

# Vitrimer Matrix Composites

Unlocking The Circular Economy For Composite Materials



# MALLINDA

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# Key Points About Vitrimers

- Completely new resin chemistry (different type of chemical bonding)
- Strength of thermosets
- Reprocessability of thermoplastics
- Fast in-mold cycle time
- Unlimited out-life
- 100% recyclable for the recovery and reuse of resin and fiber

# Vitrimers

## Vitrimers ARE:

- A new class of synthetic polymer
- 100% recyclable after cure/end of life
- Covalent network polymers with high degree of crosslinking (similar in this way to thermosets).
- Reprocessable after cure when heated above  $T_g$ , due to exchange of covalent chemical crosslinks
- Highly tunable for a diverse mechanical properties from elastomers to high modulus resins
- Highly tunable for a variety of thermal conditions

## Vitrimers are NOT:

- Thermoplastics, since vitrimers are crosslinked.
- Thermosets, since vitrimers are reprocessible after cure.

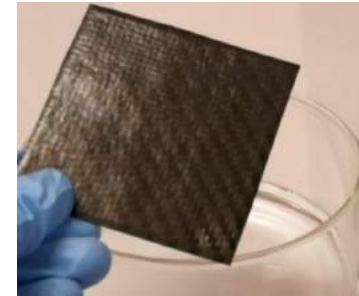
# Vitrimers: Intrinsically Recyclable

Due to the reversible crosslink chemistry in vitrimers, cured vitrimer resins can be depolymerized using chemical precursors to the resin itself. This enables circular recovery and reuse of both resin and fiber. This process can be carried out at room temperature for energy-neutral recycling. Mild heat (30 °C) can be applied for rapid depolymerization.

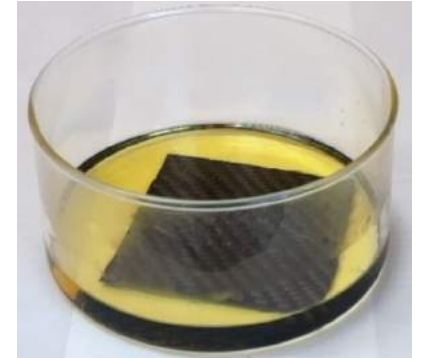
## Recover



## Reuse



## Depolymerize



## Separate



# Thermoset-Level Strength

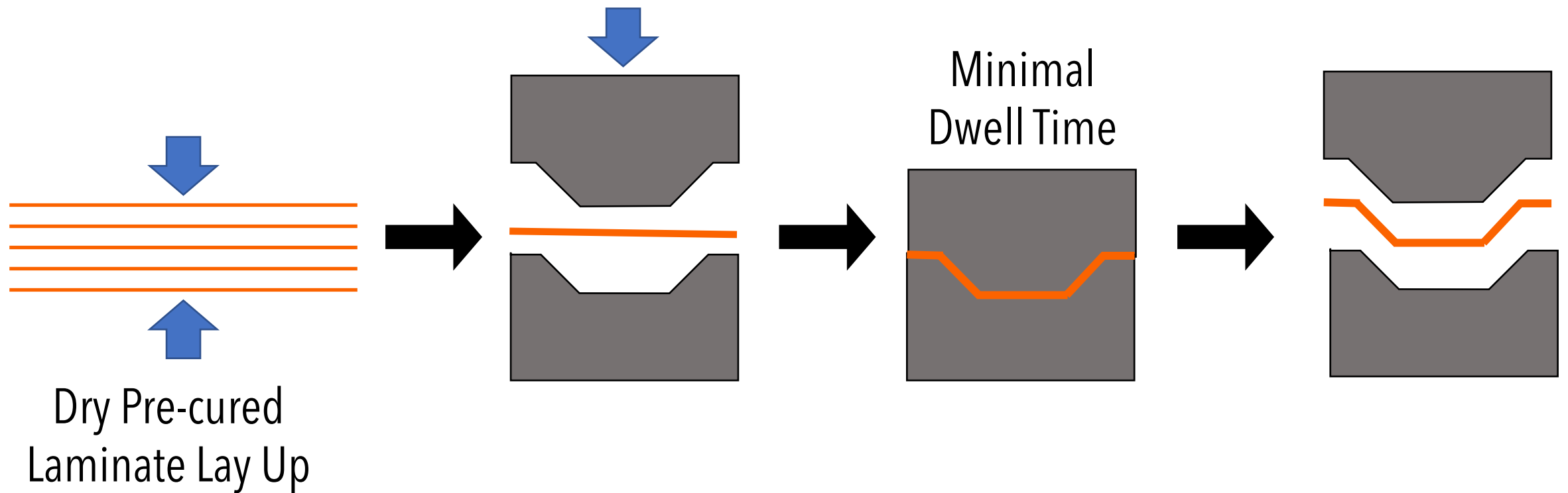
	Mallinda T130	Hexcel Snapcure
Tensile Modulus	119 GPa	118 GPa
Ultimate Tensile	2.0 GPa	2.2 GPa
Flexural modulus	124 GPa	114 GPa
Ultimate Flex	1.3 GPa	1.5 GPa
Compression modulus	118 GPa	123 GPa
Ultimate compression	1.5 GPa	1.65 GPa
Ultimate Shear	78 MPa	89 Mpa
Tg	130 °C	125 °C
In-mold dwell time	20s - 1min	20 min - 120 min

The highly crosslinked nature of vitrimers means they exhibit similar mechanical properties to thermoset composites. However, vitriomer matrix composites can be reprocessed after cure. This means that in-mold dwell times can be reduced significantly when compression forming pre-cured vitriomer matrix composite materials.

← Key Differentiation

# Thermoplastic-like Processing

## Vitrimer-Enabled High Throughput FRC Compression Molding



# Vitrimer Composite Formats

Vitrimer resins are versatile and can be used to replace traditional thermoset resins in some applications, and can be used in place of thermoplastic composites in other applications.



# Introducing First Commercial Vitrimer Products: 2020

- T-60 and T-130 for Tgs of 60°C or 130°C, respectively
- Prepreg products - available pre-cured or B-staged
- Two-part resin systems
- Unlimited outlife of pre-cured material
- Processing support for early customers
- Custom formulation/products by request





Headlight Housing with Class A finish

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