MANUFACTURING HIGH-TECH CARBON PRODUCTS FROM DOMESTICALLY SECURE COAL AND COAL/BIOMASS BLENDS

NETL

NATIONAL ENERGY TECHNOLOGY LABORATORY

OVERVIEW

Coal is an abundant resource in the United States. Although it is typically associated with energy production, its utility is far broader, especially when blended with biomass. Coal and coal/biomass blends can be used to manufacture or improve a wide range of high-tech consumer products. Examples of these products include: carbon fiber, computer electronics, paints and coatings, textiles, cements, plastics, water filtration devices, and graphite battery materials. Coal and biomass are domestically secure and can be used to insulate American manufacturers from the instability caused by foreign supply chains used to manufacture carbon materials for electric vehicle batteries, hydrogen storage tanks, lightweight automotive vehicles, aluminum and steel manufacturing electrodes, and miniaturized electronics. Additionally, coal and biomass undergo years of extensive natural processing which provides these feedstocks with the complex chemical structures that enable the performance of many high-tech materials. This means that coal and coal/biomass blends often require less synthetic processing than traditional feedstocks, which can lead to lower environmental footprints and reduced manufacturing costs. For instance, the cradle-to-gate energy footprint for manufacturing a coal-based carbon fiber uses considerably less energy than for manufacturing petroleum-based fibers. This ultimately reduces both the manufacturing cost and carbon footprint for making fibers.

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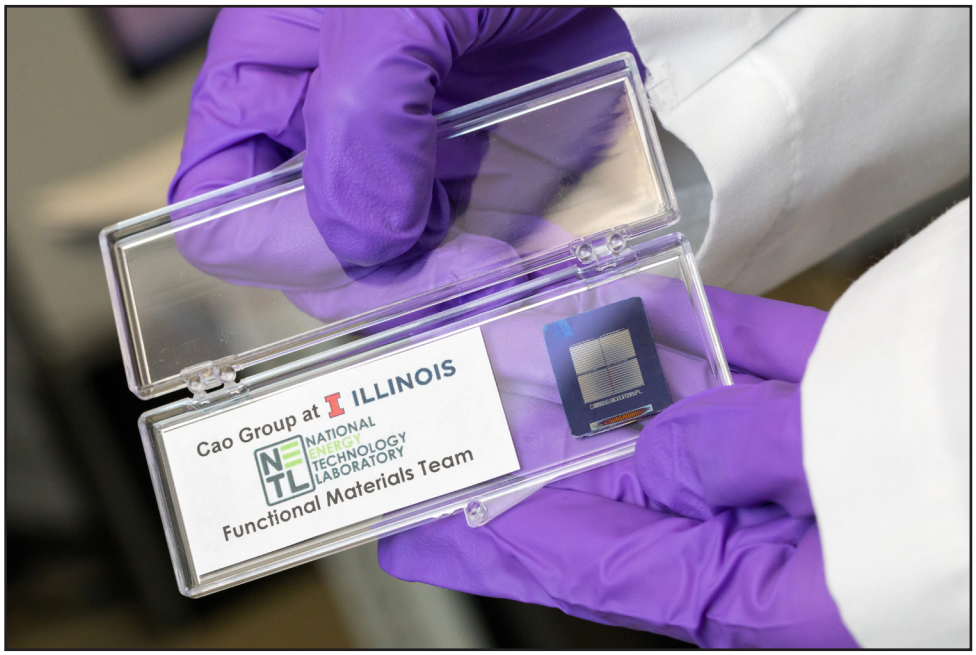
NETL has launched a research development and deployment program that focuses on the use of coal and coal/biomass blends as domestically secure manufacturing feedstocks that can improve the efficiency, cost, and environmental footprint of making high-tech carbon materials and products. NETL's effort convenes partnerships with national laboratories, universities, community partners, and industrial firms to develop new materials and manufacturing technologies that utilize domestic coal and coal/biomass blends. NETL's research program focuses primarily on creating new, commercially deployable, processing technologies and providing the economic and environmental analysis needed to evaluate how deploying these technologies would impact U.S. jobs, supply chain stability, demand for high-tech materials, and revenue in the mining and manufacturing industries. A summary of these approaches includes:

- DEVELOPING HIGHER EFFICIENCY MANUFACTURING PROCESSES WITH REDUCED ENVIRONMENTAL FOOTPRINTS: Research focuses on developing new material systems made from coal and coal/biomass feedstocks, characterizing their performance and costs, and demonstrating how they can be utilized in innovative consumer products. Current research is developing scalable synthetic methods for making battery grade graphite, porous materials for hydrogen energy storage, computer memory devices (memristors), and atomically thin biosensing materials for medical diagnostic equipment. These technologies are developed through close partnerships with industry utilizing Cooperative Research and Development Agreements (CRADA).
- EVALUATING THE ECONOMIC AND ENVIRONMENTAL IMPACT OF DEPLOYING COAL/BIOMASS MANUFACTURING TECHNOLOGIES: This research area focuses on providing the market, technoeconomic, and environmental analyses required to evaluate the commercial potential of carbon products made from coal and coal/biomass feedstocks. Current efforts focus on the following: general characterization of carbon material markets; the impact new technologies will have on domestic jobs and revenue; and the environmental footprint associated with these new technologies in comparison to traditional methods of manufacturing. Recent systems of interest include carbon fiber for lightweight automotive vehicles, carbon-based construction materials, carbon foams for extreme environments, and carbon nanomaterials.



This image shows a functional memristor computer memory device fabricated in a collaborative project between NETL and the University of Illinois at Urbana-Champaign. The atomically thin dielectric carbon film used as the switching media in this device is made directly from domestically sourced coal and outperforms the metal oxide films typically used for this application.

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