the ENERGY lab

R&D FACTS

RESEARCH & INNOVATION CENTER

Materials Engineering & Manufacturing

Materials Engineering & Manufacturing Onsite Research

The National Energy Technology Laboratory (NETL) is the lead laboratory for the Department of Energy's Office of Fossil Energy research and development (R&D) program and has established a robust onsite research program. Federal scientists and engineers work closely with contractor organizations and researchers from universities to conduct cross-disciplinary research. Onsite R&D is managed by NETL's Research & Innovation Center (RIC), which makes important contributions to NETL's mission of implementing a research, development, and demonstration program to resolve the environmental, supply, and reliability constraints of producing and using fossil resources.

NETL's onsite R&D supports the laboratory's technology lines and external government and industry customers while pursuing knowledge, science, and technology with broad societal and industrial interest. NETL's research programs assist industrial and academic partners in solving problems that would otherwise become barriers to commercializing power systems, fuels, and environmental and waste management technologies. NETL uses a variety of partnership mechanisms to conduct R&D of mutual interest with academic and private-sector organizations.

Onsite R&D efforts utilize state-of-the-art capabilities and facilities in Morgantown, WV; Pittsburgh, PA; and Albany, OR. The onsite research programs have a core group of about 150 federal scientists and engineers. Supplemental site support is provided through contractors, who are selected through a competitive process, as well as research fellows and associates at the faculty, postdoctoral, graduate, and undergraduate levels. In total, approximately a quarter of NETL's approximately 1,400 federal and contractor employees are involved with the onsite research activity.

Materials Engineering & Manufacturing

NETL is internationally recognized for its leadership in designing, developing, and deploying advanced materials for use in energy applications and extreme service environments. Of particular note is NETL's ability to design, engineer, and evaluate materials at size and time regimes ranging from atomistic to pilot-plant scales. To accomplish this, NETL utilizes a one-of-a-kind suite of computational and experimental methods for translating new material science concepts into practical technologies.

CONTACTS

Cynthia Powell
Executive Director
Research & Innovation Center
412-386-7386
304-285-4536
541-967-5803
cynthia.powell@netl.doe.gov

Bryan Morreale
Deputy Executive Director
Research & Innovation Center
412-386-5929
bryan.morreale@netl.doe.gov

David Alman
Associate Director
Materials Engineering & Manufacturing
541-967-5885
david.alman@netl.doe.gov

NATIONAL ENERGY TECHNOLOGY LABORATORY

Albany, OR • Anchorage, AK • Morgantown, WV • Pittsburgh, PA • Sugar Land, TX

Website: www.netl.doe.gov

Customer Service: 1-800-553-7681

U.S. DEPARTMENT OF ENERGY

This unique competency has been successfully demonstrated in a number of innovations including:

- Radiopaque alloys for medical coronary stents
- Enhanced processing methods to improve armor materials for military applications
- Computational tools for heat treating and homogenization processing of superalloys for advanced steam turbines
- New heat-resistant alloys
- Commercially licensed modified chrome-oxide refractory brick material for slagging gasifiers
- Commercially licensed sorbents for removal of mercury, arsenic, and other impurities from flue gases
- Basic Immobilized Amine Sorbents (BIAS) for carbon capture.

Focused Research Areas and Capabilities

Functional Materials development focuses on the design, synthesis, physical characterization, and performance testing of the nanomaterials, polymers, porous sorbents, ionic liquids, and electro-ceramics required for the next generation of carbon capture, gas separation, chemical looping, solid oxide fuel cell, chemical sensing, and fuel processing technologies.

Laboratories and specialized equipment are available for the following material research applications:

- Production and characterization of solvents, solid sorbents, and membrane (mixed matrix, hollow fiber, and supported liquid) structures
- Separation materials evaluation in simulated flue/fuel gas conditions. Continuously stirred tank reactors for liquid solvents, fixed fluidized bed reactors for solid sorbents, isochoric and isobaric permeance testing for membranes
- Synthesis of metal, semi-conductor and oxide nanoparticles, nano-composites, and thin-films
- Evaluation of solid oxide fuel cell performance under simulated coal-derived fuel conditions
- Fuel processing for catalyst performance evaluation
- Evaluation of sensor materials performance under simulated subsurface and power generation conditions

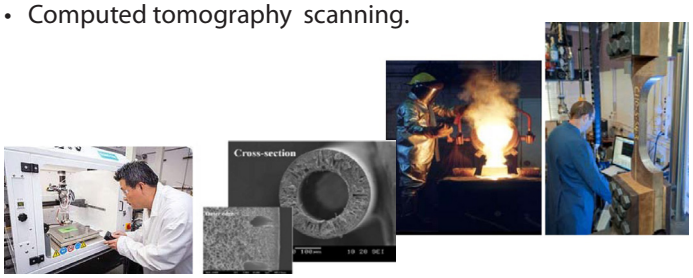
Structural Materials are being developed for use in extreme environments associated with combustion, turbine, gasification, drilling, and other applications. Research focuses on developing cost-effective materials that can withstand a combination of mechanical stress, and corrosive and erosive environments for upwards of 100,000 hours of service life. This is accomplished through improving existing alloys, designing new materials, and reducing manufacturing cost. Research also investigates corrosion, wear, hot-corrosion, oxidation, creep, and fatigue resistance. Expanding the knowledge base on these topics will enable researchers to develop materials that resist degradation in severe service environments and new models for service life predictions.

Research facilities include:

- Severe Environment Corrosion and Erosion Research Facility and related laboratories for assessing materials performance in simulated fossil fuel environments at high temperatures and high pressures
- Capabilities for fatigue and creep testing
- Laboratories for small-scale production and evaluation of refractory ceramic materials
- Facilities for melting, casting, forging, rolling, and heat-treating materials from a few grams to 100 kilograms

Materials Characterization uses NETL's full spectrum of onsite analytical techniques for determining chemical composition, microstructure, and surface analysis. These capabilities include:

- Optical microscopy
- Scanning electron microscopy (SEM), including an environmental SEM
- Transmission electron microscopy
- X-ray diffraction
- Wavelength dispersive x-ray fluorescence
- Inductively coupled plasma
- Laser ablation mass spectroscopy
- Fourier transform infrared spectroscopy
- Raman scanning tunneling microscopy
- Atomic force microscopy
- Scanning tunnel spectroscopy
- X-ray photoelectron spectroscopy (with reaction chamber)
- Brunauer-Emmett-Teller
- Thermogravimetric analysis
- Differential thermal analysis
- Differential scanning calorimetry
- Laser flash diffusivity
- Dilatometry
- Computed tomography scanning.



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