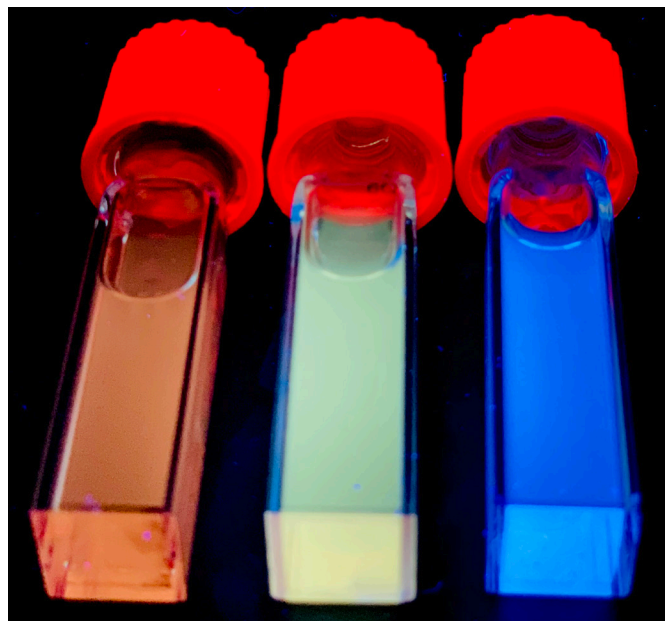# COAL MAT

NETL

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OVERVIEW

Coal is an abundant natural resource in the United States, and although it's typically associated with energy production, its utility is far more wide ranging. Coal, or additives from coal, can be used to manufacture or improve a wide range of common consumer products, including carbon fiber, computer electronics, paints & coatings, textiles, cements, plastics, water filtration devices, and battery materials — to name just a few examples. These exciting applications offer new business opportunities for the coal industry and bring innovative consumer products to market. In fact, utilizing coal feedstocks to manufacture high performance materials is a rapidly growing area of commercial interest and NETL is a key technical leader in this field.

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U.S. DEPARTMENT OF **ENERGY**

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COAL MAT

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To support innovative uses for domestic coal feedstocks, NETL recently launched the Consortium on **Coal**-based Carbon **Mat**erials Manufacturing (**COAL MAT**). COAL MAT brings together national laboratories, universities, community partners, and industrial firms to develop new materials and manufacturing technologies that utilize domestic coal and its byproducts as the carbon feedstock. COAL MAT has 3 primary technical thrusts:

- **Coal-based Materials Manufacturing Technologies**: Research in this area focuses on developing new bench- and pre-pilot- scale manufacturing processes that utilize domestic coal feedstocks directly. Initial efforts are investigating approaches to manufacture carbon fiber and carbon fiber reinforced polymer from domestically-sourced coal pitch. Future areas of interest include battery manufacturing and 3D printing processes.

- **Materials Discovery and Design**: Research focuses on developing new material systems made from coal 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 graphene materials and optimizing their chemical and physical compatibility with common manufacturing processes, composites, and devices. These materials are then evaluated for performance and cost in applications including: additives for enhancing cement; asphalt, and polymer composites; water filtration materials; carbon electronics; and stain, water, and ice resistant coatings. Future areas of interest include battery materials and 3D printing materials.

- **Systems Engineering and Analysis**: This area focuses on providing the market, technoeconomic, and environmental analyses required to evaluate the commercial potential of carbon products made from domestic coal feedstocks. Current efforts are focusing on identifying the full range of carbon products that can be made from coal and evaluating the technology, performance, cost, and entry barriers associated with introducing new coal-based products in these markets. Other areas of interest involve evaluating the precise impact new coal-based manufacturing technologies will have on employment in the U.S.

RESEARCH AND INDUSTRIAL PARTNERSHIPS

COAL MAT researchers work closely with industrial partners that help steer research results to commercially relevant conclusions. Through this partnership:

- Oak Ridge National Laboratory (ORNL), the University of Kentucky's Center for Applied Energy Research (UKy-CAER), and Ramaco Carbon are collaborating to use domestic coal-based pitch to make carbon fiber technologies for automotive applications.

- NETL and ORNL are investigating novel coal materials for battery manufacturing applications.

- NETL, Carbon Technology Company (CTC), and the Russell County Industrial Development Authority (RC-IDA) are evaluating the potential of carbons derived from coal char for enhancing cement composites for construction applications.

- NETL, the Massachusetts Institute of Technology (MIT), and Ramaco Carbon are collaborating to produce carbon materials for use in coal-based water filtration membranes and sorbents.

- NETL and the University of Illinois Urbana-Champaign are working to create new thin film dielectrics from coal for use in computer memory devices and electronic packaging applications.

- NETL and the University of Pittsburgh are collaborating to make coal-based coating systems with an engineered resistance to stains, water, and ice.

- NETL and ORNL are providing analyses of the market opportunities for coal-based carbon products and assessing the technical, cost, and environmental barriers associated with commercializing these products.

TECHNOLOGY LICENSING & COOPERATIVE RESEARCH OPPORTUNITIES

- **Cost-effective Process for using Domestic Coal to Manufacture Graphene for use in Commercial Products** (U.S. Patent Pending): This invention is available for licensing and Cooperative Research and Development Agreement (CRADA) opportunities. The technology converts lignite, bituminous, and anthracite feedstocks into graphene that can be sold to OEMs and Tier 1 and 2 firms for applications including: automotive & structural composites, carbon electronics, water purification materials, battery materials, and specialty paints and coatings. NETL's technology also co-produces rare earth elements (REEs) and distilled coal liquids, which have their own markets and help maximize the profitability of a coal-based manufacturing process. Additional details: www.netl.doe.gov/node/8689

- **Additional Technology Transfer Opportunities:** The projects outlined in this factsheet are available for additional research and development partnerships with industry through CRADAs, Contributed Funds in Agreements (CFAs), Work for Other (WFO) arrangements, and other technology transfer agreements. For additional details, please contact Dr. Christopher Matranga, Technical Director for COAL MAT: christopher.matranga@netl.doe.gov

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