Advanced Manufacturing

Oak Ridge National Laboratory draws upon unmatched capabilities in materials, neutrons and computational science to develop innovative manufacturing technologies, helping large and small companies find solutions that drive US economic competitiveness and energy productivity. Researchers focus on next-generation materials, simulations, data analytics and artificial intelligence to create new advanced manufacturing systems and processes.

Using ORNL's world-class resources for scientific discovery, researchers develop the next generation of materials designed for additive manufacturing and composites for enhanced performance in tomorrow's energy systems; simulate manufacturing processes to better understand the technology; use data analytics and artificial intelligence to create new born-qualified components; and develop the next generation of manufacturing systems.

Research and Development

Additive manufacturing, carbon fiber and composites—Additive and high-rate processing of discontinuous fiber composites

Intelligent machine tools—Subtractive and additive capabilities to produce, measure, and predict machine-tool performance

Roll-to-roll processing—Reel-to-reel or web-processing in additive and subtractive manufacturing to build structures in a continuous manner

Robotics, automation and controls—Novel large-scale metal wire arc and laser systems with multi-axis controls

Next-generation systems—Powder systems including binder jet, laser and electron beam melting with the ability to manufacture crack-free highly non-weldable alloys and demonstrate microstructure control

Data analytics and artificial intelligence—Computational modeling, in situ sensing, metrology and artificial intelligence for nondestructive component evaluation

Material recovery—Recovering and recycling raw materials such as fiber, polymer, and other valued materials from waste streams

Metrology and characterization—Comprehensive powder-to-part characterization including both in situ process evaluation and post-process capabilities for manufacturing born-qualified components

CONTROLLING microstructure in metal parts

CUTTING carbon fiber costs

ADDITIVE MANUFACTURING large-scale objects: cars, houses, molds for tooling

CREATING better batteries with new alloys

QUALIFYING additively manufactured components

"We're breaking ground at ORNL in composites by having an in-depth understanding of a material's microstructure and composition. This allows us to develop new materials for additive manufacturing and design ways to recycle them."

Vlastimil Kunc, ***Manufacturing Science Group Leader***

OAK RIDGE National Laboratory

U.S. DEPARTMENT OF ENERGY

Recent Impacts

Powder bed advancement—Fabricated industrial gas turbine airfoil without surface cracks with electron beam powder bed additive manufacturing; developed data framework containing both modeling and real-time data acquisition to recognize variations and defects in a broad range of powder bed additive manufacturing technologies

Machining integration—Designed and fabricated an additive manufacturing system that integrates additive and machining capabilities, creating a base system for a digital factory of the future

New materials—Deposited additively manufactured steel tooling to make fiber-reinforced polymer composites; deposited aluminum-cerium additively manufactured alloys with higher performance than conventionally manufactured, aerospace-grade aluminum alloys

Large-scale applications—Developed commercially available large-scale thermoset additive manufacturing system and commercially available thermoset materials; demonstration of the ability to manufacture large additively manufactured metallic structures with multiple materials and out-of-plane deposition for complex components; designed and fabricated an infrastructure-scale concrete deposition system for energy generation applications

Industry growth—More than 20 new collaborative projects with industry on fundamental advanced manufacturing research, bringing the total to more than 170 projects with industry since 2012 and demonstrating a 21-to-1 return on public investment

184 Industry Partners

52 University Partners

102 Publications in FY 2019

28 R&D 100 Awards

Unique Facilities

*The **Manufacturing Demonstration Facility** (MDF) is the nation's only large-scale open-access facility for rapidly demonstrating early stage R&D manufacturing technologies and optimizing critical processes.*

*The **Carbon Fiber Technology Facility** (CFTF) is developing methods using low-cost feedstocks to assist industry in overcoming the barriers of carbon fiber production cost, scalability of processes, and development of fiber-reinforced polymer composites for end use.*

*The **Battery Manufacturing Facility** (BMF) is the country's largest open-access battery research and development center focused on high-performance, low-cost water-borne processing technology, high-speed curing for advanced electrodes, low-cobalt and cobalt-free cathodes, and high-performance computing for advanced processing, performance validation, and life prediction.*

CONTACT:

Craig Blue
Advanced Manufacturing Program Manager

blueca@ornl.gov
865-574-4351

One Bethel Valley Road,
Oak Ridge, TN 37830

ornl.gov/manufacturing

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