<table>
<thead>
<tr>
<th><strong>Company Name</strong></th>
<th>Super Resin, Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CEO</strong></td>
<td>Yoshihiko Katsuyama</td>
</tr>
<tr>
<td><strong>Established</strong></td>
<td>25 Nov 1957</td>
</tr>
<tr>
<td><strong>Number of Employees</strong></td>
<td>150 people</td>
</tr>
<tr>
<td><strong>Scope of Business</strong></td>
<td>Fabrication &amp; processing of advanced composites materials with a focus on carbon fiber reinforced plastics (CFRP). Research/production/distribution of CFRP components for aerospace, aircraft, semiconductor manufacturing equipment, industrial machines, automobiles, etc.</td>
</tr>
<tr>
<td><strong>Concept</strong></td>
<td>We are the Composite Tailors.</td>
</tr>
<tr>
<td><strong>Headquarter Address</strong></td>
<td>2283 Sakahama, Inagi, Tokyo 206-0822 Japan</td>
</tr>
<tr>
<td><strong>Telephone Number</strong></td>
<td>+81 42 331 3611</td>
</tr>
<tr>
<td><strong>Fax Number</strong></td>
<td>+81 42 331 3100</td>
</tr>
<tr>
<td><strong>Website</strong></td>
<td><a href="http://www.super-resin.co.jp">www.super-resin.co.jp</a></td>
</tr>
</tbody>
</table>
Global Locations

Sakahama Headquarters
Engineering / R&D Lab / Factory for Prototype
2283 Sakahama, Inagi, Tokyo 206-0822 Japan

Tsukui Advanced Composite Factory
3512 Nagatake, Midori-ku, Sagamihara, Kanagawa 252-0154 Japan

Ningbo Super Resin, Inc.
197 Shanshan Rd., Wangchun Industrial Zone, Haishu District, Ningbo, Zhejiang Province 315177 P.R. China

Sakahama since 1964
Tsukui since 2003
Ningbo since 2011
Company History

1957  Established Super Resin, Inc. in Shibuya, Tokyo
1964  Established Sakahama Factory in Inagi City, Tokyo
1965  Moved the Head Office to Sakahama Factory
1986  Completed construction of ACM Plant at Sakahama Factory
2002  Obtained JIS Q 9001:2000 certification for Sakahama Head Office and Advanced Composite Factory
2003  Started operation of Tsukui Advanced Factory in Tsukui, Kanagawa
2004  Obtained JIS Q 9001:2000 (expanded) certification for Sakahama and Tsukui Factory
2006  Obtained JIS Q 9100:2004 certification for Sakahama and Tsukui Factory
2010  Established Resin R&D Department and Process R&D Department
2011  Established Ningbo Super Resin as a subsidiary of Super Resin, Inc. in China
2016  Completed construction of Machining Plant and Large Component Assembly Plant at Tsukui Factory
2017  60th anniversary of establishment
Our Business

Manufacturing Process of Composite Material (in case of fiber reinforced plastic)

The business scopes of Super Resin related to composite industry
Our Business

Business Flow of Super Resin

In the general composite processing industry, manufacturers just process with the drawings from customers. However, in Super Resin, we will not only do **high quality manufacturing**, but we also provide **design and development solutions** based on our 60 years of heritage and accumulated knowledge.

At Super Resin, we will respond to your “**I want something like this...**”
In addition to high quality composite material product design and manufacturing technology, we propose the optimum solution by high level design technology covering radio wave, mechanism and optical design.
## Our Products

### Industrial Machinery
- Industrial Robot Arm
- LCD / OLED Display Manufacturing Equipment
- Flywheel
- Semiconductor Component Mounting Apparatus

### Aviation & Aerospace
- Satellite Components (Bus Structure, Optical Bench, Antenna, Solar Cell Substrate)
- Aircraft Component (Wing Components, Tail Wing Components, Fuse Lodge Parts)

### Defense
- Radar Dome (for Navel, Ground and Aircraft Antenna)
- Components for Defense Equipment

### Transportation
- H₂ Fuel Tank
- Railway
- Exterior Aerodynamic Components
- Specialty Custom Products

### Electronic
- Laptop Components
- Mobile Phone Components
- AV components

### Others
- Architecture (Symbol of Osaka Expo 1970)
- Drone
Space Product Examples

- **AKEBONO**
  - Loop Antenna

- **HALCA**
  - Sub Reflector

- **SUZAKU**
  - HXD Cover

- **AKARI**
  - 6K Shield

- **ASNARO**
  - Lens Barrel, Support Structure, SAP Substrate

- **GEOTAIL**
  - X Band Horn Antenna
  - S Band Helical Antenna

- **HAYABUSA**
  - Radar Dome, Tank Supporter

- **KAGUYA**
  - Antenna Support Structure

- **KIZUNA**
  - Sandwich Panel for Body
Antenna Heritage

Parabolic Antenna Main Reflector
  CFRP Skin / CFRP Flexible Honeycomb (eg. for CPR); CFRP Skin / Al Honeycomb (eg. for ETS-VII)

3-axis Antenna Design & Manufacturing (eg. for Hayabusa-I)

Horn Antenna (eg. for Hayabusa-II)

CFRP Structure for Mash Antenna (eg. for ETS-VIII)

Planar Antenna (eg. for Hayabusa-II)

Radial Line Slot Array Antenna (eg. for Hayabusa-II)

Helical Array Antenna
  (eg. for Quasi-Zenith Satellites, Mercury Exploration Satellites)

Microstrip Array Antenna (eg. for Hayabusa-I, SAR)

Waveguide (eg. for Hayabusa-I)
Solar Array Panel Substrate Heritage

Achievements

Over **500** substrates manufacturing experience

1. **Commercial Satellite Substrate**
   - Size: 3100mm*2400mm, CFRP Skin / Alumni Honeycomb

2. **Small-Sized Substrate**
   - Size: 1300mm*900mm, CFRP Skin / Alumni Honeycomb

3. **Substrate for Hayabusa-II**
   - Size: 1400mm*1360mm, CFRP Skin / Alumni Honeycomb

4. **Substrate for ASTRO-H SAP**
   - Size: 2500mm*1350mm, CFRP Skin / Alumni Honeycomb

etc.
The satellite structures which Super Resin worked on were able to meet the strict requirement specification peculiar to the space environments. Many satellites with our components have been still operating in orbit. From structural design with low thermal expansion composite to precise molding, processing and assembly, we promote consistent development toward realization of customers’ requests.

**example 1  High precision assembly of the space telescope**  
Design and manufacture CFRP telescope barrel and secondary mirror support that satisfies optical requirements

**example 2  High precision molding of remote-sensing antenna reflector**  
Low thermal expansion CFRP facesheets with CFRP honeycomb core achieved extremely high mirror surface accuracy of a large reflector close to 3,000 mm diameter

**example 3  Low thermal expansion orientation design of X-ray detector**  
Eliminate thermal expansion difference between detector structure and satellite by low thermal expansion CFRP design
Radar-dome Products

Radar-dome Analysis and Manufacturing Technology of Super Resin

Super Resin has delivered a large quantity of radar-dome products from ground installing type to aircraft installing type since foundation in 1957. We provide optimum radar-dome products from the viewpoint of radio waves, structure and manufacturing.
Radio Wave Solution Example

Radar Dome

R&D Theme

The radar dome protects the antenna from natural environment such as wind, rain, sand, sunlight, and prevents contact between the mobile antenna and human beings. As radars became more and more sophisticated, it was requested from our customers to realize a radar dome with higher radio transmission rate at a lower cost.

The Key to A Solution

Optimal Design Combing Radio Analysis and Structural Analysis Technology

We acquired physical property data by using a new low dielectric glass fiber material instead of conventional E glass fiber. In addition, we designed an optimum radar dome structure that combines reduction of radio wave loss and cost reduction by radio wave analysis and structural analysis.

Results

By applying new materials and optimizing the structure, we realized a low cost radar dome with improved radio wave permeability. We will promote consistent development toward realization of customers’ desires, not only radar dome manufacturing, but also radio wave design supporting and solutions proposal.

Application of New Materials

![Graph showing improved dielectric constant](image)

**Improved by 20% in dielectric constant***

* Loss in dielectric is proportional to frequency $f$, relative dielectric constant $\varepsilon_r$, dielectric loss tangent $\tan\delta$. From this, it is important to lower the dielectric loss $\varepsilon_r$ together with the dielectric loss tangent.

Structural Optimization

![Structural comparison](image)

By setting the quasi-random distribution structure from the parallel distribution structure, we succeeded to reduce the radio wave loss.
R&D Capabilities

R&D Solutions

Fundamental Technology
- Special Resin Formulation
- Resin Compound Testing, Analysis and Reformulation
- Composite Degassing Process

Product Development
- Structural Design
- Radio Wave Characterizes Analysis
- Thermal Analysis

Engineering & Process
- Composite Structure Optimization
- Anisotropic Design
- Mechatronics
R&D Capabilities

Design & Analysis

Resin R&D
Matrix Resin Type
Polyimide Resin: Tg 250-350°C
Cyanate ester resin: Tg 200-300°C
Epoxy resin: Tg 130-180°C
Polyester resin / Bismaleimide resin
Phenolic resin / Fluoro resin

Resin Functionality Granting Technology
Heat resistance control technology / Adhesion technology / High toughness technology /
Low dielectric constant technology / Flame retardancy technology /
Filler dispersion technology / Cure reaction rate control technology / Foaming technology /
Low moisture absorption (water absorption) technology / Weather resistance technology

Proprietary Resin
Snap Curing Resin: for all fields / Weather Resistance Resin: for automobile field /
Heat Resistant Resin: for aviation & aerospace field / Flame Retardant Resin: for electronic field
R&D Capabilities

R&D Equipment

**Development & Design Software**
- Finite element analysis
- Static load analysis / Eigen value analysis /
- Frequency response analysis / Thermal analysis
- Electromagnetic field analysis
- Antenna analysis / Radar dome analysis / EMC analysis

**Equipment for Resin / Composite Material Process Development**
- Dynamic viscoelasticity measuring device (DMA) / Differential scanning calorimeter (DSC)
- Differential thermal analyzer (TG-DTA) / Thermomechanical analyzer (TMA)
- Rheometer / Fourier transform infrared spectrophotometer (FT-IR)
- Spectrophotometer / Continuous fiber reinforced 3D printer (under development)

**Composite Evaluation Device**
- Degassing evaluation equipment (ASTM E595)
- Ultrahigh precision thermal deformation evaluation device | Accuracy: ~10 bpm / K
- Moisture absorption deformation evaluation device | Accuracy: ~1 ppm
- Thermal conductivity measuring device (ASTM E1530)

Proprietary Equipment

- Instron universal testing machine: 55R-4505 (100kN)
  - 5982 (100kN) ~350°C with constant temperature test tank
- Acoustic emission / Scanning electron microscope
Manufacturing Capabilities

**Manufacturing Method**

**ACM Molding**
- Autoclave molding
- RTM molding / VaRTM molding
- Filament winding molding
- Press forming / Vacuum forming
- Hand lay-up forming

**HTC Molding**
- HTC: High Throughput Composites
- Proprietary CFRP mass production technology

**Machining**
- Ultrahigh precision machining (accuracy ±0.01/1000mm)
- Mass production machining

**Painting**
- Drying integrated painting room (34 m²)
- Clear paint / Mat paint
- Screen printing / Pad printing
Manufacturing Capabilities

**Molding & Processing Capacity**

**ACM Molding**
- Autoclave molding
- RTM molding / VaRTM molding
- Filament winding molding
- Press forming / Vacuum forming / Hand lay-up forming

**HTC Molding**
(HTC: High Throughput Composites)
- Proprietary CFRP mass production technology

**Mold Design & Fabrication**
- GFRP type / AFRP type / resin block type

**Machining**
- Ultrahigh precision machining (accuracy ±0.01/1000mm)
- Mass production machining

**Painting**
- Clear paint / Mat paint
- Screen printing / Pad printing
Manufacturing Capabilities

**Production Equipment**

**Sakahama Headquarters / Prototype Factory**

ISO 9001 / 9100 certified factory

Thermal baking and degassing vacuum chamber

Molding equipment

Autoclave: 3 units ① Φ1.2 × 2.8m ② Φ1.4 × 1.2m ③ Φ2.0 × 3.0m

Filament winding device φ1000 × 5000mm

Vacuum press machine / Automatic laminating robot

Clean room for molding (Class 100,000) 73.5 m²

<table>
<thead>
<tr>
<th>Machine equipment</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portal type machining center</td>
<td>OKUMA</td>
</tr>
<tr>
<td>Small machining center</td>
<td>Mazak</td>
</tr>
<tr>
<td>5 axis machining center</td>
<td>Mazak</td>
</tr>
<tr>
<td>NC lathe</td>
<td>OKUMA</td>
</tr>
<tr>
<td>NC milling machine</td>
<td>ENSHU</td>
</tr>
</tbody>
</table>

Drying integrated painting room 34 m³

Clear paint / Mat paint

Silk screen printing / Pad printing (plate size up to 100 × 200)
Manufacturing Capabilities

**Production Equipment**

**Tsukui Advanced Composite Factory**

ISO 9001 / 9100 certified factory

Molding equipment

Autoclave: 3 units

④ Φ3.5 × 6.0m

⑤ Φ2.5 × 6.0m

⑥ Φ1.6 × 2.5m

Clean room for molding (Class 100,000) 138m²

Clean room for molding (Class 100,000) 290m²

Clean room for molding (Class 100,000) 78m²

Machine equipment

Plano miller | Mitsubishi

Size [Accuracy] 3500 × 8000 × 900mm [±0.02/300mm]

Portal type machining center | OKUMA

2500 × 5000 × 1200mm [±0.01/1000mm]

Small machining center | Makino

600 × 1200 × 500mm

NC router (3 heads) | HEIAN

600 × 6000mm × 3EA [±0.05mm each axis]

Universal lathe | Mazak

Φ300 × 600mm

Clean room for satellite related products (Class 100,000) 222m²

※ h10m part 65m²
Manufacturing Capabilities

Production Equipment

Ningbo Factory
ISO 9001 / 13485 certified factory
Molding equipment
Autoclave: 1 unit Φ2.5×5.0m
RTM (Resin Transfer Molding) equipment
HTC (High Throughput Composite) equipment

<table>
<thead>
<tr>
<th>Machine equipment</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portal type machining center</td>
<td>3000 × 5000mm</td>
</tr>
<tr>
<td>Small machining center</td>
<td>500 × 2000mm</td>
</tr>
<tr>
<td>Small machining center</td>
<td>500 × 800mm</td>
</tr>
</tbody>
</table>

Quality Control

Arm-type 3D measuring machine
Laser tracker
Portal 3D measuring device
Electronic horizon sensor
Ultrasonic testing machine
Digital microscope
3D handy scanner
CNC vision measuring system
We are the Composite Tailors.