PEI-PEEK Tape Development Journey (OATMEAL)

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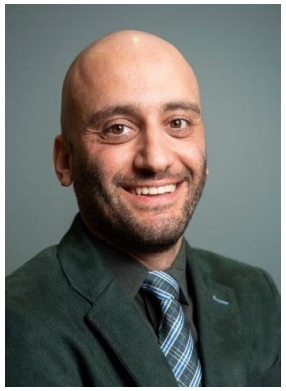

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T_g = Glass transition temperature
T_m = Melt transition temperature
PEI: Polyetherimide
PEEK: Polyetheretherketone

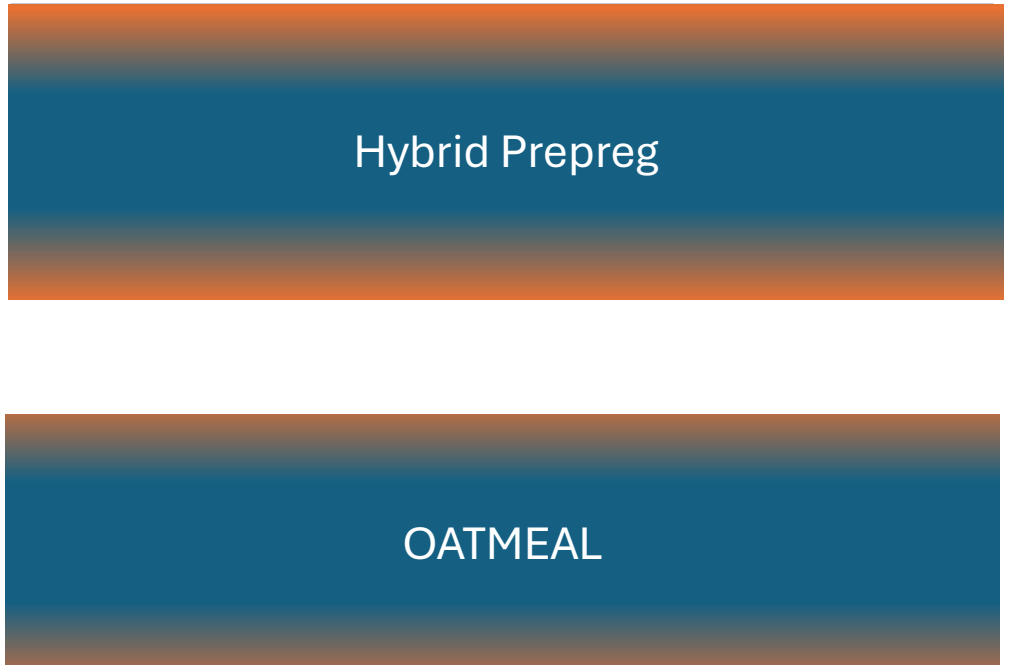
What is OATMEAL?

Out-of-autoclave **A**morphous/semicrystalline **T**hermoplastic **M**aterial for **E**nergy-efficient **A**erospace-grade **L**aminates.

	Tg (℃)	Tm (℃)	Tensile Modulus (GPa)
PEI	220	--	3.4
PEEK	143	343	3.8

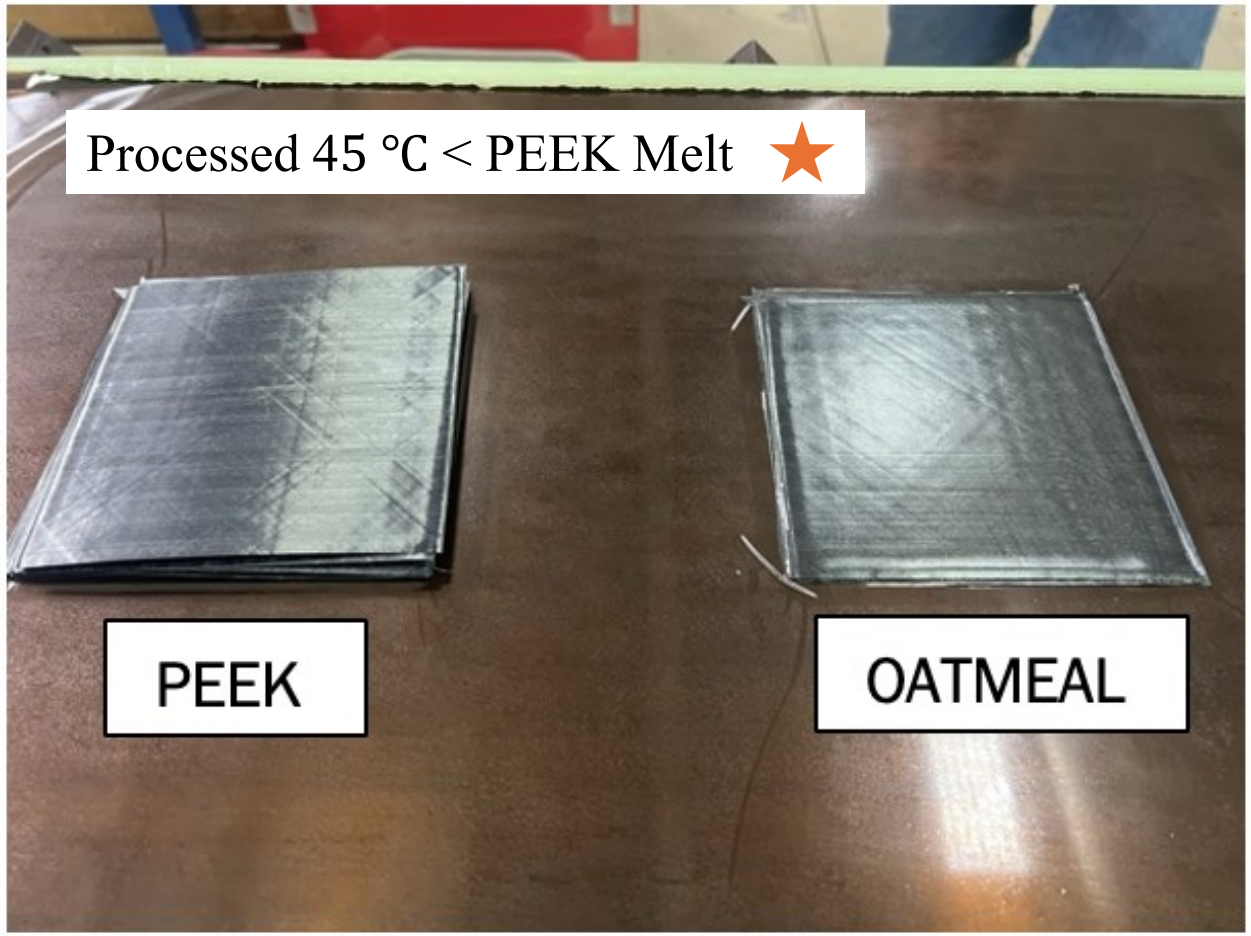
Welding Times

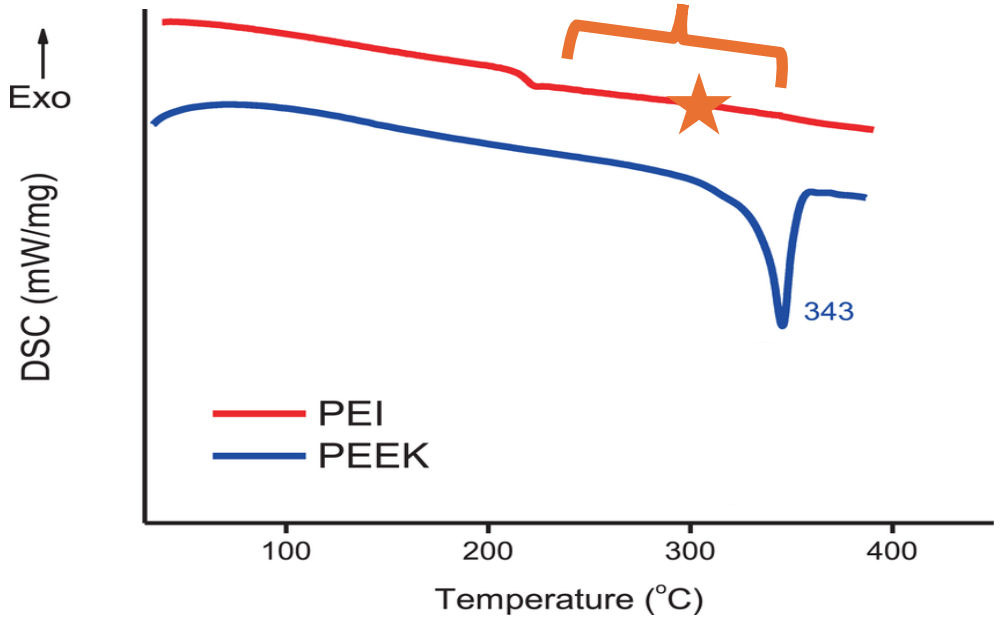
	280 ℃ (s)	320 ℃ (s)	340 ℃ (s)	420 ℃ (s)
PEI	17,155	< 1	--	--
PEEK	Won't Heal	Won't Heal	592	<1



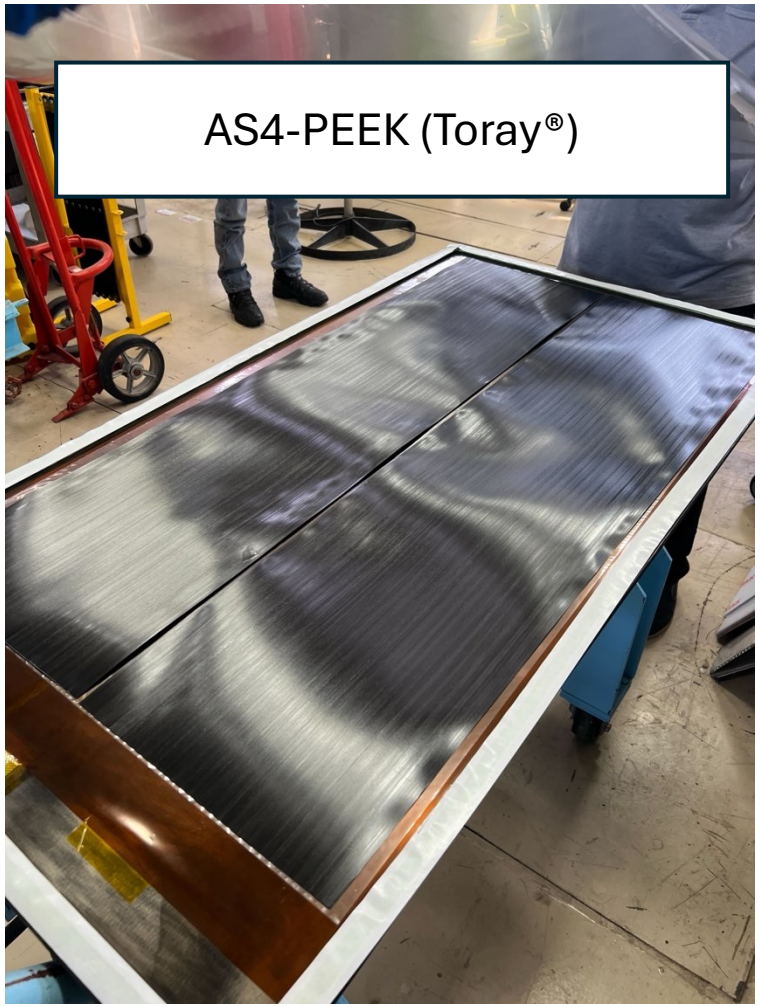
J. Barroeta Robles, M. Dubé, P. Hubert, A. Yousefpour, "Healing study of poly (ether-imide) and poly ether ether ketone using resin films and a parallel plate rheometer", Composites Part A: Applied Science and Manufacturing (2024)

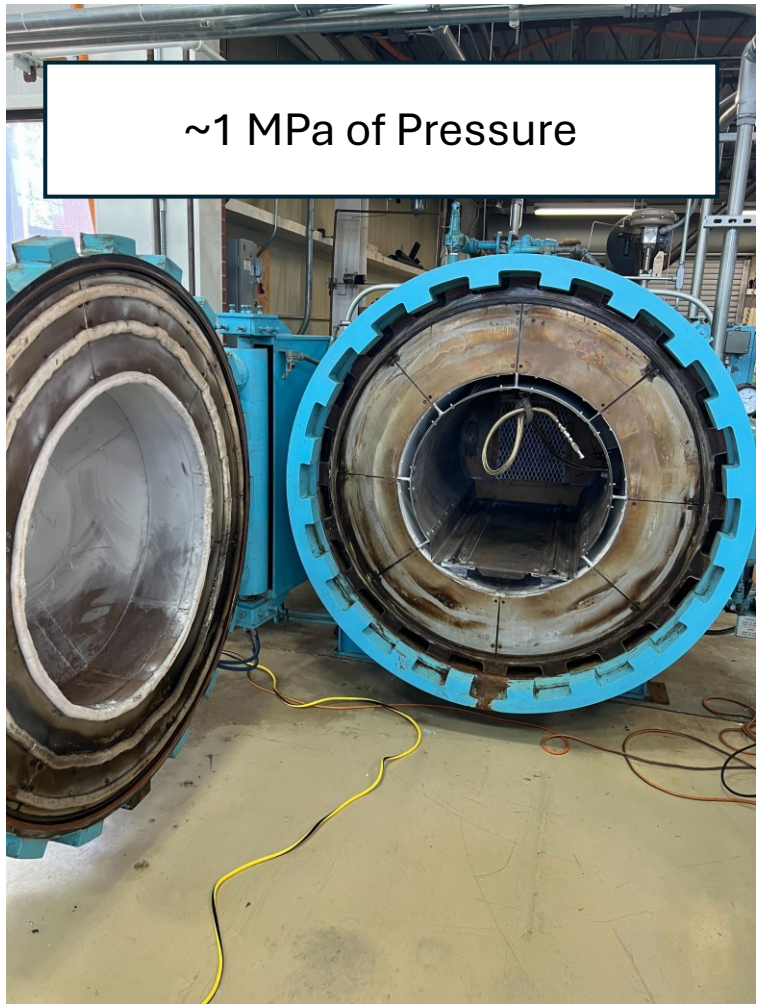
OATMEAL is Engineered to be Cooling-rate Agnostic





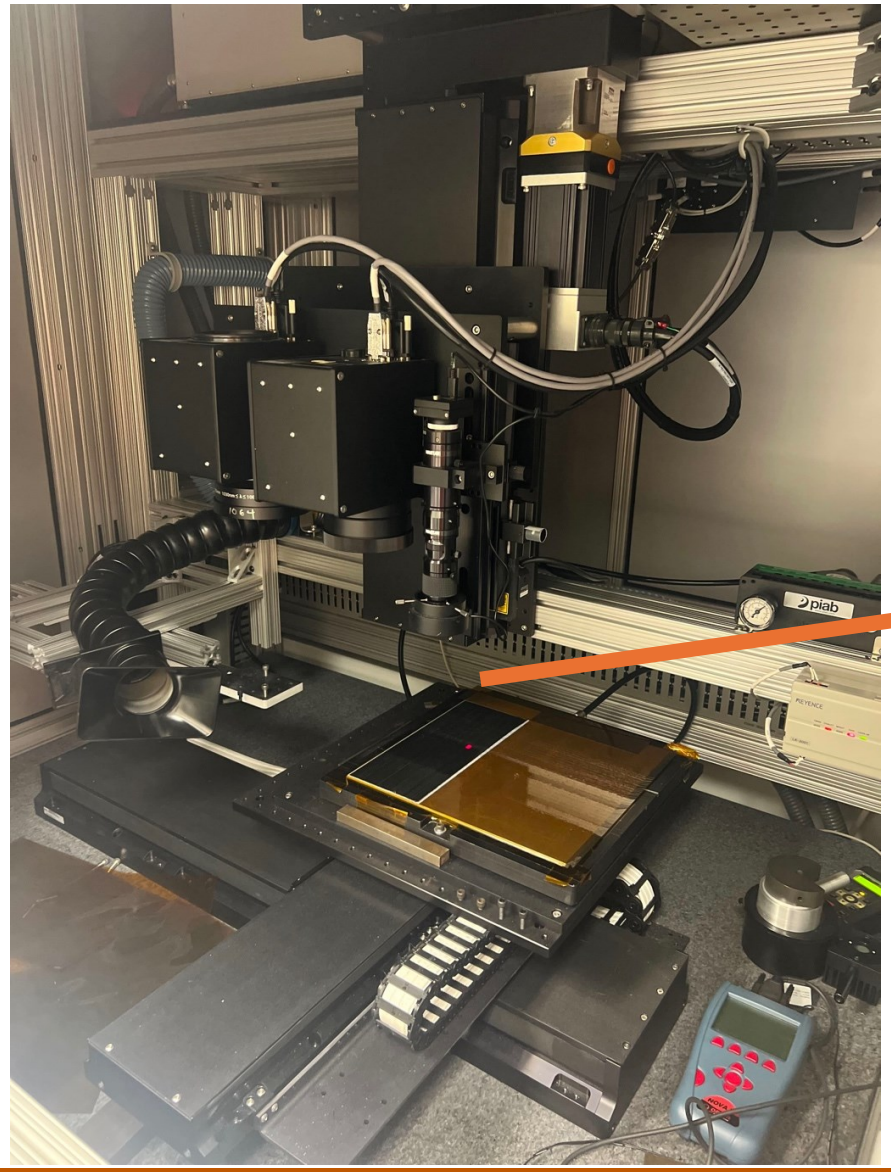
Manufacturing Bulk Amounts of Hybrid Tape

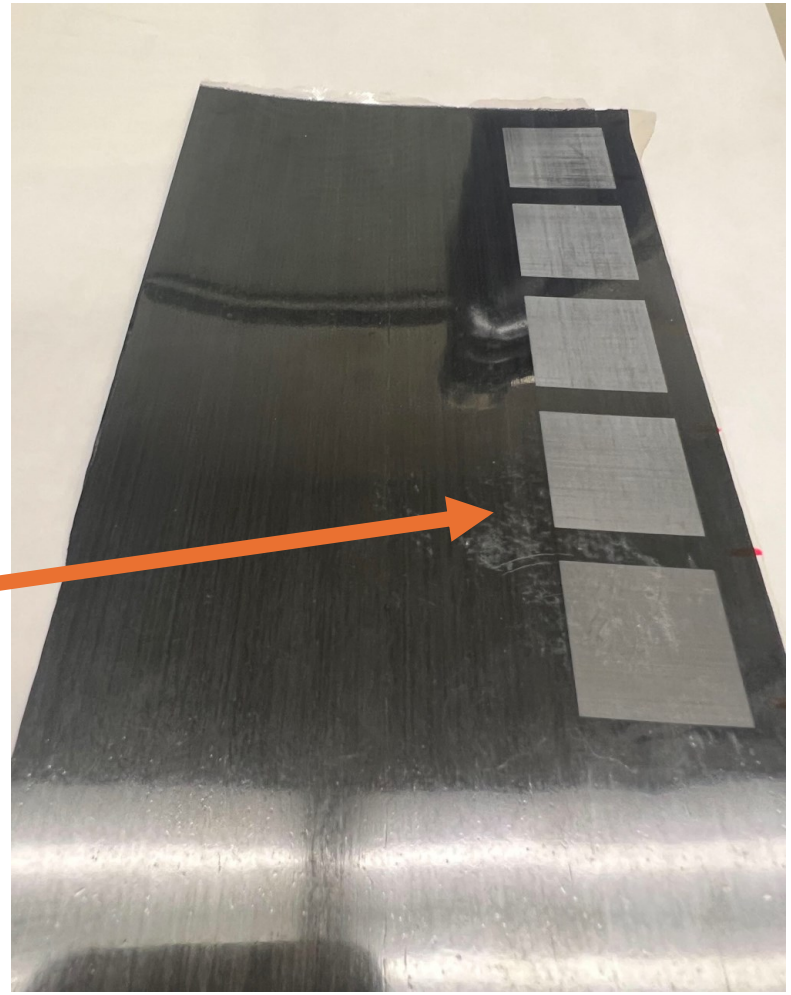




Laser Ablate Excess PEI

Ekspla Atlantic® 20 Nd:YVO_4 picosecond laser on PhotoMachining, Inc.® system

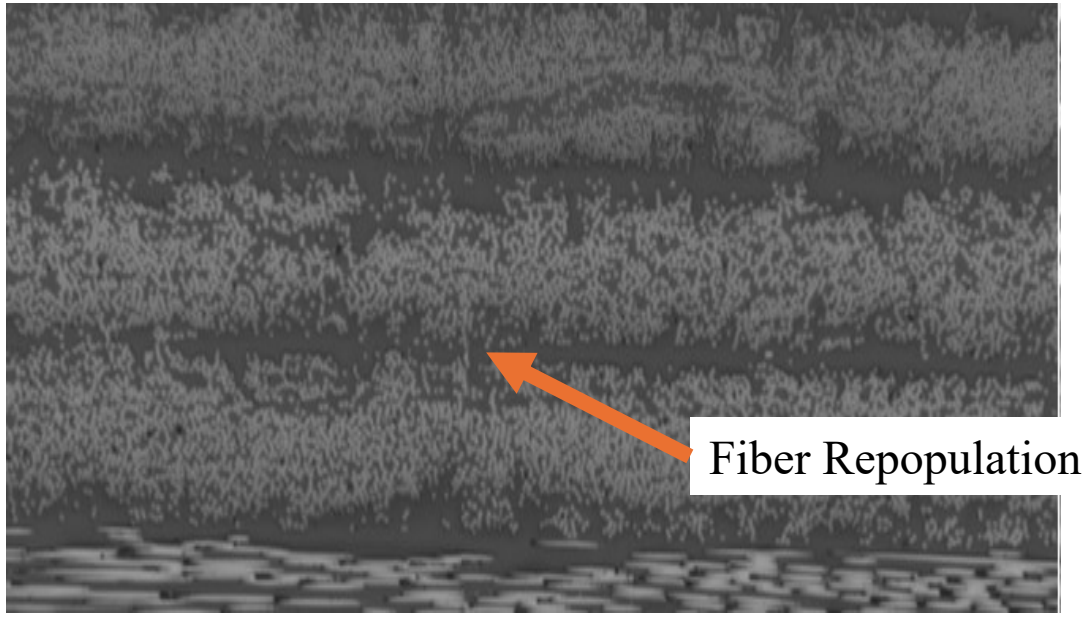




Laser Ablation Removes Excess Surface PEI

$[0, 45, -45, 90]_{2S}$ Quasi-isotropic Layup

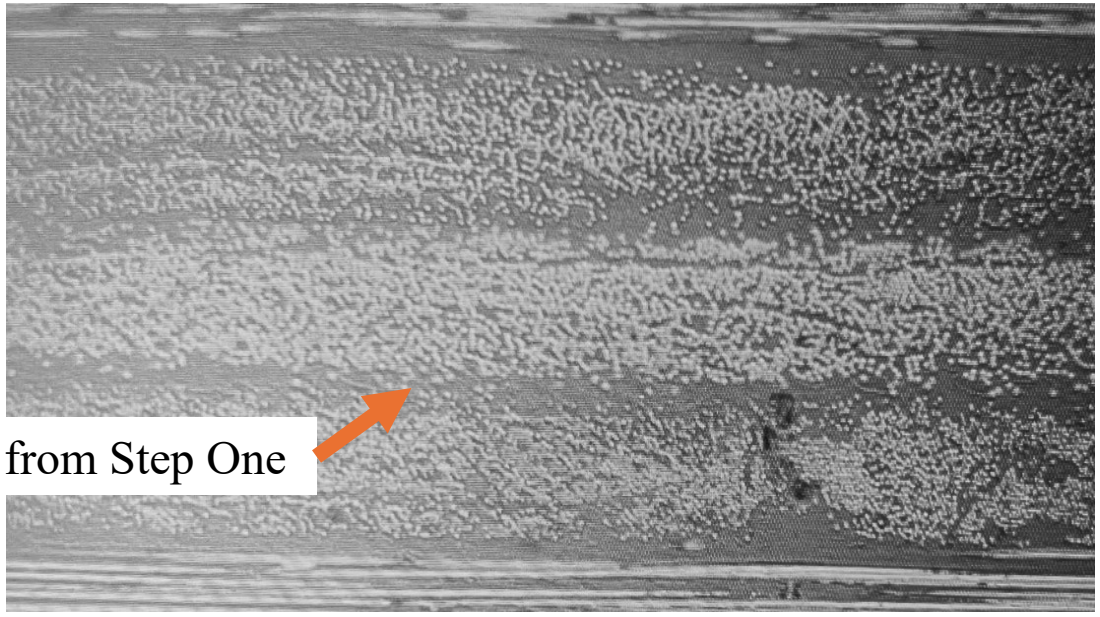
25-micron Hybrid Tape



100 μm

Volume fraction: ~50%
Short beam strength: **52.4 ± 3.4 MPa**
Interface width: 16.38 ± 5.78 μm

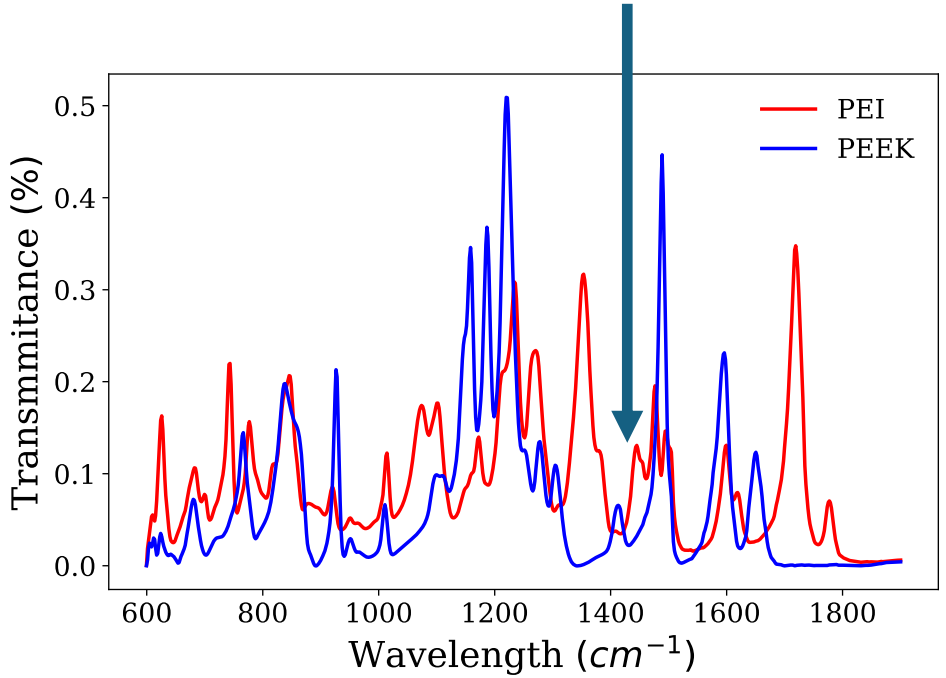
OATMEAL V1

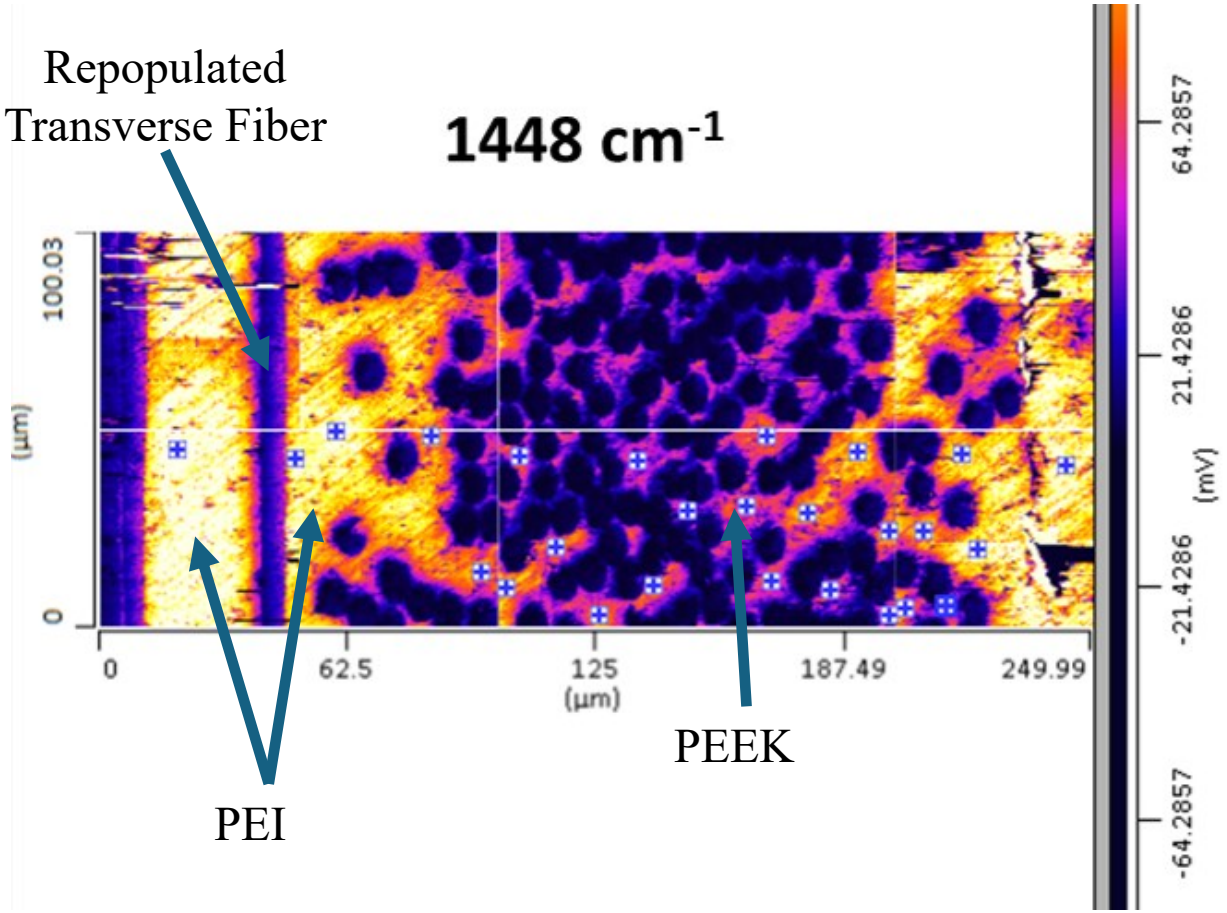


100 μm

Volume fraction: ~55%
Short beam strength: **66.8 ± 1.8 MPa**
Interface width: 9.4 ± 2.12 μm

AFM-IR Measured Interdiffusion of PEI ~25-30 µm into PEEK



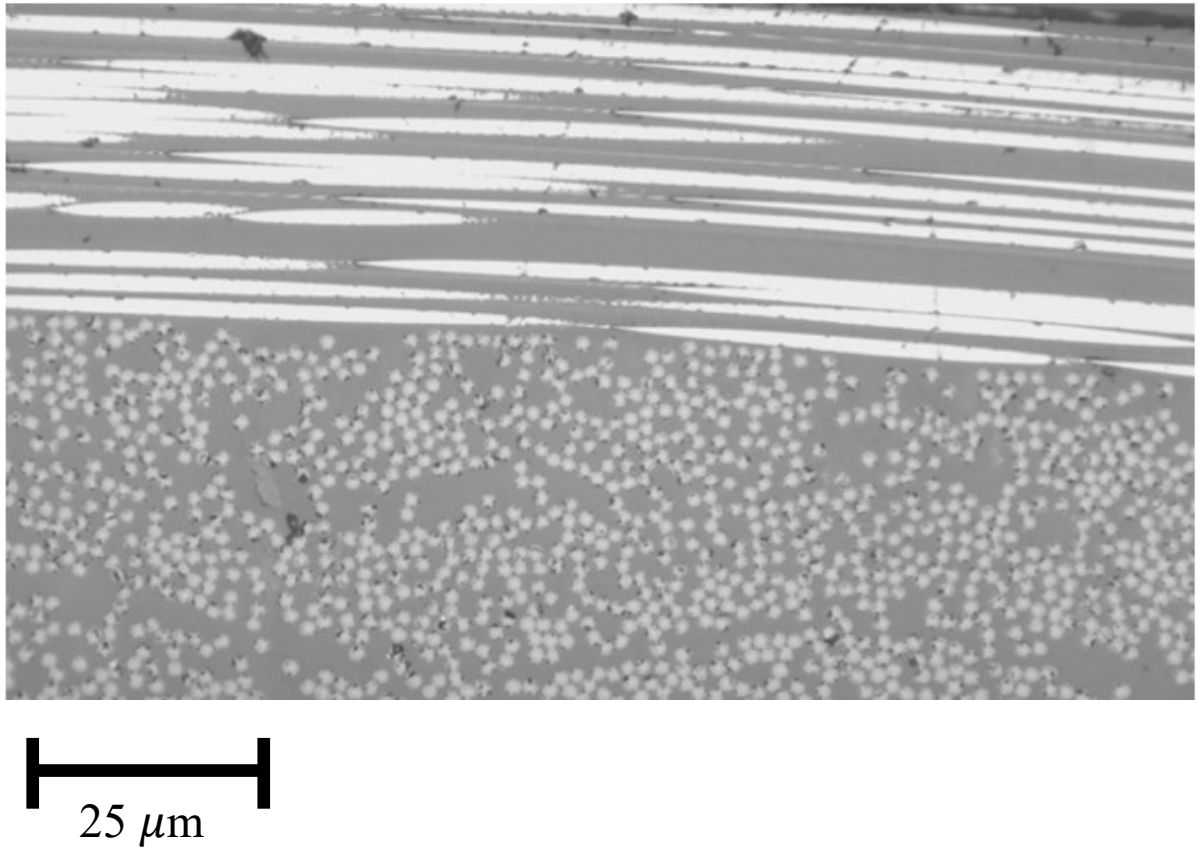


AFM-IR: Atomic Force Microscope-Infrared Spectroscopy

Reducing Pressure in Hybrid Tape Manufacturing: Less Fiber Repopulation

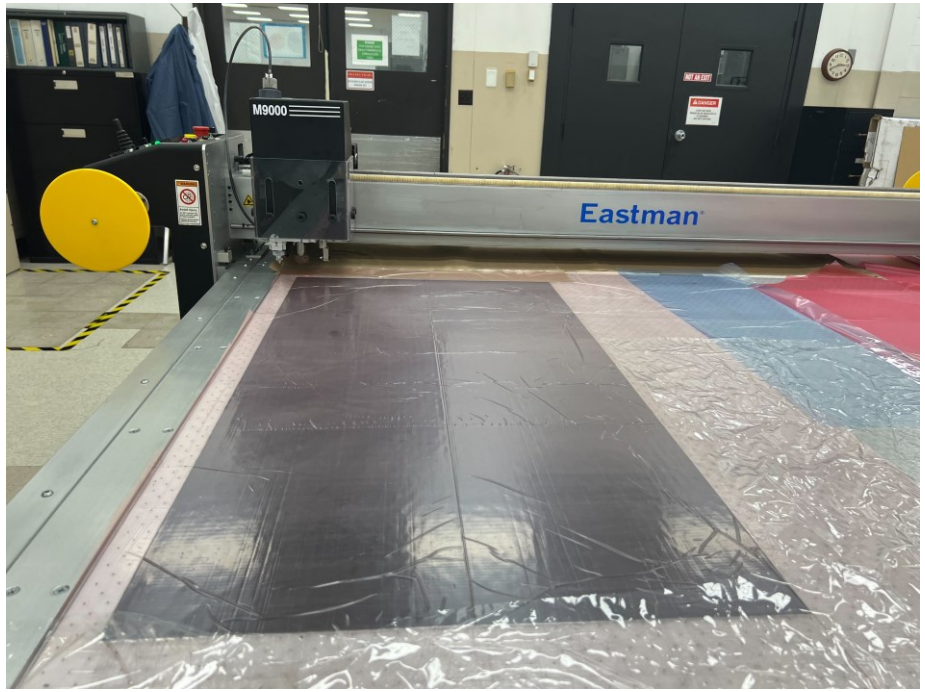
OATMEAL V2 – Processed 60 ℃ < PEEK Melt

Oven Processed in Step One (1/10 Pressure)

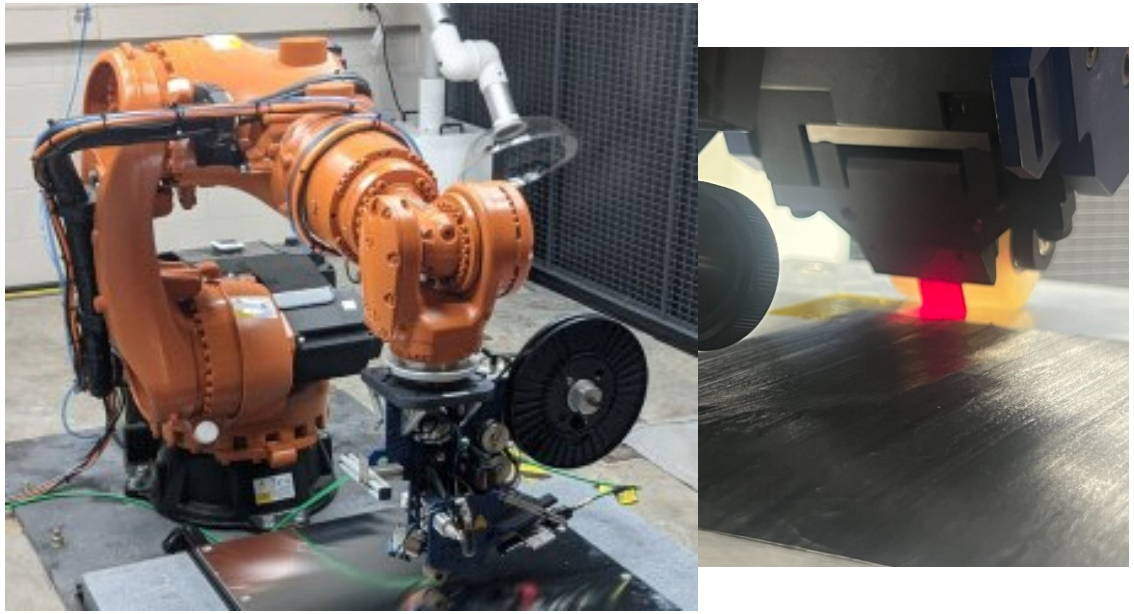


Preliminary ICAT Results are Promising

Gerber Cut 0.5 in. Slit Tapes



Tehrani Group Automated Fiber Placement (AFP) with 600 W 980 nm Laser



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Recent Publications:

1) "In situ consolidation of carbon fiber PAEK via laser-assisted automated fiber placement", Heathman et al., Composites Part B (2023)
2) "Resin percolation and intimate contact in fast processing of thermoplastic composites", Kirchhoff et al., Composite Part A (2024)
3) "Interlaminar Bonding in Thermoplastic Composites: A Comparative Analysis of Laser AFP and Post-Processing", Kirchhoff et al., SSRN (2024)
4) "Experimental Evaluation of the In-Situ Consolidation Automated Fiber Placement of Polyaryletherketone Composites", Grimsley, Hudson et al., Thermoplastics Composites Conference (2024)
5) T. Yap, N. Heathman, B. Shirani Bidabari, E. Motta de Castro, A. Tamijani, A. Asadi, M. Tehrani, "In-Plane Properties of an In-Situ Consolidated Automated Fiber Placement Thermoplastic Composite". Under review.