



OAK RIDGE NATIONAL LABORATORY

Carbon Fiber Innovation

Oak Ridge National Laboratory (ORNL) is advancing carbon fiber research by evaluating and identifying high-potential, low-cost raw materials including textile, lignin, polymer, and hydrocarbon-based precursors. Research is enabling low-cost carbon fiber for use in clean energy and accelerating deployment in applications such as wind energy, hydrogen storage, building envelopes, and lightweight vehicles. Technology development and process optimization lead to the licensing of inventions including plasma processing for rapid carbon fiber production.

The Carbon Fiber Technology Facility (CFTF), a US Department of Energy (DOE) User Facility at ORNL, provides resources for developing innovative processes for further understanding the kinetics of carbon fiber manufacturing, energy consumption, and environmental impact. In addition, the CFTF provides carbon fiber sample quantities to industrial partners for testing for continuous improvement and market evaluation.

Research and Development

Thermal (conventional) conversion—Producing up to 25 tons/year of polyacrylonitrile-based fiber with ability to convert both melt-spun and solution-spun precursors

Melt-spun precursor fiber—Developing and optimizing a variety of precursors including polyethylene fiber, spun lignin, and pitch-based in either tow or web form

Advanced technology conversion—Delivering advances in conversion technology based on microwave and plasma-processing technologies

Materials characterization—Utilizing advanced equipment including pultruder and steam stretcher to analyze custom composite materials and reduce oxidation time

Process optimization—Leveraging steam stretching textile winder/package and chopping capabilities to improve the production and delivery of carbon fiber

Artificial intelligence—Creating a data analytic framework that utilizes machine learning/statistical analysis, computer vision/quality control, sensing, management, tracking, and visualization

Advanced composites—Enabling broader use of advanced composites by lowering carbon fiber costs through textile precursor innovations and the investigation of composite production techniques including compounding, prepreg, braiding, and pultrusion



"We transfer carbon fiber technology to industry partners to increase US competitiveness in manufacturing. This, in turn, supplies a critical need for our country, creates opportunities, and stimulates the economy."

Merlin Theodore, Advanced Fibers Manufacturing Group Leader



Recent Impacts

Filter media production—Collaborated with industry to produce enough specialty filter media to supply more than 1 million face masks and respirators each day to US healthcare facilities for the ongoing COVID-19 pandemic, including the development of a novel, in-line charging device to mass-produce precursor material for N95 masks

Economic development—Utilized N95 filter media production process in collaboration with a medical device maker that resulted in the capability to mass-produce respirator masks, adding 500 jobs in the United States

Automotive lightweighting—Developed low-cost textile carbon fiber that was used to produce the first large injection-molded automotive prototype, a lightweight fender

Computational modeling—Created a 3D multiphysics computational model for the carbonization process that was faster and more energy efficient

Textile-based precursor—Developed carbon fiber using textile-based precursor; also pelletized and compounded the fiber

Equipment advancement—Developed chopping equipment for textile carbon fiber at various lengths and sizes; developed chopping equipment for commercial packaging methods

Additive applications—Utilized textile carbon fiber for large-scale additive manufacturing of a car hood mold

91
Industry
partners

14
University
partners

12
National
laboratory
partners

4
Licensed
technologies

Unique Facilities

DOE Carbon Fiber Technology Facility (CFTF) assists industry with overcoming the barriers associated with cost and technology scaling of low-cost fibers and associated composites, including product and market development. The CFTF identifies high-potential, low-cost raw materials such as textile, lignin, polymer, and hydrocarbon-based precursors and houses a highly flexible manufacturing line rated for 25 tons per year and a precursor melt-spinning line rated at 65 tons per year.

DOE Manufacturing Demonstration Facility (MDF) creates and accelerates next-generation advanced manufacturing technologies, where materials, processes, and systems are holistically integrated to strengthen the US manufacturing base. Researchers at the MDF develop new tools and methods that are more cost-effective, efficient, and reliable for the nation's security, economy, and energy portfolio. Through a robust technology transfer program, the MDF provides industry partners affordable and convenient access to facilities, tools, and expertise to facilitate rapid deployment of new technologies and clean energy solutions.



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