NATIONAL ENERGY TECHNOLOGY LABORATORY

ACCOMPLISHMENTS

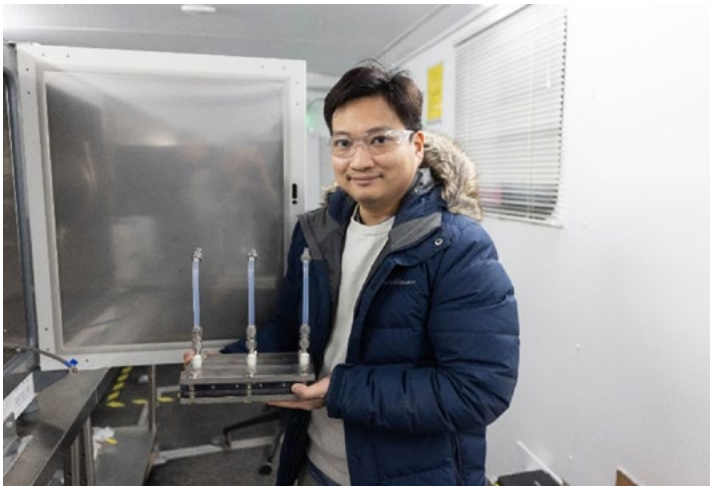
Q2 FY25

U.S. DEPARTMENT of ENERGY

NETL ACCOMPLISHMENTS

Quarter 2 – Fiscal Year 2025

Thien Tran Won Young Membrane Scientist Award for Gas Separation Membrane Research



NETL research scientist Thien "James" Tran won the Young Membrane Scientist Award, presented by the North American Membrane Society (NAMS), for his contributions in developing new gas separation membrane materials including separations from fossil-based industrial point sources such as electric power production, and steel and cement manufacturing. Tran is the second NETL scientist to receive the NAMS Young Membrane Scientist Award. Fellow NETL research scientist Lingxiang Zhu was honored with the award in 2023. Tran and Zhu have been instrumental in the development of NETL's high-performance gas separation membrane mobile test unit, which is undergoing field trials at the U.S. Steel Edgar Thomson plant in Braddock, Pennsylvania. Tran's contributions to membrane module design, material scaleup, and field testing are not only important to the success of NETL's work, but also to the commercial relevance of membranes for gas separations.

NETL Study Revealed New Biological and Chemical Insights of Bakken Shale Formation

A first-of-its-kind NETL research project involving the Bakken Shale is providing new insights into how subsurface variations affect well site operational and water management challenges. The Bakken Shale and underlying Three Forks Formation in the U.S. and Canada are important reservoirs of hydrocarbons that can be recovered using unconventional oil and gas extraction methods, including horizontal drilling and hydraulic fracturing. Although the region's geochemistry and microbiology are not well understood, they are known to have major implications for well site productivity and water management. A better understanding of the geochemistry and microbiology in the subsurface might lead to more efficient recovery operations with a reduced environmental footprint. NETL's research can also set a precedent for studying other formations. It showed that great variations can occur not only among different shale formations but also among different well sites located within the same formation.

NETL Contributed to Exascale Computing Project That Earned DOE Achievement Award

NETL contributed to the success of the Exascale Computing Project (ECP), which DOE recognized with an Achievement Award. The ECP Leadership Team completed a seven-year, $1.8 billion initiative that included contributions from nearly 3,000 multidisciplinary researchers and other staff. NETL supported the ECP by bringing its premier Multiphase Flow with Interphase eXchanges (MFiX) code to the next level, resulting in **MFiX-Exa** — which researchers are using for a range of studies, from conducting small-scale, high-fidelity simulations to investigate detailed physicochemical phenomena, to modeling large-scale engineering systems to assess performance. NETL developed MFiX-Exa to minimize risk and accelerate deployment of emerging energy technologies, making it a valuable tool for scientific exploration, design, optimization and scale-up. Work undertaken through the ECP resulted in the development and enhancement of 25 scientific application codes to provide breakthrough simulation results on exascale computers. Additionally, more than 70 software technology products were delivered in an integrated package widely used by the high-performance computing community

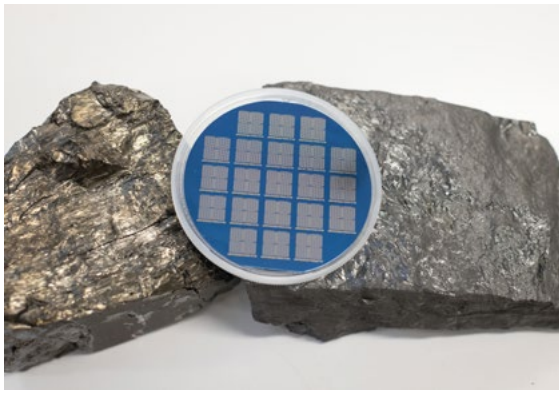
NETL's Christina Wildfire Won 2025 Federal Laboratory Consortium Award for Microwave Synthesis Work

For her work in developing microwave ammonia synthesis and enhancing America's energy security and prosperity in the process, NETL's Christina Wildfire won a 2025 Outstanding Researcher Award from the Federal Laboratory Consortium. Wildfire is an expert in microwave technology and helped to establish this capability within NETL. This area of research is considered a next frontier of science and holds the promise of disruptive innovation. She leads the Center for Microwave Chemistry, which is an NETL key lab initiative. With Wildfire's contribution, a partnership between West Virginia University, NETL, and Malachite Technologies led to the development of a process using microwaves to lower the processing temperature and pressure for ammonia synthesis, which will enable distributed ammonia production for local farm communities. She initiated the execution of 17 technology transfer partnership agreements, was the driving force behind development of new technology that led to two startups being formed and is currently leading development of a "think piece" around technology transfer as part of her Oppenheimer Science & Energy Leadership Program Fellow appointment.

NETL Helped Develop Microscopic Cementing Agents To Seal Underground Fractures

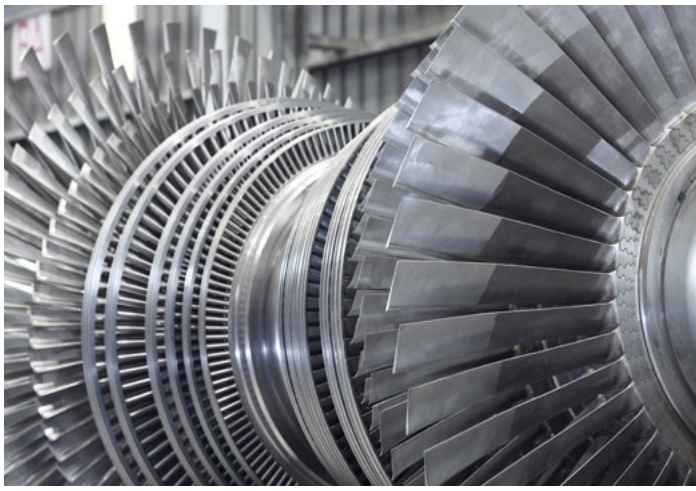
NETL helped scientists at Montana State University evaluate microscopic cementing agents developed by the University that can more effectively penetrate microfractures to improve underground storage of carbon dioxide, enhance gas well efficiency and seal fluid pathways in shales fractured for natural gas recovery. The research targeted use of a process called ureolysis-induced calcium carbonate precipitation (UICP), which produces a biomineral solution that can reduce undesired fluid flow. This could enable the more effective restimulation of previously hydraulically fractured shale formations and reduce flow through fractured rocks above storage formations. UICP is used to strengthen and stabilize soils, repair cracks in concrete, solidify heavy metals, and it presents a viable opportunity to control permeability — a measure of the ability of a fluid or gas to pass through a material — in underground well bores and CO_2 storage sites.

International Research Journal Designated NETL Publication on Coal-Based Microelectronics as Editors' Choice



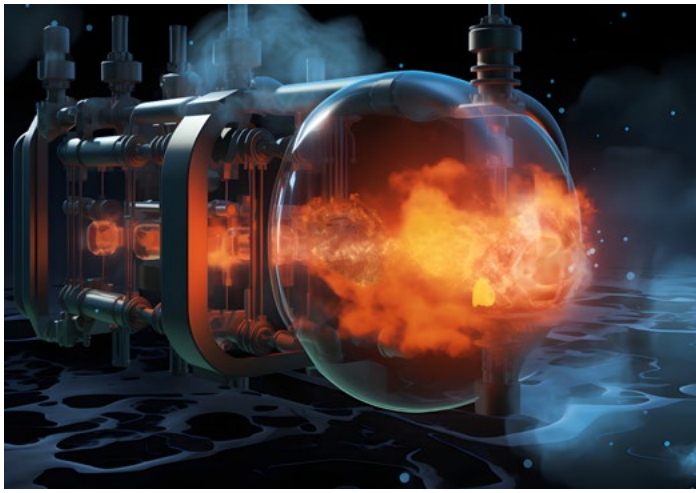
Nature Portfolio's Communications Engineering publication designated a technical article authored by an NETL-led team as an editor's choice. The article, which discusses a process for using coal as a manufacturing feedstock for high-tech products like computer microelectronics, was one of only 14 selections for the recognition. In addition to NETL researchers, authors on the article, "Ultrathin quasi-2D amorphous carbon dielectric prepared from solution precursor for nanoelectronics," also included experts from the University of Illinois Urbana-Champaign, Oak Ridge National Laboratory, and Taiwan Semiconductor Manufacturing Company. The article describes a versatile solution-deposited approach to creating dielectrics, which can help reduce energy consumption of computer microelectronics by five-to-twentyfold and double the speed potential. Dielectrics are insulators that help separate positive and negative charges.

NETL Developed Simulation To Study How Corrosion Occurs on Gas Turbines' Barrier Coatings



NETL researchers reported a breakthrough in efforts to extend the life and improve the efficiency of energy-producing gas turbines by refining a process that can simulate how corrosion-causing thermally grown oxide develops and causes cracking in the environmental barrier coatings (EBCs). This development is crucial for protecting next-generation turbine blades from thermal cycling damage. Better coatings can lead to more effective, longer-lasting gas turbines. In the NETL approach, researchers performed large-scale three-dimensional simulations to model the formation of interconnecting cracks. The simulations provide insights into EBC cracking and its dependence on the coating system's structure and properties. The results highlight the potential of the damage model as a useful tool for designing more durable EBCs. The researchers reported their success in a paper published in the journal Acta Materials, titled "Phase-Field Modeling of Thermally Grown Oxide and Damage Evolution in Environmental Barrier Coatings."

NETL Created Cost-Saving Process To Produce Syngas from Coal



NETL researchers developed and patented a novel catalytic steam gasification process for producing nitrogen-free, hydrogen-rich syngas streams from coal and biomass — a method that can reduce the cost of traditional syngas production. According to Ranjani Siriwardane, a research physical scientist with NETL's functional materials team who conducted key research and co-authored a paper about the breakthrough with NETL researchers Jarrett Riley and Chris Atallah, the new process is different from traditional catalytic gasification because the catalyst resides in the reactor bed and enhances the rates of coal conversion. Because the resulting syngas stream in the process does not contain nitrogen, there is no need for expensive air separation units that are used in traditional gasification processes. In addition, hydrogen-rich syngas production rates in the new catalytic process are significantly faster than coal/steam under similar reaction conditions. The process can also be used to produce syngas from other solid fuels such as biomass like wood chips in addition to coal.

DOE Recognized NETL Security Specialist for Excellence

NETL's Jonathan White was named the DOE Security Professional of the Year (Federal Employee) in recognition of his exemplary service essential to the continued safe and efficient protective mission of DOE and the Office of Fossil Energy and Carbon Management. Per DOE, White has demonstrated a high degree of technical expertise and a continual quest for improvement. It was noted that White's selection for the award "recognizes [his] dedication, superior technical knowledge, demonstrated results and commitment to excellence."