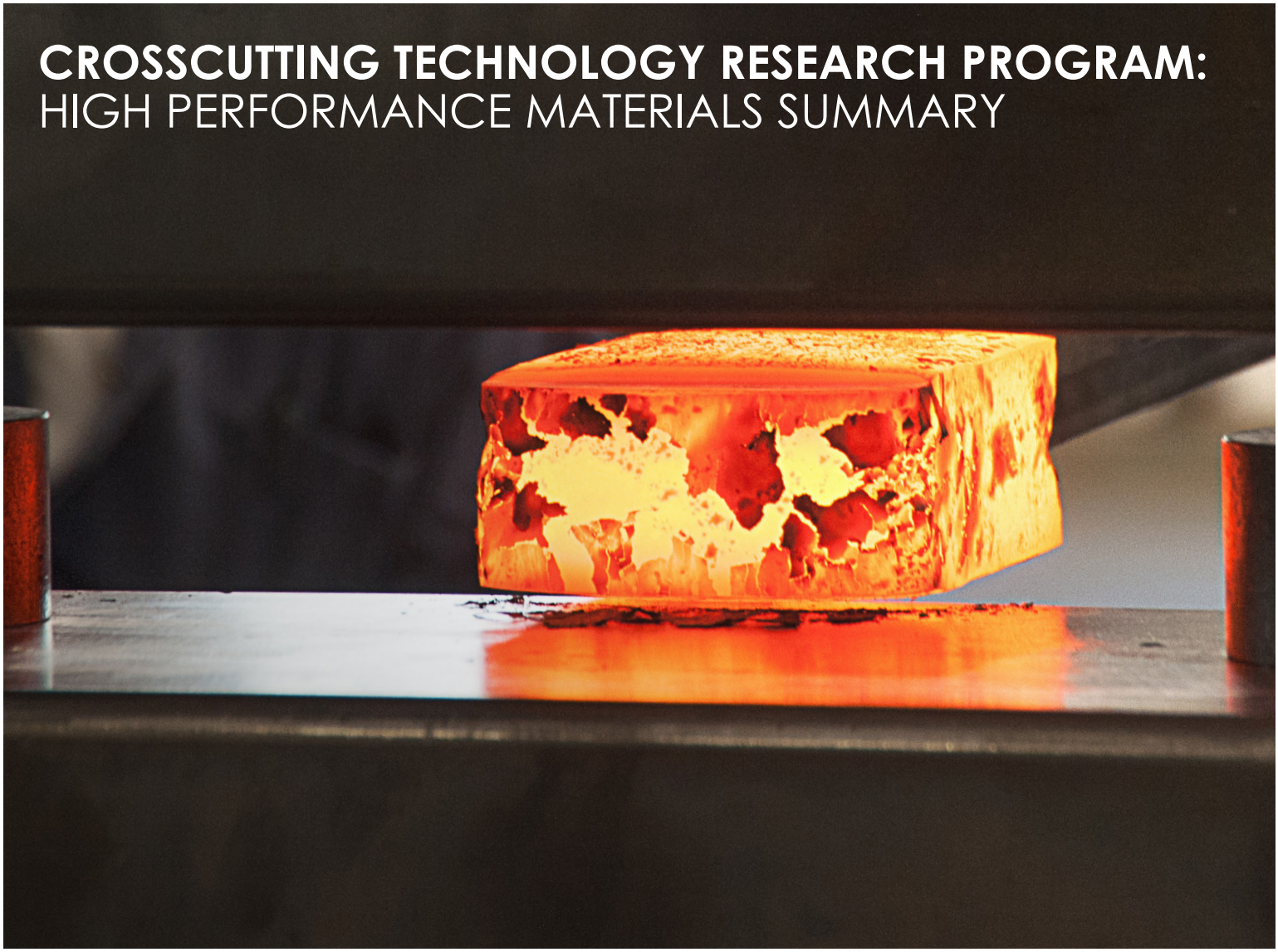
CROSSCUTTING TECHNOLOGY RESEARCH PROGRAM:
HIGH PERFORMANCE MATERIALS SUMMARY



NETL

NATIONAL ENERGY TECHNOLOGY LABORATORY

OVERVIEW

High-Performance Materials focuses on materials that will lower the cost and improve the performance of fossil-based power-generation systems. New materials are essential for advanced power generation systems with carbon capture and storage capability to achieve performance, efficiency, and cost goals. Materials of interest are those that enable components and equipment to perform in the harsh environments of an advanced power system. There are four primary research areas where work is being focused.

HIGH PERFORMANCE MATERIALS

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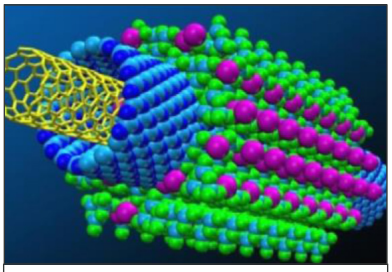
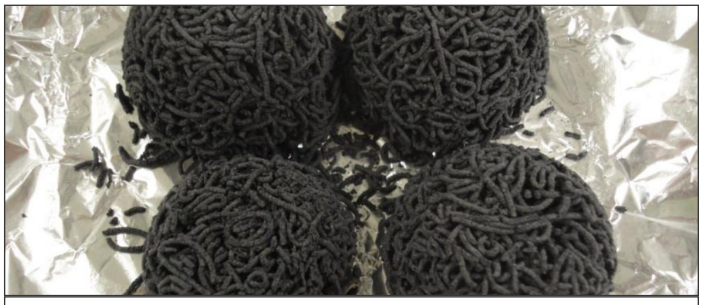


Computational Material Design

Computational Based Materials Design and Performance Prediction utilizes computational materials modeling to enable rapid design and simulation of new and novel alloys. Computational methods are also used to provide validated models capable of simulating and predicting long-term performance and failure mechanisms of the newly developed materials.

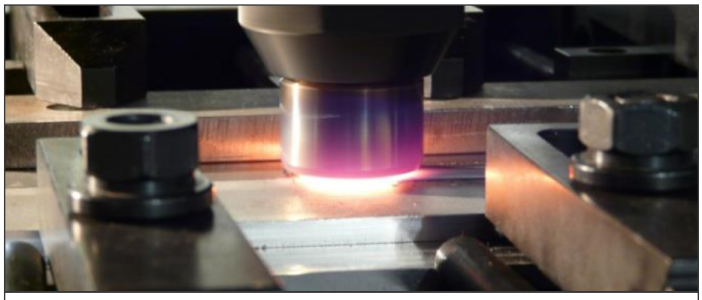
Inconel®740H Pipe after Extrusion at Wyman-Gordon

Advanced Structural Materials for Harsh Environments research provides advanced materials that enable deployment of transformational technologies that are capable of operating in the harsh environments (e.g., high temperature and pressure) associated with these new technologies. Both improved alloys and coatings are developed that meet the application and performance criteria for the high-temperature corrosive environments for advanced power systems. Operation of power systems at higher temperature and pressure are the key to achieving higher efficiencies and reducing environmental foot print. NETL is working with Industry as a part of the advanced ultrasupercritical consortium (AUSC) to develop and certify new materials for advanced power systems applications. These new materials can also be used to upgrade existing power systems to improve their performance and enhance their ability to provide cycling service as more renewable energy resources are deployed.



Oxygen Carrier Pellets for Chemical Looping Prepared from Extrusions (University of Toledo)

Functional Materials for Process Performance Improvements research develops advanced functional materials that enable deployment of transformational process technologies that are capable of operating in the harsh environments associated with these new technologies. (e.g., refractory, sorbents, catalysts, chemical-looping oxygen carriers, and high-temperature thermo-electrics).



Friction Stir Welding of ¼" Thick Dispersion Strengthened Sandvik APMT Plate

Advanced Manufacturing for High Performance Structural and Functional Materials provides technologies to fabricate and assemble components using the techniques and materials developed for transformational technologies. Fabrication, workability, and joining of advanced components are also demonstrated.

IMPACTS AND BENEFITS

The following impacts are possible through this proposed research:

- Accelerating the selection of materials for fossil-energy applications
- Utilizing multi-scale computational methods with focused validation experiments to predict alloy behavior in a variety of relevant environments
- Developing techniques for the virtual and rapid design of materials using advanced manufacturing
- Providing specimens for demonstration of component life through advanced alloy design and manufacture
- Facilitating process intensification for lowering cost, reducing material requirements, and shortening lead times
- Allowing production of parts with complex geometries through advanced manufacturing

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