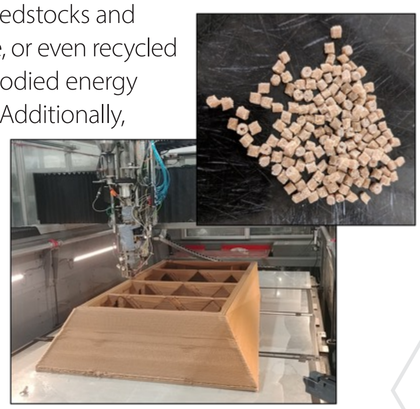
OAK RIDGE NATIONAL LABORATORY

Sustainable Manufacturing Technologies Group

Developing scalable, sustainable materials and manufacturing technologies to enable circular economies and reduce dependence on fossil fuels through bio-based products

Technical Area Overview

Researchers in the Sustainable Manufacturing Technologies Group develop high-performance bio-based composites as well as high-volume polymer and composite recycling practices that enable circular economies. This research helps to reduce the impact of manufacturing on climate change, mitigate waste and pollution, and reduce dependence on fossil fuels. Recycled feedstocks and bio-based materials derived from forest products, agricultural waste, or even recycled cardboard offer low-cost, lower carbon footprint, and overall embodied energy as compared to traditional single-use petroleum-based materials. Additionally, widespread implementation of bio-based materials can increase demand for local feedstocks nationwide, enabling distributed manufacturing and benefiting local or rural economies. Simultaneously developing new recycling technologies and moving toward circular economies in manufacturing will reduce the current and forthcoming volume of waste, upcycle valuable materials, create a wealth of new domestic jobs, and lead the U.S. toward more efficient and environmentally friendly manufacturing practices to achieve sustainability.



Bio-based feedstock Polylactic Acid (PLA)/wood fiber composite pellets (top) and utilization in Additive Manufacturing process(bottom)

APPLICATION AREAS

- MOLD FABRICATION
- MACHINE PARTS
- AUTOMOTIVE
- BUILDING AND CONSTRUCTION
- ADVANCED RECYCLING
- WIND TURBINE PARTS
- PACKAGING AND TRANSPORTATION
- NEXT GENERATION AM

Research and Development

Value-Added Bio-Based Materials

- Developing advanced bio-based materials (polymers, fibers) and chemical intermediates
- Designing and enabling high-value bio-based products such as advanced lightweight bio-composites, additive feedstocks, bio-foams
- Optimizing processing and manufacturing techniques of bio-based materials and enabling scale-up

Circular Economy

- Enabling recycling of manufacturing scrap and end-of-life polymer and composite products
- Designing materials for sustainability and re-use and increasing lifetime of existing products/processes
- Recycling and remanufacturing of advanced multi-material products
- Enhancing efficiency of manufacturing and recycling systems

Research Highlights/Impacts

- Supertough bioplastic—Developed a bioderived polymer that is 10 times tougher than polylactic acid without sacrificing strength or stiffness and with improved manufacturability.
- Printing with plants—Incorporated natural fibers such as wood, bamboo, and microcellulose into polymer composites for 3D printing.
- Enabling nanocellulose—Optimized nanocellulose extraction and processing techniques for use in high performance polymer composites.
- Thermochemical recycling—Used pyrolysis to recover glass and/or carbon fiber at pilot scale.
- Mitigating waste—Developed reclaimed carbon fiber compositions and methods to produce a Class A finish for structural automotive parts.
- AM waste upcycling—Downsized and re-printed composite scrap.

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