method), Prepreg sheet

### Example of application of this technology

- Structural materials for aircraft
- Structural materials for automobiles
- Structural materials for large machinery
- Sports and leisure

### Technological challenge, constraints, business plan

- It is necessary to develop a technology for mass-producing large moldings (under development).
- Further cost reduction is needed.
- To use this technology, it is necessary to obtain a license for the Fukui Prefecture’s patent.

### Collaborator needed to improve this technology or develop a new technology

- Example of application of this technology
- Technological challenge, constraints, business plan

### Company outline

<table>
<thead>
<tr>
<th>Location</th>
<th>6-10 Kawaiwashizuka, Fukui-shi, Fukui, 910-0102, Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>69</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td></td>
</tr>
<tr>
<td>Product line</td>
<td></td>
</tr>
<tr>
<td>Major customers</td>
<td></td>
</tr>
<tr>
<td>Certification</td>
<td>Patent granted in Japan, United States, China, South Korea and Europe</td>
</tr>
<tr>
<td>Dept./personnel</td>
<td>Chief researcher: Dr. Kazumasa KAWABE, Senior researcher: Dr. Hidenori SASAYAMA, New Industrial Creation R&amp;D Department</td>
</tr>
<tr>
<td>Contact</td>
<td>TEL: +81-776-55-0664, E-mail: <a href="mailto:composites@fklab.fukui.fukui.jp">composites@fklab.fukui.fukui.jp</a></td>
</tr>
</tbody>
</table>

### Conventional technology

**Quasi-isotropic laminate (Conventional)**

- Cross section
- Cracking easily progresses
- Delamination

### New technology

**Thin-ply quasi-isotropic laminate (New)**

- Cross section
- Crack dose not easily progress!
- Transverse crack is fixed between these
- Delamination does not occur easily

### Tensile properties of quasi-isotropic laminates. (CF/Epoxy)

<table>
<thead>
<tr>
<th>Strain, $\varepsilon_t$ [%]</th>
<th>Stress, $\sigma_t$ [MPa]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-45</td>
<td>0.2718</td>
</tr>
<tr>
<td>0</td>
<td>0.0906</td>
</tr>
<tr>
<td>45</td>
<td>0.1599</td>
</tr>
<tr>
<td>90</td>
<td>0.3906</td>
</tr>
</tbody>
</table>

### Compressive properties of quasi-isotropic laminates. (CF/Epoxy)

<table>
<thead>
<tr>
<th>Strain, $\varepsilon_t$ [%]</th>
<th>Stress, $\sigma_t$ [MPa]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-45</td>
<td>0.2718</td>
</tr>
<tr>
<td>0</td>
<td>0.0906</td>
</tr>
</tbody>
</table>

### Fatigue properties of quasi-isotropic laminates. (CF/Epoxy)

<table>
<thead>
<tr>
<th>Number of cycles to failure (Cycles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.14 mm</td>
</tr>
<tr>
<td>0.045 mm</td>
</tr>
</tbody>
</table>

### By reducing the ply thickness, the tensile, compression and fatigue properties are drastically improved.

### Since a thin-ply prepreg sheet can be manufactured from a large carbon tow, both high performance low-cost and can be achieved.
**Company/organization name**
FUKUI FIBERTECH CO., LTD.

**Subject**
Materials for large structures for cost saving

**Keyword(s)**
Draw molding, fiber hybrid composites, non-crimp fabric (NCF), pultrusion

---

<table>
<thead>
<tr>
<th>Point of the proposed technology</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimum alignment of expensive carbon fibers for cost saving</td>
<td>Weight reduction, longer service life, shorter construction period</td>
</tr>
<tr>
<td>Application of non-crimp fabric (NCF) not commonly used in the conventionally draw molding composites for stronger adhesion</td>
<td></td>
</tr>
</tbody>
</table>

---

**Development stage**

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)

**Joint researcher(s) and their role**

- Hirose Co., Ltd. (Structure design and its construction)
- Toray Industries Inc. (Design and supply of carbon fibers)

- Owns any intellectual property right: Yes

---

**Conventional technology**

- Fiberglass roving with strong anisotropy are used as a major component.
- Special care has to be taken for adhesion because of their high anisotropy.

**New technology**

- Carbon fibers are effectively aligned in accordance with structural needs.
- In view of better adhesion carbon fibers are aligned in the 90 and plus and minus 45 degrees directions.
- Adhesion to nonferrous metals is allowed.

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**Example of application of this technology**
Bridge and various structural products

**Technological challenge, constraints, business plan**
Cannot be used as a building material because of poor fire resistance.

**Collaborator needed to improve this technology or develop a new technology**
Structural engineering consultants, local government, and general construction companies

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**Company outline**

- **Location**: 5-1 Iwanishi Nakahara-cho, Toyohashi-shi, Aichi 441-3106 Japan
- **Capital/No. of employees**: 95 million yen / 60
- **Overseas base(s)**: None
- **Product line**: Various fiber products, fiber reinforced polymer (FRP) and FRP matrix
- **Certification**: ISO9000 and Aichi Quality
- **Dept./personnel**: Komiya Iwao, Technical Dept.
- **Contact**: TEL: +81-532-41-1211, E-mail: i-komiya@fukui-fibertech.co.jp
- **Homepage**: http://www.fukui-fibertech.co.jp

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**Inquiries**

**Homepage**: http://www.fukui-fibertech.co.jp
Unidirection (UD) tape of the carbon fiber reinforced thermoplastic polymer (CFRTP) composite, "UD Tape", high in strength but low in weight

<table>
<thead>
<tr>
<th>Effect(s)</th>
<th>Point of the proposed technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Light weight and high strength, a potential for replacement of metal!</td>
<td>- Can be used as an industrial design material</td>
</tr>
<tr>
<td>- Can be provided in the form of a roll in the length from a few tens to hundreds of meters by continuous fabrication process.</td>
<td></td>
</tr>
<tr>
<td>- The UD tape has a big potential depending on how to use it and what is applied for!</td>
<td>- A wide range of thermoplastic resins can be used.</td>
</tr>
<tr>
<td>- Effect of weight reduction: 75% reduction relative the weight of steel given the same volume.</td>
<td></td>
</tr>
<tr>
<td>- Multilayered configuration allows for optimization of the strength in final products.</td>
<td></td>
</tr>
</tbody>
</table>

Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: 70%)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

Joint researcher(s) and their role

None

Yes

Conventional technology

- Metal
  In the past very light metal, for example, aluminum, is used for the products with high strength, high modulus, and energy saving in production and usage.

  ~Issue~
  - Weaker in strength than steel
  - Further reduction of weight is required

- Carbon fiber reinforced thermoset polymer (CFRP) composite

  The CFRP composite with light weight and high strength is used in the field of the space and aircraft industry for replacing metal.

  ~Issue~
  - The materials have to be kept under refrigeration.
  - The service life of the matrix is short.
  - Low productivity: a long cycle time of the fabrication process
  - Secondary molding is not possible.

New technology

- Unidirection (UD) tape of carbon fiber reinforced thermoplastic polymer (CFRTP) composite, "UD Tape"

  Unidirectionally aligned carbon fibers are impregnated with the thermoplastic resin.

  There are many ways for fabrication of the CFRTP-UD tape, and the secondary molding is one way to maximize the properties of the thermoplastic polymer!

Example of application of this technology

- Interior and exterior components for automobile
- Parts for aircraft
- Parts for appliances

Technological challenge, constraints, business plan

- The maximum size currently available for the CFRTP-UD tape is 40 mm wide or less.
- The material is still expensive because of the early stage of development. Needs of the material and growth of the market will encourages investing the equipment for improving the productivity and establishing the manufacture technology with optimization of the manufacture cost.
- At first we would like to sell only the raw material for the UD tape. Production of the material for secondary molding (laminated sheet, randomly oriented fiber sheet) will be considered after confirming their needs.

Collaborator needed to improve this technology or develop a new technology

- The company actively developing the wider use of CFRTP with knowledge of its potential market and the required quality and considering the manufacture cost for this market.
- The company actively working to manufacture the raw material for secondary molding using the UD tape and trying to find-use of UD tape

Company outline

<table>
<thead>
<tr>
<th>Location</th>
<th>93-66 Sanjushashita-cho, Fukui-shi, Fukui 918-8585, Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>¥2,103 billion yen 854</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td>US, Thailand, Vietnam</td>
</tr>
<tr>
<td>Product line</td>
<td>Building materials, industrial materials, and process equipment for fine chemicals</td>
</tr>
<tr>
<td>Major customers</td>
<td>Home, Auto, Electronic Manufacturer etc.</td>
</tr>
<tr>
<td>Certification</td>
<td>ISO 9001, ISO14001, OHSAS18001</td>
</tr>
<tr>
<td>Inquiries</td>
<td>Hidekazu Kaneiwa, Manager, Research &amp; Development Division</td>
</tr>
<tr>
<td>Contact</td>
<td>TEL +81-776-38-8060</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:h.kaneiwa@fukuvi.co.jp">h.kaneiwa@fukuvi.co.jp</a></td>
</tr>
<tr>
<td>Corporate website</td>
<td><a href="http://www.fukuvi.co.jp/">http://www.fukuvi.co.jp/</a></td>
</tr>
<tr>
<td>Technical information website</td>
<td><a href="http://www.jyushiseikei.jp/">http://www.jyushiseikei.jp/</a></td>
</tr>
</tbody>
</table>
**Subject:** Lamination process for enhancing the strength of the drive shaft

**Keyword(s):** Simultaneous winding of multilayered prepregs

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**Point of the proposed technology:**

A method of winding the prepreg that deformation of the fiber and occurrence of voids can be minimized when the prepreg is wound.

**Effect(s):**

Improvement of the strength by 20% as compared to the conventional method

---

### Development stage

<table>
<thead>
<tr>
<th>Conventional technology</th>
<th>New technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>An inner image of a drive shaft by ultrasonic testing</td>
<td></td>
</tr>
<tr>
<td>There is a weak point in structure of the drive shaft. Defects such as voids are likely to occur, preventing the prepreg from developing the original strength.</td>
<td></td>
</tr>
<tr>
<td>The strength development ratio of the drive shaft was improved by reducing the weak point in structure and the occurrence of voids.</td>
<td></td>
</tr>
<tr>
<td>Improvement of the torsional strength of the CFRP drive shaft by simultaneous winding of the multilayered prepregs</td>
<td></td>
</tr>
<tr>
<td>High torsional stiffness of the drive shaft allows for replacing the steel drive shaft with the drive shaft made of the carbon fiber reinforced plastics (CFRP).</td>
<td></td>
</tr>
</tbody>
</table>

---

### Example of application of this technology

A drive axle to transmit the torque in vehicle and aircraft

### Technological challenge, constraints, business plan

Nothing in particular

### Collaborator needed to improve this technology or develop a new technology

The company capable of non-destructive testing for defects within the CFRP shaft

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### Company/organization name

**Fujikura Rubber Ltd.**

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### Inquiries

**Dept./personnel:** Jyoutarou Minakami, Sales development

**Contact:** TEL +81-3-3527-8111

**E-mail:** kaihatsu@fc.fujikura.co.jp

**Homepage:** [http://www.fujikurarubber.com/](http://www.fujikurarubber.com/)
### Coordinator
Hokuriku S.T.R. Cooperative

<table>
<thead>
<tr>
<th>Subject</th>
<th>Planer heating element of knitted carbon fibers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyword(s)</td>
<td>Carbon fiber, planar heating element</td>
</tr>
</tbody>
</table>

#### Point of the proposed technology
- Lower consumption of energy than the nichrome wire heating element and excellent flexibility against being bended
- Design flexibility in accordance with the calorific value
- Release of far infrared rays

#### Effect(s)
- Energy saving by 30 to 50% as compared to the conventional heating element
- Flexible to match to the final shape of the product
- Release of far infrared rays at about 10μ, the wavelength being said to be beneficial to health

#### Development stage
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered [yes] / [no])

#### Conventional technology
- **Nichrome wire heating element**
  1. A conventional nichrome wire is cheap but heavy and weak when bended.
  2. In the nichrome wire heating element one break anywhere in the system stops conducting electricity and thus stops heating.
  3. A temperature controller has to be installed because of low resistance of nichrome.

#### New technology
- **Planar heating element of knitted carbon fibers**
  1. Very light in weight and highly flexible to match to various geometry.
  2. In the case of partial breakage of carbon fibers its grid form prevents the heating element from losing its function.
  3. Temperature distribution in breakage of the heating system
  4. Temperature of the heating element can be controlled by the applied electric current.

#### Example of application of this technology
- Various types of heaters (cushion, bed sheet, snow melting system, panel heater, vest, heating floor, seat for vehicle and train, and blanket)

#### Technological challenge, constraints, business plan
- Establishment of the electrical safety circuit
- Development of the temperature controller

#### Collaborator needed to improve this technology or develop a new technology
- The company of developing commercial products based on the net shape heating element of knitted carbon fibers

<table>
<thead>
<tr>
<th>Company/organization name</th>
<th>Hokuriku S.T.R. Cooperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject</td>
<td>Planer heating element of knitted carbon fibers</td>
</tr>
<tr>
<td>Keyword(s)</td>
<td>Carbon fiber, planar heating element</td>
</tr>
</tbody>
</table>

#### Company outline
- **Location**
  355-1, Yasui-cho, Oyabe, Toyama, 932-0121, Japan

- **Capital/No. of employees**
  121 million yen 30

- **Overseas base(s)**
  China (3 Plants)

- **Product line**
  Foundation garment and lingerie, fabric materials, and industrial materials

- **Major customers**
  Kao Corporation, Itochu Corporation

- **Certification**

- **Dept./personnel**
  Kei Miyairi, Manager, New Business Dept.

- **Contact**
  TEL +81-766-61-4546

- **E-mail**
  k.miyairi@str.or.jp

- **Homepage**
  [http://www.str.or.jp/](http://www.str.or.jp/)

---

### Description of Technology

#### Nichrome wire heating element

1. A conventional nichrome wire is cheap but heavy and weak when bended.
2. In the nichrome wire heating element one break anywhere in the system stops conducting electricity and thus stops heating.
3. A temperature controller has to be installed because of low resistance of nichrome.

#### Planar heating element of knitted carbon fibers

1. Very light in weight and highly flexible to match to various geometry.
2. In the case of partial breakage of carbon fibers its grid form prevents the heating element from losing its function.
3. Temperature distribution in breakage of the heating system
4. Temperature of the heating element can be controlled by the applied electric current.

#### Example of application of this technology

- Various types of heaters (cushion, bed sheet, snow melting system, panel heater, vest, heating floor, seat for vehicle and train, and blanket)

#### Technological challenge, constraints, business plan

- Establishment of the electrical safety circuit
- Development of the temperature controller

#### Collaborator needed to improve this technology or develop a new technology

- The company of developing commercial products based on the net shape heating element of knitted carbon fibers

---

### Diagrams

**A net shape heating element of knitted carbon fibers (Japanese Patent No. 5436491)**

- **Temperature distribution in breakage of the heating system**

**Relation between the temperature of heating elements and the applied electric current**
Maeda Industry Co., Ltd.

Subject
Development of the laser based technology for joining dissimilar materials between metal and carbon fiber reinforced polymer (CFRP) for the weight reduction of automotive parts.

Keyword(s)
Laser-based joining technology, laser-assisted fabrication with diffractive optical elements, fabrication system

Point of the proposed technology
Weight reduction of the vehicle is essential for improving the fuel economy and energy saving. At present use of CFRP is evaluated as the light weight material. In the present study the laser-based technology for "joining dissimilar materials using the elastomer as the insert material" is applied to develop the practical system to join metals with CFRP.

Effect(s)
Weight reduction by 50%

Development stage
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

Joint researcher(s) and their role
Osaka University: for simulation analysis of the laser beam profiles for optimization to propose the better fabrication process.
National Institute of Advanced Science and Technology: for evaluation and analysis of the joining section and development of the non-destructive testing method.
Industrial Technology Center of Okayama Prefecture: for evaluation and analysis of the joining section to propose a method to improve the strength at joint.

Conventional technology
- Requiring a larger number of parts⇒ bolt, nut, O-ring, collar, etc.
- Requiring many steps for fixation⇒ collar insertion, compressing of the O-ring, and tightening with a bolt

New technology
- An insert material (thermoplastic elastomer) is placed between joining objects followed by laser heating to join the objects.
- Laser-assisted fabrication by the diffractive optical element (DOE)⇒ enabling uniform heating of a large area

Example of application of this technology
- Body components and interior components in vehicle
- Interior components in office automation equipment

Technological challenge, constraints, business plan
- Identification of markets for products necessitating the present technology, understanding of properties and durability required for these products
- Strength testing including durability and establishment of the practical technology including countermeasures

Collaborator needed to improve this technology or develop a new technology
- The company of developing the joining technology between CFRP and metal for commercial products.
- University and research institution capable of evaluating the properties of welding products between dissimilar materials and studying related technologies.

Company outline
- Location: 22-Yon-no-shimo, Nawa-machi, Tokai-shi, Aichi 476-0002 JAPAN
- Capital/No. of employees: 35 million yen / 35
- Product line: Service of laser processing requested
- Major customers: Toyota Motor Corporation, Aishin Seiki Co., Ltd., Toyota Boshoku Corporation
- Certification: ISO 9001, ISO 9100

Inquiries
- Contact: +81-52-634-8850
- E-mail: mikame@maeda-kogyo.co.jp

Homepage: http://www.maeda-kogyo.co.jp
Collaborator needed to improve this technology or develop a new technology

- Companies having technology related to high-pressure gas, and related companies having knowledge on processing technology such as a gas control technology and a control system
- Related companies having technology for use of renewable energy, research institutes such as universities

Example of application of this technology

- 106 MPa accumulator for hydrogen stations, 45 MPa compound vessel for transport, 70 MPa fuel tank for FCV
- Compact simplified hydrogen station, high-pressure hydrogen transport system

Research and development of a type-4 (resin liner) 106 MPa compound vessel accumulator

- Dramatic weight-saving is achieved by adopting a CFRP compound vessel instead of the conventional steel vessel containing chromium-molybdenum steel.
- Substantial increase in reliability and safety with use of type-4 (resin liner) --- long-term use for 15 years can be achieved.
- Proposal for building an ultra-compact simplified hydrogen station and a transportation system by using Maruhachi’s compound vessel.
- Bold deregulation and legislation are needed.

Effect(s)

- Type-4 (made of resin liner) CFRP compound vessel accumulator with a design withstand pressure 107 MPa, minimum burst pressure 250 MPa, and normal temperature pressure cycles 100,000 cycles of more
- Substantial increase in reliability and safety with use of type-4 (resin liner) --- long-term use for 15 years can be achieved.
- Proposal for building an ultra-compact simplified hydrogen station and a transportation system by using Maruhachi’s compound vessel.
- Bold deregulation and legislation are needed.

Company

Name: MARU HACHI Co.,

Subject: Building of infrastructure for the hydrogen society by using a type-4 (resin liner) 106 MPa compound vessel accumulator

Keyword(s): 106 MPa accumulator for hydrogen stations, 45 MPa compound vessel for transport, 70 MPa tank for FCV

Point of the proposed technology

- Dramatic weight-saving is achieved by adopting a CFRP compound vessel instead of the conventional steel vessel containing chromium-molybdenum steel.
- Substantial increase in reliability and safety with use of type-4 (resin liner) --- long-term use for 15 years can be achieved.
- Proposal for building an ultra-compact simplified hydrogen station and a transportation system by using Maruhachi’s compound vessel.
- Bold deregulation and legislation are needed.

Joint researcher(s) and their role

- Osaka University (role: design analysis of high-pressure vessels; analysis simulation of progress of damage to advanced composite)
- Tokyo Metropolitan University (role: design analysis of compound vessels; evaluation technique)
- University of Tokyo (role: technology, analysis and evaluation related to compound vessels)
- National Institute of Advanced Industrial Science and Technology (technical instructions on hydrogen society)

New technologies (new products of Maruhachi)

- At the world’s largest advanced composite exhibition JEC 2014 (Paris) held in March 2014, the technology was presented with the Innovation Award in the High Pressure Vessels category. This compound vessel technology developed by Maruhachi and Osaka University was internationally acknowledged.
- A plastic liner molding technology and fusing technology have been developed. A hydrogen barrier technology is being developed in cooperation with AIST.

Design analysis for achieving 100,000 cycles required for the hydrogen station

Example of application of this technology

- 106 MPa accumulator for hydrogen stations, 45 MPa compound vessel for transport, 70 MPa fuel tank for FCV
- Compact simplified hydrogen station, high-pressure hydrogen transport system

Technological challenge, constraints, business plan

- Companies/research institutes interested in the development of a 106 MPa accumulator, a 45 MPa compound vessel for transport and, a 70 MPa fuel tank for automobiles
- Companies/research institutes interested in the research and development of a 45 MPa high-pressure hydrogen transport system
- Companies/research institutes interested in the research and development of an ultra-compact simplified hydrogen station

Collaborator needed to improve this technology or develop a new technology

- Companies having technology related to high-pressure gas, and related companies having knowledge on processing technology such as a gas control technology and a control system
- Related companies having technology for use of renewable energy, research institutes such as universities

Company outline

- Location: 12-1 Gennyo, Maruoka, Sakai-shi, Japan
- Capital/No. of employees: 80 million yen 20
- Overseas base(s): None
- Product line: Advanced composite, high-pressure vessels, highly-functional films
- Major customers: Major trading companies, automotive/aviation-related companies, molding companies
- Certification

Inquiries

- Dept/personnel: Masataka Sugahara, President
- Contact: TEL +81 — 776 — 67 — 0808
- Homepage: http://www.maruhati.co.jp

- 75 -
**Subject:** Commercialization of thermoplastic resins, thermosetting resin prepreg sheets and advanced composite materials

**Keyword(s):** Weight-saving, high strength, quick molding, opening, provision of cutting-edge composite materials

### Point of the proposed technology

- Thermoplastic prepreg sheet that allows quick molding
- Viro thermosetting resin prepreg sheet
- Opened yarn woven fabric, prepreg sheet
- Capable of providing equipment/materials with polyamide (nylon), TPX (olefin-based resin), PC (polycarbonate), TPU (thermoplastic polyurethane resin), etc., as well as various resins such as polyimide and PEEK.

### Effect(s)

- Weight-saving: 30% or more achievable
- Strength: 700 to 900 Mpa → 1300 Mpa max.
- Molding time: can be drastically shortened

### Development stage

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Joint researcher(s) and their role</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in [month] [year]; progress: %)</td>
<td>Osaka University (role: analysis simulation for progress of damage to advanced composites)</td>
</tr>
<tr>
<td>2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)</td>
<td>Kyushu Institute of Technology (role: evaluation technology for advanced composite materials)</td>
</tr>
<tr>
<td>4. Commercialization completed (already delivered: yes)</td>
<td>University of Tokyo (role: technology, analysis and evaluation related to composite materials)</td>
</tr>
</tbody>
</table>

### New technology

**List of thermoplastic and thermal prepreg products**

- Uni-Directional Woven Fabrics
- Tape Fabrics
- Random Mat
- Laminates & Sandwich Panels
- Micro-ply Thin layer sheets & UD with Spread fiber technology

**Thermo Plastic Prepregs**

- UD Fabrics & Laminates
- UD Prepregs
- UD Tape

**Thermo Setting Prepregs**

- Viro Woven Fabric
- Woven Fabric

**Example of application of this technology**

- Automobile chassis, body and other members
- Aircraft members (under development), electronic equipment members (PC housings, housings for mobile terminals such as smart phones, cases)

**Technological challenge, constraints, business plan**

- Developing prepreg impregnated with thermoplastic/thermosetting resin. Width and length ranges will cover 1,000 mm, and 1,000 mm, respectively.
- Opened yarn woven fabrics, UD thermoplastic/thermosetting prepreg UD, fabrics, tapes
- Providing thin-layer/multi-axis/laminated sheets, and processed laminate products

**Collaborator needed to improve this technology or develop a new technology**

- Processing companies desiring to develop CFRP moldings, companies desiring to sell advanced composite materials
- Research institutes such as universities having technologies and equipment for developing molding method(s), and for designing, analyzing and evaluating CFRP products

**Company outline**

- **Location:** 12-1 Genno, Maruka, Sakaï City, JAPAN
- **Capital/Nr. of employees:** 80 million yen
- **Product line:** Advanced composites, high-pressure vessels, highly-functional films
- **Certification:**
- **Inquiries:**
  - **Contact:** TEL +81-776-67-0836
  - **Homepage:** [http://www.maruhati.co.jp](http://www.maruhati.co.jp)
Conventional technology

Design and manufacture of the metal progressive molding die⇒the progressive die

Metal stamping and forming

Design and manufacture of the direct-pressure type molding die for resins

Molding of resins

Insert molding

Metal insert

Joining insert to the metal part⇒consecutive insert to the metal part

Design and manufacture of automated processing equipment

Ultrasonic welding, fusion, welding, joining by crimping, laser processing, assembly

* Manufacture of molded parts for the automotive electrical and electronic system
* Manufacture of molded parts for medical devices
* Manufacture and sale of assistive devices⇒medical assistive devices

New technology

A resin molded part is sandwiched between carbon fiber reinforced polymer sheets as an insert and then compressed to form a structural part with high strength without use of metal.

Current steel parts by deep drawing

Prototype obtained by compression molding of polyamide 6 sandwiched between carbon fiber reinforced polymer sheets as the insert.

Example of application of this technology

Weight reduction by using only resin as the structural material. Higher flexibility in design.

* Insert molding technology in which thick wall parts can be sandwiched between carbon fiber reinforced polymer sheets.

Technological challenge, constraints, business plan

Use of only resin in automotive structural parts. Shortening of the residence time in molding using high damping effects with the robotic arm.

Collaborator needed to improve this technology or develop a new technology

We would like to cooperate with the carbon fiber manufactures for improving the adhesion to the polymer.
### Mie Industrial Research Institute

#### Subject
Research activity on the fiber reinforced thermoplastic polymer composite

#### Keyword(s)
Molding technology, simulation technology for molding

<table>
<thead>
<tr>
<th>Point of the proposed technology</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulation and analysis of the resin flow in injection molding is performed together with real injection molding of parts for assisting the production of the prototype molded parts.</td>
<td>Reduction of the lead-times during prototyping for mass production</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Joint researcher(s) and their role</th>
<th>Owns any intellectual property right</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in [month] [year]; progress: %)</td>
<td>No particular partner (Depending on the possible cooperative research activity, arrangement will be made.)</td>
<td>None</td>
</tr>
<tr>
<td>2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Commercialization completed (already delivered: yes / no)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Conventional technology

A post evaluation of injection molded products ⇒ Modification of the mold die

#### New technology

The CAE analysis prior to the injection molding is performed to identify where the weldline is formed and how fibers are oriented to provide the information used for designing the mold die, thereby reducing the lead-times for production of the prototype parts.

- Fiber orientation in the CAE analysis (left) and the injection molded prototype part (right) (The arrow indicates the flow direction of the resin).

#### Example of application of this technology
Automotive components for replacing metal parts with plastic parts.

#### Technological challenge, constraints, business plan
Consistent service on the flow analysis of the polymer to the production of the prototype part for the companies including those outside the Mie Prefecture to develop the molding technology for reducing the weight by replacing the metal parts with the plastic parts.

#### Collaborator needed to improve this technology or develop a new technology
Organization having the facility for properties evaluation and the sample production unavailable to the Mie Prefecture.

#### Company outline

<table>
<thead>
<tr>
<th>Location</th>
<th>5-4-5 Takajaya, Tsu-shi, Mie 514-0819 Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>- yen 64 employees</td>
</tr>
<tr>
<td>Product line</td>
<td>Research and testing, technology support, people training</td>
</tr>
<tr>
<td>Certification</td>
<td>ISO 9001 (Instrument rental service)</td>
</tr>
<tr>
<td>Inquiries</td>
<td>Takeshi Saito, General Management Staff and Director, Manufacturing Technology Research Division</td>
</tr>
<tr>
<td>Contact</td>
<td>TEL +81–59–234–405</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:kougi@pref.mie.jp">kougi@pref.mie.jp</a></td>
</tr>
</tbody>
</table>

#### Analytical instruments, equipment for the properties analysis, and instruments for the shape measurement are available while a fee is required.

- Applicable to the small scale kneading of pellets blended with various filler.
- Applicable to preparation of a small scale prototype part using an injection molding machine.

#### Injection molded parts using carbon fiber reinforced thermoplastic pellets

- Applicable to the small scale kneading of pellets blended with a various filler.
- Applicable to preparation of a small scale prototype part using an injection molding machine.

- | Injection molded part using carbon fiber reinforced thermoplastic pellets |
- | Fiber orientation in the CAE analysis (left) and the injection molded prototype part (right) (The arrow indicates the flow direction of the resin). |
- | A post evaluation of injection molded products ⇒ Modification of the mold die |
- | The CAE analysis prior to the injection molding is performed to identify where the weldline is formed and how fibers are oriented to provide the information used for designing the mold die, thereby reducing the lead-times for production of the prototype parts. |
- | Consistent service on the flow analysis of the polymer to the production of the prototype part for the companies including those outside the Mie Prefecture to develop the molding technology for reducing the weight by replacing the metal parts with the plastic parts. |
- | Organization having the facility for properties evaluation and the sample production unavailable to the Mie Prefecture. |
- | Analytical instruments, equipment for the properties analysis, and instruments for the shape measurement are available while a fee is required. |
- | Applicable to the small scale kneading of pellets blended with a various filler. |
- | Applicable to preparation of a small scale prototype part using an injection molding machine. |
- | Injection molded part using carbon fiber reinforced thermoplastic pellets |
- | Fiber orientation in the CAE analysis (left) and the injection molded prototype part (right) (The arrow indicates the flow direction of the resin). |
- | A post evaluation of injection molded products ⇒ Modification of the mold die |
- | The CAE analysis prior to the injection molding is performed to identify where the weldline is formed and how fibers are oriented to provide the information used for designing the mold die, thereby reducing the lead-times for production of the prototype parts. |
- | Consistent service on the flow analysis of the polymer to the production of the prototype part for the companies including those outside the Mie Prefecture to develop the molding technology for reducing the weight by replacing the metal parts with the plastic parts. |
- | Organization having the facility for properties evaluation and the sample production unavailable to the Mie Prefecture. |
# LE Sheet® for mechanical drilling - CFRP/Titanium Grade -

**Subject**

- **MITSUBISHI GAS CHEMICAL COMPANY, INC.**

**Keyword(s)**

- drilling, CFRP, titanium, drill bit life, hole quality, productivity, drill breakage, scuffing, delamination, burr, uniformity of hole diameter, aircraft, difficult-to-cut-metal, automobile

**Point of the proposed technology**

LE Sheet®, a material for drilling process, which is a solid lubricating sheet. By using LE Sheet®,

- The liquid lubricant is NOT necessary during the drilling process.
- The drill bit life is extended and/or hole quality is improved.
- CFRP and titanium board can be drilled at one time.

**Effect(s)**

- Increase of the drill bit life.
- Improvement in productivity of drilling of CFRP/titanium stacks.
- Improvement of hole quality.

## Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in December, 2015; progress: 80%)
4. Commercialization completed (already delivered: yes / no)

## Joint researcher(s) and their role

- **Professor Umehara of Nagoya University for development and evaluation**

## Conventional technology

### Liquid lubricant method

- Liquid lubricant
- CFRP
- Titanium board

Drilling of CFRP/titanium stacks with liquid lubricant is a difficult task due to drill bit life, drill breakage, and hole quality such as scuffing and delamination of the CFRP, exit-side burr and uniformity of hole diameter of the titanium board.

**CFRP for aircraft:** t5mm

**Titanium board (Ti-6Al-4V):** t3mm

**Uncoated solid carbide drill bit:** $\phi$ 6mm

**Processing conditions:**

- 500rpm, 25mm/min, cooling with the wind blow, and 100hits/drill

## New technology

### LE Sheet® method

- LE Sheet®
- CFRP
- Titanium board

**CFRP for aircraft:** t5mm

**Titanium board (Ti-6Al-4V):** t3mm

**Uncoated solid carbide drill bit:** $\phi$ 6mm

**Photo of drill wear after 100hits of drilling**

**Example of application of this technology**

- CFRP and titanium products for aircraft parts
- Difficult-to-cut metal products for automobile

**Technological challenge, constraints, business plan**

- We plan to visit the fabrication sites to learn the requirements and the form of products to which our technology can be applied.

**Collaborator needed to improve this technology or develop a new technology**

- The company with a knowhow for drilling of CFRP and titanium board for aircraft products and the difficult-to-cut metal products for automobile.

## Company outline

**Location**

Mitsubishi Building, 5-2,Marunouchi 2-chome Chiyoda-ku, Tokyo 100-8324 Japan

**Capital/No. of employees**

41,970 billion yen 4,243 Overseas base(s) US, Germany, Singapore, Thailand, China

**Product line**

Manufacture and sale of various chemical products Major customers Information not to be disclosed

**Certification**

ISO 9001, ISO 14001

**Inquiries**

- **Dept./personnel**
  - Shigeru HORIE, Manager, Planning & Development Division, Information & Advanced Materials Company
- **Contact**
  - TEL: +81-3-3283-4736
  - E-mail: shigeru-horie@mgc.co.jp
- **Homepage**
  - [http://www.mgc.co.jp/](http://www.mgc.co.jp/)
MITSUBISHI HEAVY INDUSTRIES PLASTIC TECHNOLOGY CO., LTD.

Subject
Prevention of fiber breakage in injection molding of the long fiber reinforced thermoplastic (LFT) composite

Keyword(s)
LFT material, injection molding, screw, fiber length, strength

Point of the proposed technology
Use of a new screw specific for injection molding of the long fiber reinforced thermoplastics (LFT) instead of a conventional screw prevents the fibers as reinforcing material from breaking, thereby substantially increasing the strength of molded parts for automotive components.

Effect(s)
Fiber length: longer than 25 times or more as compared to the conventional injection molded parts
Strength: stronger 1.5 times or more as compared to the conventionally injection molded part
Weight reduction in automobile components by replacing metal components

Development stage
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)

Joint researcher(s) and their role
None

Commercialization completed (already delivered: yes / no)
Yes

Example of application of this technology
Functional parts for vehicle

Technological challenge, constraints, business plan
Products commercially available

Collaborator needed to improve this technology or develop a new technology
None

Company outline
Location: 1-Takamichi, Iwatshika-cho, Nakamura-ku, NAGOYA-shi, Aichi 453-8622, Japan
Capital/No. of employees: 450 million yen / 158
Overseas base(s): North America, China, India, South East Asia etc.
Product line: Injection molding machine
Major customers: Domestic and foreign manufacturers of injection molded parts
Certification: ISO 14001

Inquiries
Dept./personnel: Naoki Toda, Deputy General Manager, Engineering Department
Contact: TEL +81-52-412-1129
E-mail: naoki_toda@pt.mhi.co.jp
Homepage: http://www.mhi-pt.co.jp/index.htm

Conventional technology
Screw for injection molding

New technology
Screw (LFT screw) for injection molding specific to the LFT

Development of a screw with the optimum geometry satisfying both plastication (melting) of the LFT material and prevention of fiber breakage

Example of application of this technology
Functional parts for vehicle

Technological challenge, constraints, business plan
Products commercially available

Collaborator needed to improve this technology or develop a new technology
None

Company outline
Location: 1-Takamichi, Iwatshika-cho, Nakamura-ku, NAGOYA-shi, Aichi 453-8622, Japan
Capital/No. of employees: 450 million yen / 158
Overseas base(s): North America, China, India, South East Asia etc.
Product line: Injection molding machine
Major customers: Domestic and foreign manufacturers of injection molded parts
Certification: ISO 14001

Inquiries
Dept./personnel: Naoki Toda, Deputy General Manager, Engineering Department
Contact: TEL +81-52-412-1129
E-mail: naoki_toda@pt.mhi.co.jp
Homepage: http://www.mhi-pt.co.jp/index.htm

1. Prevention of the fiber breakage is difficult in injection molding with a conventional screw (targeted fiber length cannot be obtained).
2. Sufficient strength of molded parts (components and final products) cannot be obtained.
3. Difficult to replace metal parts with plastics for weight reduction in automotive parts

1. Use of the LFT screw developed allows for keeping the fiber length 2.5 times or more as compared to the one in the conventional screw.
2. Substantial increase of the strength in molded parts to 1.5 times or more as compared to the one in the conventional screw.
3. Automotive metal parts can be replaced with plastic parts to achieve the weight reduction.


### Point of the proposed technology

Complex shapes can be molded at low cost in short time by press molding a sheet material in which short fibers are randomly oriented (thermosetting: SMC; thermoplastic: stampable sheet) in place of the conventional UD prepreg using continuous fiber. In addition, by adopting pitch-based carbon fiber, high rigidity, high thermal conductivity and low thermal expansion, which were impossible with PAN-based fiber, are achieved.

#### Effect(s)

- Thermal expansion rate: 3 × 10^-6°C^-1
- Thermal conductivity: 10 W/mK or less

### Development stage

- 1. Idea stage (to be completed in [month] [year]; progress: %)
- 2. Prototyping/experiment stage (to be completed in March, 2015; progress: 80%)
- 3. Development completion stage (to be completed in [month] [year]; progress: %)
- 4. Commercialization completed (already delivered: yes / no)

### Conventional technology

[Autoclave molding of UD prepreg]
- Material cost of UD prepreg is high
- Involvement of a specialized engineer is essential in lamination design
- Cutting and lamination of prepreg require manpower and cost
- Autoclave molding takes 4 h or more, not capable of mass production

### New technology

[Press molding of SMC and stampable sheet]
- Material cost is low
- Lamination design is not required, beginner can easily handle
- The only requirement is to measure the material and place it in the metal die
- Press molding takes approx. 1 to 10 min, capable of mass production

### Fiber properties of pitch-based carbon fiber DIALEAD (comparison with conventional material)

- **Thermal conductivity**
  - Pitch: 12 W/mK
  - PAN short (estimate): 6 W/mK

- **Thermal expansion rate**
  - Iron: 1 × 10^-6/°C
  - PAN short: 3 × 10^-6/°C

- **Specific strength**
  - PAN short: 0.6

### Example of application of this technology

Application to various parts in the fields of automobiles, transport and industrial machinery

### Technological challenge, constraints, business plan

Reduction of cost for initial prototyping/examination (incl. metal die cost), mass production and cost reduction of material, accumulation of various data required for design such as fatigue

### Collaborator needed to improve this technology or develop a new technology

In application development, it is preferable to cooperate with a molding manufacturer, automobile part manufacturer, etc.

### Company outline

- **Location**: 1-1-1, Marunouchi, Chiyoda-ku, Tokyo 100-8252 Japan
- **Capital/No. of employees**: 21,503 billion yen / 9,497
- **Overseas base(s)**: United States, Germany, China, Taiwan
- **Product line**: Carbon fiber, prepreg, CFRP, C/C brake
- **Major customers**: (not disclosed)
- **Certification**: ISO 9001 (as a manufacturing plant)

### Inquiries

- **Dept./personnel**: Senior Manager, Masashi Yamashita, Strategy & Marketing Group, Carbon Fiber Products Dept.
- **Contact**: TEL +81-3-6748-7360, E-mail yamashita.masashi@mc.mpi.co.jp
- **Homepage**: http://www.mpi.co.jp/products/industrial_materials/pitch_based_carbon_fiber/index.html
## Company/organization name

### Mitsuya Co., Ltd.

### Subject
Low cost thin-ply carbon fiber reinforced thermoplastic prepreg

### Keyword(s)
Fiber opening and spreading technology, thermoplastic, thin ply

## Point of the proposed technology
Cost reduction by 50%

## Development stage

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Idea stage (to be completed in [month] [year])</td>
</tr>
<tr>
<td>2.</td>
<td>Prototyping/experimental stage (to be completed in [month] [year])</td>
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<tr>
<td>3.</td>
<td>Development completion stage (to be completed in September, 2014)</td>
</tr>
<tr>
<td>4.</td>
<td>Commercialization completed (already delivered: yes / no)</td>
</tr>
</tbody>
</table>

## Conventional technology

- The process in which carbon fibers are impregnated in viscous thermoplastic resins costs high for manufacture of the prepreg.

## New technology

- The technology for opening and spreading of fibers is used to produce the carbon fiber reinforced thermoplastic prepreg at high rate achieving the substantial reduction of the manufacture cost.

## Example of application of this technology

- Engine components for aircraft
- Automotive parts

## Technological challenge, constraints, business plan

- At present the prototype machine is used for production of the prepreg and new investment is required for mass production.

## Collaborator needed to improve this technology or develop a new technology

- The company having the own technology for forming

### Company outline

<table>
<thead>
<tr>
<th>Location</th>
<th>89-1, yamamuro-cho, Fukui-shi, Fukui 910-0108, Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital/No. of employees</td>
<td>307.1 million yen 162</td>
</tr>
<tr>
<td>Overseas base(s)</td>
<td>Hongkong</td>
</tr>
<tr>
<td>Product line</td>
<td>Fabric weaving, dyeing and finishing, manufacture of composite materials</td>
</tr>
<tr>
<td>Major customers</td>
<td>Toray Inc., Asahi Kasei Corporation, Teijin Ltd.</td>
</tr>
<tr>
<td>Certification</td>
<td>ISO 9001, ISO 14001</td>
</tr>
</tbody>
</table>

## Inquiries

<table>
<thead>
<tr>
<th>Contact</th>
<th>TEL +81-776-55-2210</th>
<th>E-mail <a href="mailto:mitsuya-cf@e-mitsuya.jp">mitsuya-cf@e-mitsuya.jp</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Homepage</td>
<td><a href="http://www.e-mitsuya.jp/">http://www.e-mitsuya.jp/</a></td>
<td></td>
</tr>
</tbody>
</table>
Chopped fiber strands are fed to the thermoplastic resin just melted to mix, thereby minimizing fiber breakage and keeping the fiber length long. Keeping the length of carbon fibers long can improve the mechanical strength after mixing with thermoplastic resins useful for weight reduction and higher strength of molded products.

A conventional injection molding machine is difficult to keep the fiber length long. An injection molding machine melts a resin fed from a hopper by rotating a screw to travel forward and is equipped with the venting plastication section for degassing the moisture or gas generated from the resin through the opening at the middle of the heated cylinder. We are at present developing the technology of which the chopped fiber strands are fed through this opening to keeping the fiber length long. The kneaded mixture of the resin and the fibers are extruded through the T-die at the tip of the machine to the sheet, which is pressed with a press die, thus enabling to produce a molded product with a large area which cannot be produced by conventional injection molding.

Example of application of this technology
Small to large components for vehicle and aircraft

Technological challenge, constraints, business plan
Evaluation of the manufacture process and the product properties with the actual component.

Collaborator needed to improve this technology or develop a new technology
Manufacturer for automotive components and aircraft components

Company outline
- Location: 2 Ohne, Kitataki-cho, Ohbu-shi, Aichi, 474-8666 Japan
- Capital/No. of employees: 1.11 billion yen / 168 employees
- Overseas base(s): None
- Product line: Injection molding machine for plastics
- Major customers: Toyota Tsusho Corporation, Japan Steel Works Ltd.
- ISO 9001, ISO 14001 Certification

Inquiries
- Contact: Mikio Nagata, Director, Management Strategy Office
  TEL: +81-562-48-2121
  E-mail: mikio.nagata@meiki-ss.co.jp
- Homepage: www.meiki-ss.co.jp
Inquiries

Yoshiaki Sakai, President,
TEL +81-761-21-6166
E-mail y-sakai@mec-as.co.jp

Homepage http://www.mec-as.co.jp/

Company outline

Location
NJ57-1, Hitotsuharimachi, Komatsu-shi, Ishikawa, 923-0043 Japan

Capital/No. of employees
20 million yen
20 employees

Overseas base(s)
Thailand, China

Product line
Jigs, robotics and control system

Major customers
Komatsu Ltd.

Certification
ISO 9001 (FM 615309)

Inquiries

Dept./personnel
Yoshiaki Sakai, President

Contact TEL +81-761-21-6166
E-mail y-sakai@mec-as.co.jp

Homepage http://www.mec-as.co.jp/

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Homepage http://www.mec-as.co.jp/

Mechatro Associates Co., Ltd.

Subject
Robotics and control system for cutting the fiber reinforced plastic (FRP) composite used in the aircraft and automotive industries

Keyword(s)
Robotics and control system, cutting process, FRP, composite, plastics

Company outline

Location
NJ57-1, Hitotsuharimachi, Komatsu-shi, Ishikawa, 923-0043 Japan

Capital/No. of employees
20 million yen
20 employees

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Company outline

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NJ57-1, Hitotsuharimachi, Komatsu-shi, Ishikawa, 923-0043 Japan

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Homepage http://www.mec-as.co.jp/

Development stage

Joint researcher(s) and their role

Industrial Research Institute of Ishikawa

○ Evaluation of the cutting performance of milling tools

Industrial Research Institute of Ishikawa

○ Optimization of the process conditions in milling the FRP composite with the robotics system

None

Technological challenge, constraints, business plan

・ Application to production of three dimensional parts using a 3D printer and 3D data.

・ The present prototype equipment is integrated with the software and other tools to expand the business opportunity.

Collaborator needed to improve this technology or develop a new technology

Cutting tool manufacturers.

Example of application of this technology

・ Cutting (trimming, drilling of hole) of the CFRP and GFRP composites for the aircraft and automotive components

Conventional technology

New technology

Development of the robotics and control system for cutting FRP composite materials

Milling using the NC machine tool

Milling using the multi-joint industrial robot

High cost in installation of equipment

Requirement of a large space for installation of equipment

Risk that powder chips of FRP composites invade in the sliding surface of the machine

Approximately 30% reduction in the cost for installation of equipment

Approximately 50% reduction in the space for installation of equipment

Reduction of the cost for installation of equipment

Easy to change the layout owe to the compact equipment

Development of the CAD/CAM system for the dedicated robot for cutting

The off-line programing allows for calculating and generating the tool path for trimming the material.

Work can be coordinated with the jig for clamping

In order to prevent interference with the robot, the jig for clamping panel components is operated and closed, linking with the movement of the robot.

Point of the proposed technology

Effect(s)

The robotics and control system for replacing the conventional numerical control (NC) machine tool is provided for cutting the FRP composite and the plastic material. The dedicated CAD/CAM system allows for generating the tool path created from the 3D CAD data. The cost and the space for installation of equipment can be reduced as compared to those for the NC machine tool.

Development stage

1. Idea stage (to be completed in [month] [year], progress: %)

2. Prototyping/experimental stage (to be completed in [month] [year], progress: %)

3. Development completion stage (to be completed in [month] [year], progress: %)

Commercialization completed (already delivered: yes / no)

Collaborator needed to improve this technology or develop a new technology

Cutting tool manufacturers.

Technological challenge, constraints, business plan

・ Application to production of three dimensional parts using a 3D printer and 3D data.

・ The present prototype equipment is integrated with the software and other tools to expand the business opportunity.

Collaborator needed to improve this technology or develop a new technology

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Technological challenge, constraints, business plan

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Collaborator needed to improve this technology or develop a new technology

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Collaborator needed to improve this technology or develop a new technology

Cutting tool manufacturers.

Technological challenge, constraints, business plan

・ Application to production of three dimensional parts using a 3D printer and 3D data.

・ The present prototype equipment is integrated with the software and other tools to expand the business opportunity.

Collaborator needed to improve this technology or develop a new technology

Cutting tool manufacturers.

Technological challenge, constraints, business plan

・ Application to production of three dimensional parts using a 3D printer and 3D data.

・ The present prototype equipment is integrated with the software and other tools to expand the business opportunity.
Point of the proposed technology

Fine dust generated by fabrication of the carbon fiber reinforced polymer (CFRP) composite deteriorates the working environment, possibly creating the health problems among workers. In particular the CFRP composite for the aircraft components has to be manually fabricated using a manual tool generating fine dust. The present dust collector can locally collect the fine dust to prevent it from flying off and protect the worker from being exposed. The present dust collector is small, lightweight, and easy to operate by using only air.

Effect(s)
- Improvement of the work environment (Assurance of no hazard to workers)
- Easy operation (Equipment is small and lightweight)

Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in December 2014; progress: 80%)
4. Commercialization completed (already delivered: yes / no)

Joint researcher(s) and their role
Daido University for assisting the technology development

Conventional technology

- A conventional portable dust collector is bulky and not easy to move, and has to be operated near the site where fine dust is generated, thereby causing interference with the fabrication work.
- A large scale plumbing system has to be installed for a large dust collector requiring big investment for the facility and making a change of the layout difficult.
- When the dust collector is unavailable, the protective cloth, masks, goggles, and gloves are required for protection of workers reducing the workability and increasing the burden to the workers and requiring the special facility such as the dedicated space for work and air showers.

New technology

- A small and light weight dust collector allows the workers to carry it by attaching to the body and thus effectively collect fine dust at any location and thus keeping the work environment clean. (Workers need only minimum protection).
- The worker can dispose of the harmful fine dust without being exposed.
- Recording of the date, the type of fabrication work, an amount of fine dust collected, and the name of worker on the dust collection bag allows for good work management.

Example of application of this technology

Sites with fine dust generated in fabrication of the CFRP composite

Technological challenge, constraints, business plan
Identification of market needs for the collection of dust generated in fabrication of not only the CFRP composite but also various materials in industry.

Collaborator needed to improve this technology or develop a new technology
Research organization for investigating the effects of the CFRP composite to human health

Company outline

Location
HQ: 446-268 Shimokagamida, Hanaki, Togo-cho, Aichi-gun, Aichi, 470-0162 Japan
R&D Center: 168, Shimenomachi Minami, Kanazawa, Ishikawa, 920-0059 Japan

Product line
Manufacture and sales of machine tool and industrial machine

Certification
ISO 9001 in 2008, ISO 14001 in 2004

Capital/No. of employees
305 million yen
115 employees

Overseas bases
Beijing China

Major customers
Trading companies for machine tool, electronic component manufactures

Inquiries
Hideya Tomiyama, Sales Director, Sales Department
Contact
TEL +81-561-38-2101
E-mail htimiyama@uht.co.jp

Homepage
www.uht.co.jp
Subject: A work environment improving system capable of cooling with wind and dust collection in drilling a hole in the carbon fiber reinforced polymer composite

Keyword(s): Drilling of hole, dust collector

Point of the proposed technology:

In drilling a hole on the CFRP composite the conventional drill bit allows for drilling only a few tens of holes before failure. There is also a problem of handling fine dust generated in drilling. The new system with a dedicated special drill bit and the drilling equipment allows for drilling more than 1,000 holes without failure and prevents fine dust generated from flying in the area, and thus substantially improving the work environment.

More than 1000 holes can be drilled without failure.
More than 99.5% of dust can be collected.

Development stage:

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in September 2011; progress: 100%)
4. Commercialization completed (already delivered: yes / no)

Joint researcher(s) and their role:

Notoalloy Co, Ltd, for development of the tool materials
BTT Co., Ltd. for fabrication and polishing of the tool
Nagoya Municipal Industrial Research Institute for evaluation of the properties of the tool
Daido University for assisting the technology development
Gifu University for evaluation of the quality of holes (no damage, smooth surface)

New technology:

- An exchangeable drill bit sustaining to drill more than 1000 holes without failure.
- A hollow core drill bit allowing the dust extraction from the center of core.
- The dust collection efficiency of the dust collector is greater than 99.5%.
- The number of drill bit rotation and the driving speed of the drill can be freely adjusted as needed depending on the various conditions such as materials.

Example of application of this technology:

Fabrication of the composite such as the CFRP composite

Technological challenge, constraints, business plan:

Optimization of the size and functionality of the equipment for practical use. Reduction of the manufacture cost before commercialization

Collaborator needed to improve this technology or develop a new technology:

Companies for development of a new actuator for further reduction of the size and the weight of the integrated system.

Company outline:

- Location:
  - HQ: 446-288 Shimotakamida, Haruki, Togo-cho, Aichi-gun, Aichi, 470-0162 Japan
  - R&D Center: 168, Shimenomachi Minami, Kanazawa, Ishikawa, 920-0059 Japan

- Capital/No. of employees:
  - 305 million yen
  - 115 employees

- Product line:
  - Manufacture and sales of machine tool and industrial machine

- Overseas base(s):
  - Beijing China

- Major customers:
  - Trading companies for machine tool, electronic component manufactures

- Company certification:

- Inquiries:
  - Department/personnel:
    - Hideya Tomiyama, Sales Director, Sales Department
  - Contact:
    - TEL: +81-561-38-2101
    - E-mail: htomiyama@uht.co.jp
  - Homepage:
    - www.uht.co.jp
RAPIIT Co., Ltd.

**Subject**
Use of sandwich molding for cost reduction and improvement of the strength in the manufactured part

**Keyword(s)**
Sandwich pattern technology, press molding

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<table>
<thead>
<tr>
<th>Company/organization name</th>
<th>RAPIIT Co., Ltd.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subject</strong></td>
<td>Use of sandwich molding for cost reduction and improvement of the strength in the manufactured part</td>
</tr>
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</tbody>
</table>

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The major intermediate spacer material in the conventional sandwich molding is foamed polyurethane, paper, and an aluminum honeycomb. A thin-wall sandwich pattern with good strength in any direction is developed using the CFRP composite and applied in press molding to produce the three dimensional shape products at low cost.

**Development stage**

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Joint researcher(s) and their role</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Idea stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
</tr>
<tr>
<td>2. Prototyping/experimental stage (to be completed in September 2014; progress: 30%)</td>
<td></td>
</tr>
<tr>
<td>3. Development completion stage (to be completed in [month] [year]; progress: %)</td>
<td></td>
</tr>
<tr>
<td>4. Commercialization completed (already delivered: yes / no)</td>
<td></td>
</tr>
</tbody>
</table>

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**Conventional technology**

A thick single prepreg has to be used for increasing the strength of the molded product, resulting in an substantial increase of the material cost.

**New technology**

Optimization of the shape and the height of the sandwich pattern in the intermediate spacer material can substantially increase the strength of the molded product in any direction and drastically reduces the material cost. The material for the intermediate layer is not particularly limited, and a stampable sheet can be used.

---

**Example of application of this technology**

- Automobile components, aircraft components, general industrial components

**Technological challenge, constraints, business plan**

The process in which the H-shaped pattern is sandwiched between two prepreg sheets and thermally bonded by pressing is under investigation. The prepreg sheet with thickness of 5T is used to give enough strength in the large area of the molded product. Molding and assembly is under way within the company.

A thick single prepreg has to be used for increasing the strength of the molded product, resulting in an substantial increase of the material cost.

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**Company outline**

- **Location**: 50-19 Oseg, Aakaiwa-shi, Okayama, 709-0717 Japan
- **Capital/No. of employees**: 10 million yen, 30 employees
- **Product line**: Manufacture of the automotive prototype components using a metal sheet; Manufacture of the molded prototype parts using the composite
- **Major customers**: Fiber manufactures, resin manufactures, automotive component manufactures
- **Certification**: 

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**Inquiries**

- **Dept./personnel**: Takuro Shigetomo, Representative director
- **Contact**: TEL +81-86-955-9123, E-mail rapiit-shigetomo@rapiit.com
- **Homepage**: [http://www.rapiit.com](http://www.rapiit.com)

---

Optimization of the shape and the height of the sandwich pattern in the intermediate spacer material can substantially increase the strength of the molded product in any direction and drastically reduces the material cost. The material for the intermediate layer is not particularly limited, and a stampable sheet can be used.
RIKEN VITAMIN CO., LTD.

**Subject**
Improvement of the flexural modulus and the flexural strength of carbon fiber reinforced thermoplastic composite

**Keyword(s)**
Maleic anhydride modified polypropylene, improvement of adhesion

<table>
<thead>
<tr>
<th>Point of the proposed technology</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maleic anhydride modified polypropylene (PP) which is used in the fiberglass-PP composite for improving the adhesion is applied to the carbon fiber-PP composite for improving the adhesion at the interface between carbon fibers and PP and thus improving the mechanical properties.</td>
<td>Improvement of the flexural modulus and the flexural strength</td>
</tr>
</tbody>
</table>

**Development stage**

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in April 2015; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes)

**Joint researcher(s) and their role**
None

**Conventional technology**

Effects of Rikeaid MG-400P to the fiberglass-PP composite

**New technology**

![Graph showing flexural modulus and flexural strength](image)

**Example of application of this technology**
No data in the carbon fiber reinforced thermoplastic polymer (CFRTP) composite yet. Plan to apply to the automotive components of CFRTP.

**Technological challenge, constraints, business plan**
Accumulation of data in use of the CFRTP composite from sales

**Collaborator needed to improve this technology or develop a new technology**
Manufactures of the CFRTP compound, manufactures of CFRTP products, carbon fiber manufactures, research organization for evaluating the properties of the interface between carbon fibers and the resin.

**Company outline**

<table>
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<tr>
<th>Capital/No. of employees</th>
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<td>2.537 billion yen</td>
<td>China, Malaysia, Singapore, Germany, US, Taiwan, etc.</td>
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<tr>
<td>2-9-18, Misaki-cho, Chiyoda-ku, Tokyo, 101-8370 Japan</td>
<td>China, Malaysia, Singapore, Germany, US, Taiwan, etc.</td>
</tr>
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</table>

**Company technology**
None

**Joint researcher(s) and their role**
None

**Collaborator needed to improve this technology or develop a new technology**
Manufactures of the CFRTP compound, manufactures of CFRTP products, carbon fiber manufactures, research organization for evaluating the properties of the interface between carbon fibers and the resin.

**Company/organization name**
RIKEN VITAMIN CO., LTD.

**Subject**
Improvement of the flexural modulus and the flexural strength of carbon fiber reinforced thermoplastic composite

**Keyword(s)**
Maleic anhydride modified polypropylene, improvement of adhesion

**Inquiries**
Dept./personnel Koji Kanehara, Manager, Chemicals development department
Contact TEL: kou_kanehara@rike-vita.co.jp / ryo_ishii@rike-vita.co.jp
Homepage [http://www.rikenvitamin.com/](http://www.rikenvitamin.com/)
Subject: Technology for evaluating the impact strength of various composites

Keyword(s): Evaluation of properties, impact strength, fracture toughness, energy absorption

### Point of the proposed technology

- Use of the split Hopkinson pressure bar (SHPB) method allows for accurate measurement and evaluation of various properties of the composite at high strain rates.
- The strength such as adhesion strength and energy absorption characteristics critical for application to vehicle parts can be measured.

### Development stage

1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in [month] [year]; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)
4. Commercialization completed (already delivered: yes / no)

### Conventional technology

- The drop weight impact test and the Charpy impact test cannot accurately measure the properties of the composite at high strain rates because of multiple reflections of the stress wave generated within the test machine.

### New technology

- Use of the SHPB method allows for the accurate measurements of material properties at high strain rates without effects of the multiple reflections of the stress waves generated within the test machine.

### Example of application of this technology

- Evaluation of the impact strength at adhesively bonded joints
- Evaluation of the characteristics of the impact energy absorbing materials

### Collaborator needed to improve this technology or develop a new technology

RETEX CO., LTD.

Subject: Manufacture of fiberglass reinforced plastic (FRP) composite by resin transfer molding (RTM)
Keyword(s): Fiberglass reinforced plastic (FRP), resin transfer molding (RTM)

Point of the proposed technology:
Reduction of the cycle time and formation of the uniform wall thickness in resin transfer molding (RTM).

Effect(s):
Cost reduction by 30%

Development stage:
1. Idea stage (to be completed in [month] [year]; progress: %)
2. Prototyping/experimental stage (to be completed in March 2014; progress: %)
3. Development completion stage (to be completed in [month] [year]; progress: %)

Joint researcher(s) and their role:
None

Conventional technology:
- Subject to the operator’s skill, resulting in wide variation of the quality of products.
- Poor work environment
- Difficult for mass production

New technology:
- Consistency in the quality of products because of use of the mold set
- Good work environment because of little exposure to the resins
- Suitable for the medium volume production
- A new resin transfer molding system in which the formwork set and drain valves for the preform are used is developed to substantially reduce the cycle time (about 1/3 of conventional cycle time) from injection to demolding.

Example of application of this technology:
Interior components for aircraft, interior and exterior components for automobile

Technological challenge, constraints, business plan:
Cost reduction in the mold set for mass production

Collaborator needed to improve this technology or develop a new technology:
University having knowledge of FRP related technology

Company outline:
- Location: 444-6 Hisakane, Kamiichimachi, Nataniikawa-Gun, Toyama 930-0381 Japan
- Capital/No. of employees: 20 million yen / 20 employees
- Product line: Manufacture and fabrication of fiberglass reinforced plastics (FRP) composites
- Certification: ISO 9001 in 2008
- Overseas base(s): None
- Major customers: Yokohama Rubber Co., Ltd., Jamco Corporation

Inquiries:
- Dept./personnel: Masayoshi Hori, General Manager
- Contact: TEL +81-76-472-5620 E-mail retex-co@ma.net3-tv.net