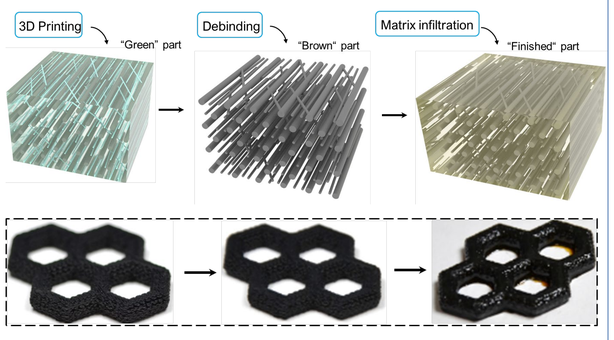
ADDITIVE MANUFACTURING OF RECYCLED CARBON FIBER/THERMOSET COMPOSITES

Chunyan Zhang (PhD.M.S.E.G.)[2], Prof. Chaoying Ni[1,2], Dr. Kelvin Fu[1,3]
University of Delaware | Center for Composite Materials[1] | Department of Material Science and Engineering[2] | Department of Mechanical Engineering[3]

Introduction

Carbon-based materials are promising structural materials for applications in energy, aerospace and automotive. A strategy to produce composites through additive manufacturing of 3D carbon scaffold using recycled carbon fibers (rCFs) is developed. The 3D carbon scaffold structure is enabled by a shear flow of rCFs in a thermoplastic matrix, followed by debinding and sintering to achieve well-bonded, oriented rCF scaffold. This rCF scaffold offers complex geometry design flexibility and multiscale reinforcing effect for 3D composite structures. Our processing strategy provides a rapid processing route, which increases cost-efficiency and structure scalability of structural carbon fiber composite production by infiltrating thermoset resin into the scaffold, and a solution to the recycling and reutilization of carbon fiber wastes.

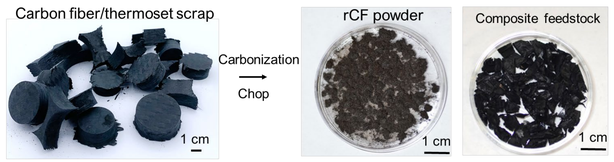
Methodology

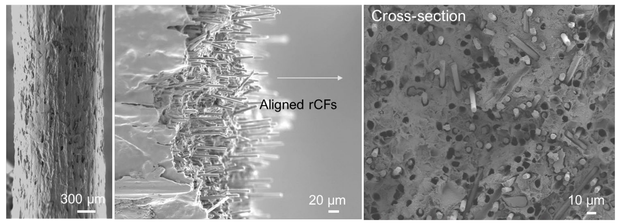


Macroscopic assembly of recycled carbon fibers for structural and functional 3D structure

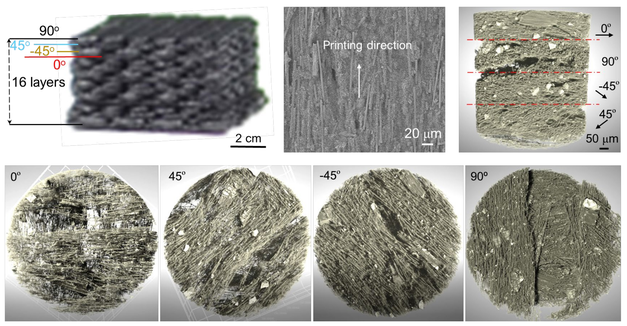
Green Part Formation of rCF Composite

❖ Filament Preparation

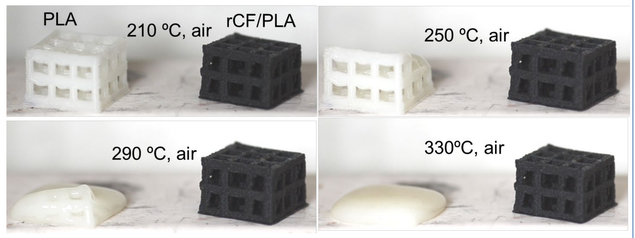




❖ Printed Recycled Carbon Fiber Structure



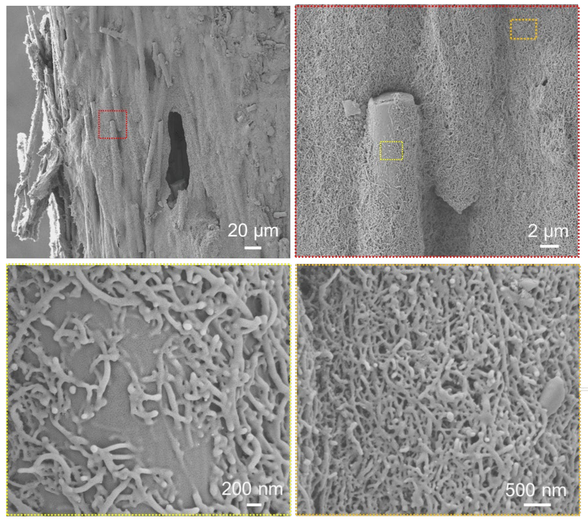
❖ Thermo-Mechanical Stability



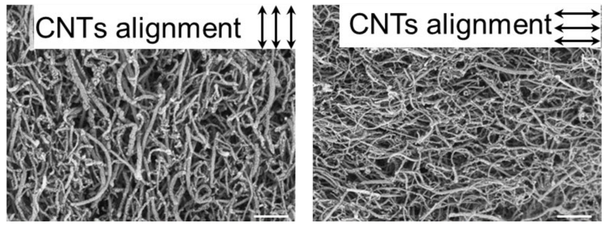
The rCF/PLA sample remains structurally stable during the "green-to-brown" transition with heat applied.

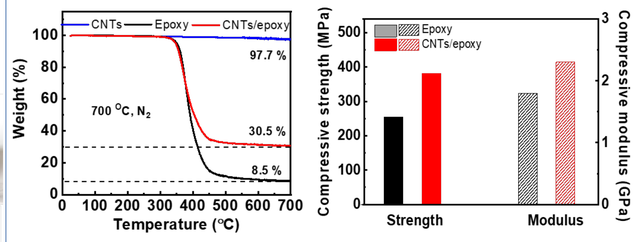
Morphology of Brown State After Carbon Coating

❖ Multiscale Reinforcement

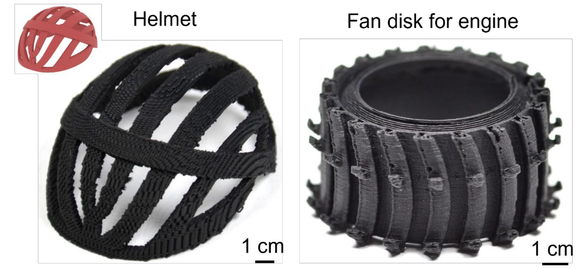


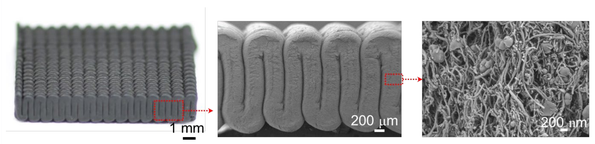
Characterization of Finished State





Structure and Application





Structural Battery Electrodes

Carbon Monolith Catalysis

Conclusion

- Turning recycled carbon fiber to 3D architecture with complex geometry and desired alignment.
- Zero volume shrinkage from "green" to "brown" transition.
- Potentially manufacturable for carbon/metal, carbon/ceramics composite.

Acknowledgements

This work is supported by the University of Delaware.