

FUNCTIONAL MATERIALS TEAM

The Department of Energy's (DOE) National Energy Technology Laboratory's (NETL) Materials Engineering and Manufacturing (MEM) Core Competency Directorate is internationally recognized for its expertise in designing, developing and deploying advanced structural materials and tailored functional materials for use in energy applications and extreme service environments. The MEM Directorate is organized into three teams that collectively maintain NETL's applied materials science and engineering competency: 1) Structural Materials Team, 2) Functional Materials Team, and 3) Materials Characterization Team.

R&D227, May 2024



FUNCTIONAL MATERIALS TEAM

The Functional Materials Team (FMT) seeks to design, develop and deploy advanced materials needed to enable efficient and sustainable carbon management surrounding modern energy platforms. These efforts focus on the design, synthesis, physical characterization and performance testing of nanomaterials, polymers, porous sorbents, ionic liquids, catalysts, membranes and electro-ceramics required for the next generation of carbon capture, gas separation, hydrogen production, carbon dioxide conversion, chemical looping, solid oxide fuel cells, chemical sensing, fuel processing and carbon materials technologies. The FMT is supported by a full complement of chemical synthesis laboratories; vapor-phase deposition equipment for materials growth; crystallographic and electronic structure characterization tools; surface science, imaging and analysis instrumentation; mineral processing and separation laboratories; membrane manufacturing and testing facilities; and sensor manufacturing and testing facilities.



CAPABILITIES

The FMT provides expertise in the design, synthesis, characterization and performance testing of carbon materials, catalysts, nanomaterials, polymers, solvents, sorbents, membranes, single-crystal optical fibers, functional sensor materials and electro-ceramics. These materials enhance the performance and reduce the costs of:



Mineral, coal, and natural gas processing



Combustion and gasification processes for generating power and heat



Solid oxide fuel cells (SOFC) for generating electricity



Separation/purification technologies for water, power plant, and mineral processing applications

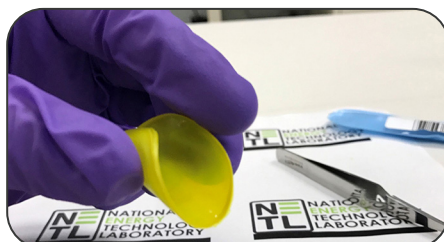


Magnetic alloys for power converters and the electrical grid

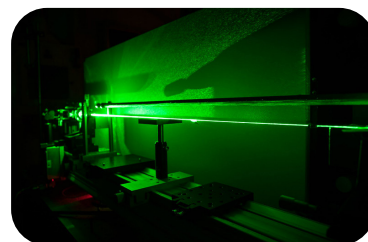
ON-SITE RESEARCH



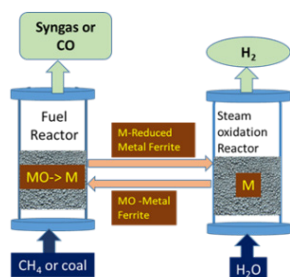
High-value carbon products from coal and natural gas feedstocks for converting into high-value carbon materials, characterizing performance and costs and integrating into innovative products.



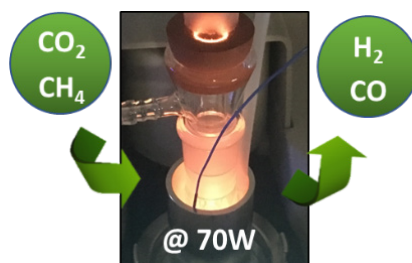
Membranes, sorbents and solvent materials development for gas- and liquid-solid separation for applications such as pre- and post-combustion carbon dioxide capture, rare earth elements from coal and coal byproducts, and water purification.



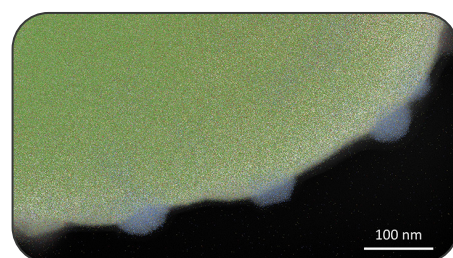
Harsh environment sensors for providing customized state of the art sensor solutions to customers in the fossil energy, nuclear and industrial sectors.



Materials with long-term chemical and mechanical stability for catalytic and non-catalytic processes for economically converting natural gas or coal to hydrogen and high-value carbon materials to achieve a commercially viable process.



New technologies for converting carbon dioxide into industrially relevant chemicals and fuels and producing carbon-neutral products.



Rational catalyst design, synthesis and testing allows selective chemical reactions resulting in improved energy efficiency and reduced precious metal requirements.

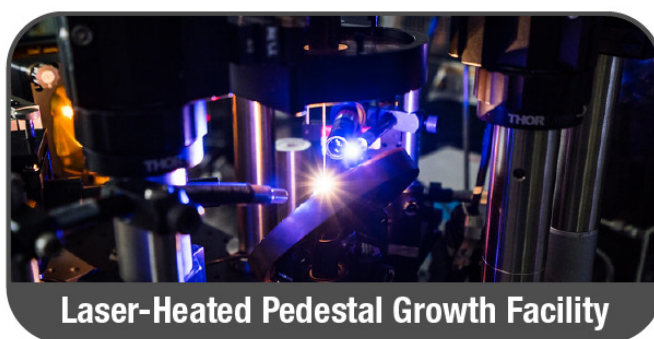
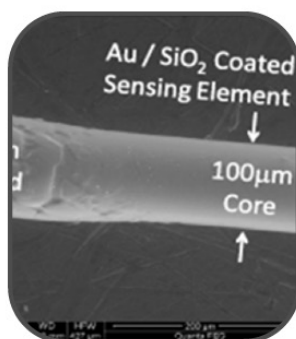
ON-SITE FACILITIES

The functional materials capability houses a full complement of chemical synthesis laboratories; vapor-phase deposition equipment for materials growth; crystallographic and electronic structure characterization tools; surface science, imaging and analysis instrumentation; mineral processing and separation laboratories; membrane manufacturing and testing facilities; and sensor manufacturing and testing facilities. Key facilities and equipment include:

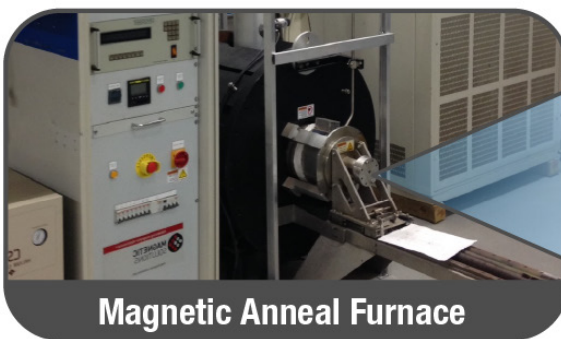
- Functional Materials Synthesis Laboratory, a fully equipped wet chemistry facility with over 4000 square feet of space.
- Full suite of testing facilities for evaluating separations materials, catalysts and sensor materials under ideal and real conditions.
- Microwave reactor facilities for catalytic reactions and materials processing.
- SOFC testing laboratory.
- World-class laser-heated pedestal growth facility for growing optical fibers of unlimited length.
- Power electronics/magnetic materials component fabrication and testing facilities.
- Surface chemical analysis and scanning probe microscopy facilities.



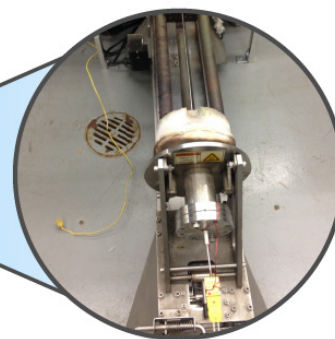
Hollow Fiber Spinning Apparatus



Laser-Heated Pedestal Growth Facility



Magnetic Anneal Furnace





NETL is a U.S. Department of Energy (DOE) national laboratory dedicated to advancing the nation's energy future by creating innovative solutions that strengthen the security, affordability and reliability of energy systems and natural resources. With laboratories and computational capabilities at research facilities in Albany, Oregon; Morgantown, West Virginia; and Pittsburgh, Pennsylvania, NETL addresses energy challenges through implementing DOE programs across the nation and advancing energy technologies related to fossil fuels. By fostering collaborations and conducting world-class research, NETL strives to strengthen national energy security through energy technology development.

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