



Composites Innovation Group

Developing scalable disruptive high-rate composites manufacturing solutions

Technical Area Overview

The Composites Innovation (CI) Group at Oak Ridge National Laboratory develops novel integrated high-rate polymer/composites manufacturing processes driven by data to create multifunctional objects with highly tailored performance. The CI Group's expertise in high-rate composite manufacturing technology is pioneering next generation manufacturing processes for advanced composites. By working closely with a wide range of industry partners—from material suppliers, system manufacturers, to the original equipment manufacturers—researchers support industry needs in the automotive, aerospace, hydropower, wind energy, and building markets.

Researchers utilize an advanced numerical simulation framework to create a digital twin of manufacturing processes which reduces the energy consumption. The final goal is rapid production of end use components satisfying given application requirements, or "Born Qualified" composite parts, that enable domestic manufacturing in the United States.

Research and Development

Advanced Manufacturing

- Large-scale Additive Manufacturing (AM)
- Out-of-plane robotic AM
- Continuous Fiber Printing (CFP)
- Automated Fiber/Tape Placement (AF/TP)



Integrated Manufacturing Processes

- Additive Manufacturing - Compression Molding (AM-CM)
- Additive Manufacturing - Automated Fiber/Tape Placement (AM- AF/TP)
- Additive Manufacturing - Injection Molding (AM-IM)
- Additive Manufacturing - Filament Winding (AM-FW)

High-Rate

Manufacturing Processes

- Extrusion Compression Molding (ECM)
- Injection Molding (IM)
- Sheet Molding Compound (SMC)
- Filament Winding (FW)
- Thermoforming (TF)

Scale-Up Science and Demonstration

- Scaling technologies from lab-scale to industry floor
- Collaboration with The Institute for Advanced Composites Manufacturing Innovation (IACMI)- Scale-Up Research Facility (SURF)

APPLICATION AREAS



LARGE-SCALE ADDITIVE MANUFACTURING



AUTOMOTIVE, AEROSPACE, AIR MOBILITY



ADVANCED INTEGRATED PROCESSES



MOLD MANUFACTURING



HYDROPOWER



STRUCTURE HEALTH MONITORING



WIND ENERGY



BUILDING AND INFRASTRUCTURE

Research Highlights/Impacts

- Integrated Polymer Processes—Integrated high-rate compression molding manufacturing processes with controlled deposition of additive manufacturing, local control of microstructure.
- Transformational Polymer Manufacturing Technologies—Developed world's first large-scale AM system in collaboration with industry partners.
- Mold and Dies—Reduced the lead time and cost for mold manufacturing holding records on 3D-printed polymer molds/dies solutions.
- Multi-Functional Materials—Printed largest dual material 3D-printed mold; world's

first 3D-printed lightning strike protection system and large scale 3D-printed foam structures.

- Simulation-Assisted Design—Designed framework for AM process simulation that predict component's mechanical/thermal performance.
- Material Development and Characterization —Developed new feedstock materials for large-scale AM; innovative structural health monitoring and nondestructive testing/evaluation techniques for composites.

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