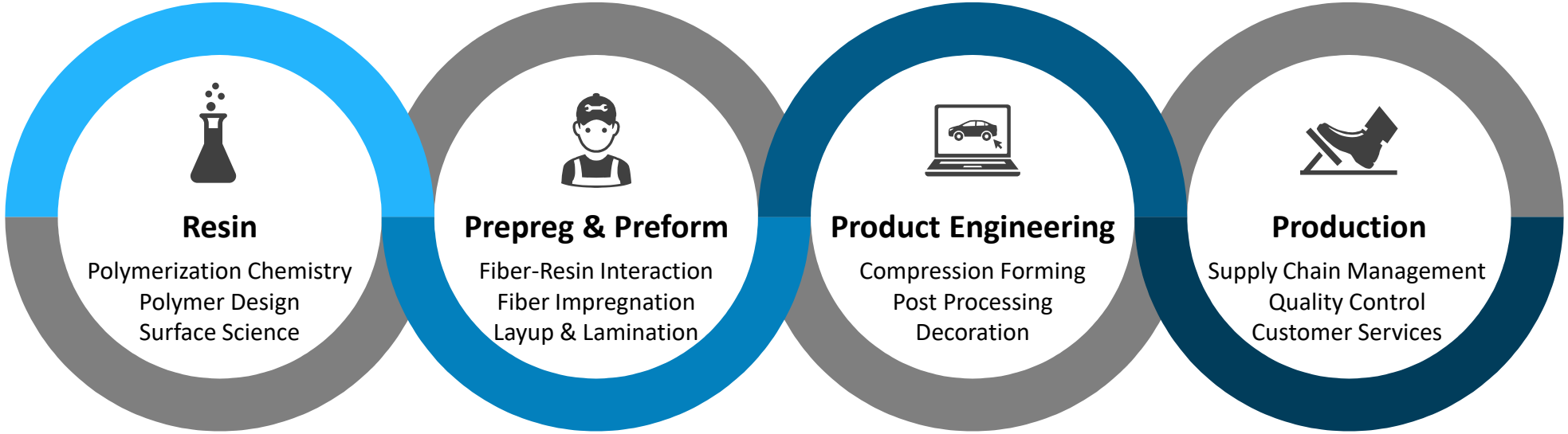
Global
Manufacturing
Solutions

Advanced Thermoplastic Technology

TECHNICAL KNOWLEDGE MANAGEMENT

Complete Services & In-Depth Knowledge Offering

- The traditional model for designing with composites is highly fragmented, with specific knowledges and skills compartmented between several industries with little interaction.



- GMS team has knowledge of all steps involved in composite part manufacturing, from raw material selection and modification to part finishing, through prepreg manufacturing, preform design and part forming.

MATERIAL CUSTOMER APPLICATION

DAILY APPLICATION

Products focus on personal daily applications. Implement composite benefits to daily life

- Headband
- Flat panel
- Support

AUTOMOTIVE

Advanced material technology to fit safety protocols and weather-resistant with outstanding strength

- Door cover
- Car mark
- Gas hatch
- Heat shield

SPORTING GOODS

Concentrate on fatigue resistance/durability and functional performances

- Shoe plate
- Shank
- Golf head
- Bike frame
- Bike fork
- Crank
- Brakes handle

ELECTRONIC DEVICES

Provide cosmetic focus with flexible strength requirement. Meet the functional specification

- Laptop cover
- Desktop cover
- Mobile accessories
- Keyboard
- Earphone’s cone

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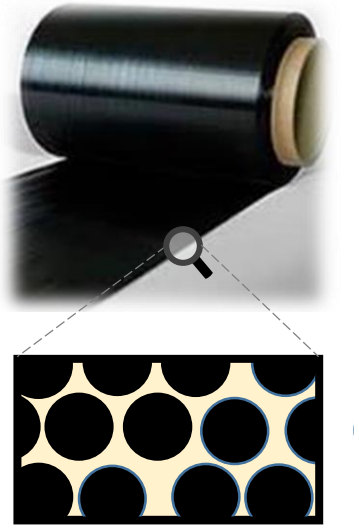
Continuous Fibers Reinforced Thermoplastic Process Walkthrough

FROM RAW MATERIALS TO FINISHED PART

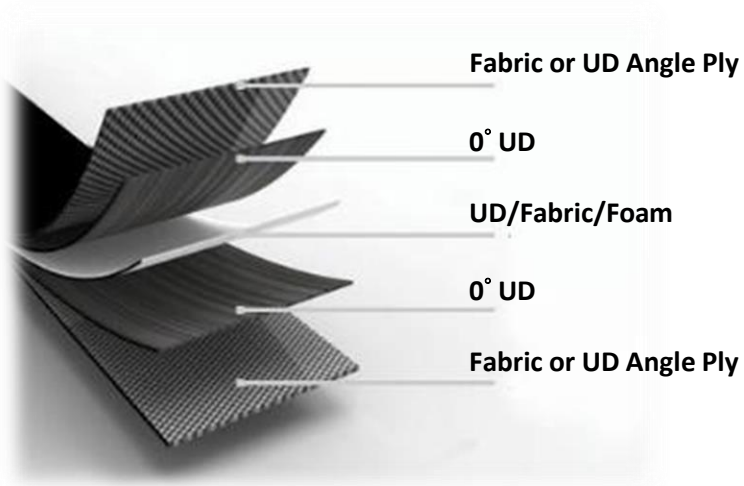
Simplified Process From Start to Finish

FIBER
Toray/Mitsubishi
Teijin/Formosa

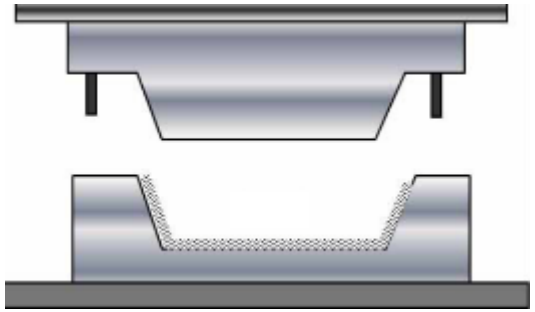
MATRIX
Polymer
COREX D/C/U/X/XE/XI Series



IMPREGNATION PROCESS = PREPREG
Fiber Spreading + Resin
Dimension: 1000 x 1000mm



LAMINATION & PRE-CUT
Stack of Prepreg
Angle sequence design (Layup)
Pre-Cut = Wider/Longer Pattern



MOLDED PART
Consolidation
Temperature/Pressure/Time

EXCLUSIVE MATRIX Series (2/2)

	U	D	C	X	XE	XI
Fabric Forming Temp.	**190˚C**	**220˚C**	**270˚C**	**300˚C**	**340˚C**	**350˚C**
UD Forming Temp.	180˚C	200˚C	220˚C	280˚C	300˚C	310˚C
Highest Operation Temp.	105˚C	100˚C	125˚C	170˚C	195˚C	200˚C
Lowest Operation Temp.	-40˚C	-40˚C	-40˚C	-100˚C	-100˚C	-100˚C

MATERIAL TESTING

Utilizing physics & chemical Foundations to understand material behavior, generate mathematical models unlocking innovation and measuring the resulting improvements

MECHANICAL TESTER

Applies controlled deformation at a defined rate to a sample and measures the resultant forces. Used to characterized material mechanical properties such as tensile, compressive, shear and flexural moduli and strengths, Poisson's ratios, creep…

TGA & DSC

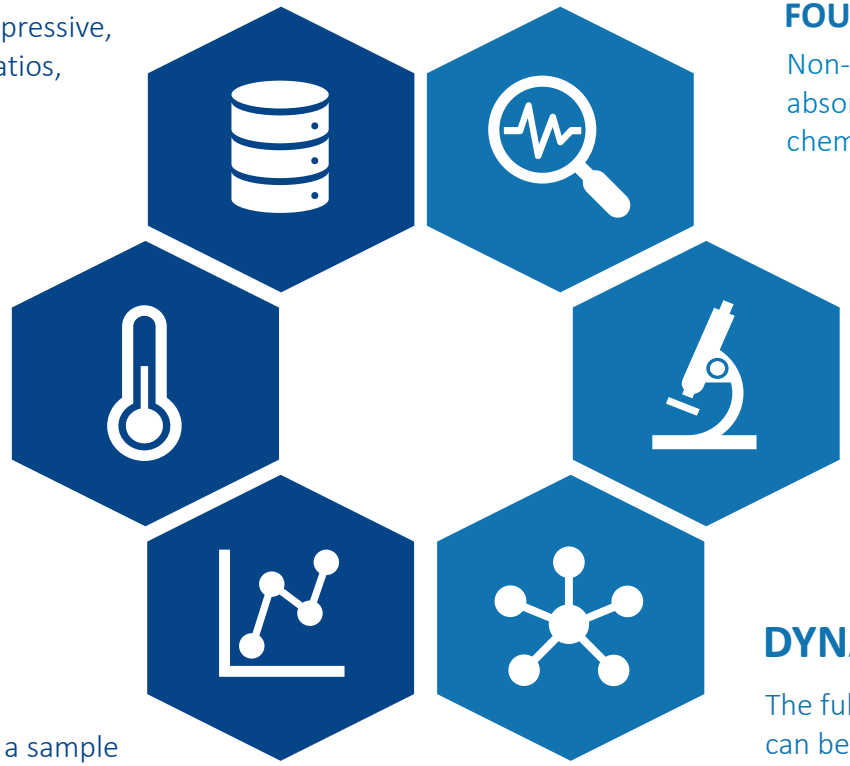
THERMOGRAVIMETRIC ANALYZER
DIFFERENTIAL SCANNING CALORIMETRY

TGA measures the mass of a sample as a function of time and temperature giving information about degradation temperature and kinetics.
DSC measures the changes in heat capacity of a sample, giving information about thermal transitions (glass transition, melting, crystallization)

DMA

DYNAMIC MECHANICAL ANALYZER

Applies sinusoidal torsional deformations to a sample to extract dynamic properties as a function of deformation rate and temperature. Provides information on elasticity
and dampening properties of solids as well as viscosity of complex fluids such as polymer melts.



FTIR

FOURIER-TRANSFORM INFRARED SPECTROSCOPY

Non-destructive technique used to obtain the infrared absorption spectrum of a sample, giving information about its chemical composition.

OPTICAL MICROSCOPY

The standard method to identify product inner structure. Captured by normal, photosensitive cameras to generate a micrograph.
Automatic ultra-fine polishing of the sample cross section to produce high resolution, low artefact micrographs.
Several optical filters and computer treatment of the image.

DYNAMIC RHEOMETER

The full rheological profile of viscoelastic fluids (polymer melts) can be obtained by shearing the fluids and measuring the resulting stress and relaxation times. The complex viscosity of the fluid can then be measured at different frequency (shear rates) and temperatures to produce a full rheological profile by using TTS (time-temperature superposition).

CARBON FIBER UNIDIRECTIONAL - CFUD

UNI-DIRECTIONAL FIBER [CARBON]

Dimension: 1000 x 1000mm
Fiber Weight: 80 – 150 gsm.
Resin Content: 40%
Thickness: 0.09 – 0.19mm/ply

MULTI-ANGLE DESIGN

Each ply of the structure can have its own fiber type and orientation to optimize stiffness and strength in the directions that matters

ULTRA-THIN

Our typical UD sheets are only 0.09mm thick. This enhance the freedom of design by allowing more fiber angle variation in a laminate.
It also allows the production of thinner and lighter parts.

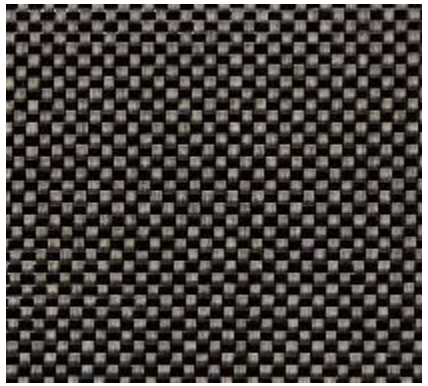
Unidirectional prepregs are characterized by extremely high modulus and strength in the fiber direction (0º or longitudinal direction).
However the properties are quite poor across the fibers (90º or transversal direction).
This conundrum is solved by adding plies having different fiber directions to achieve a more isotropic structure. Cross-plies (0º and 90º plies are often combined to create a structure with high properties in both longitudinal and transversal directions

Property	Unit	C	D	X	XE	XI	U
Flammability	UL94	V1	V1/V0	V1/V0	V0	V0	TBD
Tensile Modulus 0º	GPa	120	105	116	128	123	100
Tensile Strength 0º	MPa	1930	1978	1788	2028	2037	TBD
Poisson's Ratio 0º		0.326	0.360	0.339	0.386	0.347	TBD
Tensile Modulus 90º	GPa	6.45	6.30	6.95	6.94	7.30	57 (0/90º [2])
Tensile Strength 90º	MPa	19.1	30.7	25.7	40.6	78.8	TBD
Poisson's Ratio 90º		0.017	0.022	0.017	0.020	0.022	TBD
In-Plane Shear Modulus	GPa	2.42	2.67	2.89	3.05	3.48	TBD
In-Plane Shear Strength	MPa	40.4	42.7	47.8	54.5	68.3	TBD
Flexural Modulus 0º	GPa	112	99	110	118	122	100
Flexural Strength 0º	MPa	1420	1347	1440	1631	2013	TBD
Interlaminar Shear Strength 0º (SBS)	MPa	59.5	63.8	69.5	66.1	98.8	TBD

UD composites mechanical properties comparison (different resin system)

3K CARBON FABRIC

3K Plain fabric



Max width: 1000mm
Fiber Weight: 200 – 220gsm.
Resin Content: 40%
Thickness : 0.22mm/ply

3K Twill fabric

3K fabrics are commonly referred as being equivalent to cross-ply (0/90) UD structures. In reality, the strength and modulus of a fabric is significantly lower than a cross-ply UD structure, due to the non-random distribution of fiber, weaving effect and fabric deformation, all contributing to a reduction in effective modulus and strength.
There is also a limitation in layup design compared to when UD is used.
However, 3K fabric are often used as outer layers of a laminate for their highly recognizable pattern that has become synonymous with performance.

	XE UD, FVF=50%	XE 3K plain, FVF=50%
FAW (g/m^2)	80	220
Ply thickness (mm)	0.08	0.22
Flexural Modulus 0^o (GPa)	118	47
Flexural Strength 0^o (MPa)	1630	750
Flexural Modulus 90^o (GPa)	7.1	47
Flexural Strength 90^o (MPa)	82	750
Flexural Modulus $[(0/90)_3]_s$ (GPa)	**78**	**47**
Flexural Strength $[(0/90)_3]_s$ (MPa)	**1200**	**750**
Flexural Modulus $[(90/0)_3]_s$ (GPa)	**53**	**47**
Flexural Strength $[(90/0)_3]_s$ (MPa)	**1180**	**750**

CHOPPED AND FORGED CARBON FIBER

CHOPPED FIBER (FORGED CARBON FIBER)

Fiber dimension: customized
Fiber Weight: 80gsm.
Resin Content: 40%

SUSTAINABILITY

Leftover materials are cut or crushed into small chips to create high fiber content compounds that can be used to create new objects by compression molding, to replace traditional injection molding of structural features on a composite part or to add a cosmetic layer to an existing laminate.

FLEXIBILITY OF DESIGN

Different sizes and colors of chips can be used and mixed to create a unique look and fine-tuning mechanical properties.
A part made from chopped fibers is almost fully isotropic (strength and modulus are the same in all directions)
No limitation in thickness variations.

HIGH PERFORMANCE

Modulus is identical to that of a 3K fabric and higher than a short fiber-filled injection-molding compound.