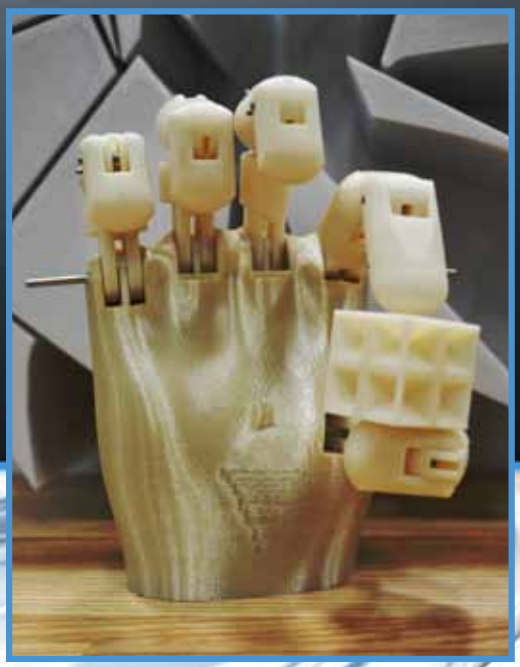
Additive Manufacturing

REALIZING THE PROMISE OF NEXT-GENERATION MANUFACTURING



Innovative Materials and Manufacturing Technologies to Make Next-Generation Products

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

Next-Generation Manufacturing

Oak Ridge National Laboratory is working with additive manufacturing equipment manufacturers and end users to revolutionize the way products are designed and built. Our research and development in this crucial field are enabling a wealth of opportunities for product customization, improved performance, multifunctionality, and lower overall manufacturing costs. Not only does additive manufacturing remove the traditional limits on part geometry, but highly complex components can also be fabricated faster while consuming less material and using less energy. Additive manufacturing also eliminates the need for expensive part tooling and detailed drawing packages, causing a paradigm shift for the design-to-manufacture process.

ORNL has a long history of working closely with industry and offers world-leading capabilities in materials development, characterization, and processing. It also has specialized facilities for modeling and simulation, creating an unmatched environment for breakthroughs in additive manufacturing.

What Is Additive Manufacturing?

Additive manufacturing creates components directly from a computer model, adding material only where needed, which means unlimited design flexibility, decreased energy consumption, and reduced time to market.

Strategy for Success

Through collaboration with every aspect of the manufacturing supply chain, ORNL is identifying the critical equipment and materials advancements required to establish additive manufacturing as a mainstream manufacturing process and help realize the vast potential of this technology. Research and development projects currently under way will ensure additive manufacturing center-stage status in the next-generation manufacturing process by

- Expanding current build volumes
- Optimizing build parameters to increase deposition rates
- Integrating smarter in situ process controls for rapid certification and quality control
- Developing new materials and technologies for improved material properties
- Investigating alternate low-cost feedstock materials
- Increasing performance enhancements for materials, materials combinations, and functionality of components

Tools for Innovation

ORNL's Manufacturing Demonstration Facility (or MDF) includes comprehensive additive manufacturing capabilities. These technologies significantly impact numerous application areas, from aeronautic to robotic and automotive to biomedical. For aerospace components this design-to-manufacture process has already demonstrated the potential to reduce the buy-to-fly ratio from an industry average of 8:1 (that is, 8 pounds of material will produce 1 pound of aerospace-quality material) to nearly 1:1. The increased design flexibly has also enabled radical improvements in anthropomorphic designs for robotic manipulators—allowing internal routing of hydraulic and pneumatic lines for actuation—and reduced the design-cycle time from months to days. This revolutionary process also enables the customization of biomedical implants as well as surface modifications for increased biocompatibility. And new fluid-powered systems, from large multi-ton material-handling equipment to very small biomedical devices, are being developed in partnership with several companies to create next-generation additive manufacturing systems, consumables, and application concepts.

Metal Powder Bed Consolidation
uses a high-power electron or laser beam to create a site-specific melt pool in a bed of metal powder.

Direct Metal Deposition
uses inert gas to spray powder into a melt pool created by a high-power laser beam.

Polymer Extrusion
uses a heated nozzle to deposit small beads of thermoplastic material into a two-dimensional pattern.

Ultrasonic Consolidation
is a low-temperature joining process that uses ultrasonic energy to bond thin sheets of material to produce a three-dimensional component.

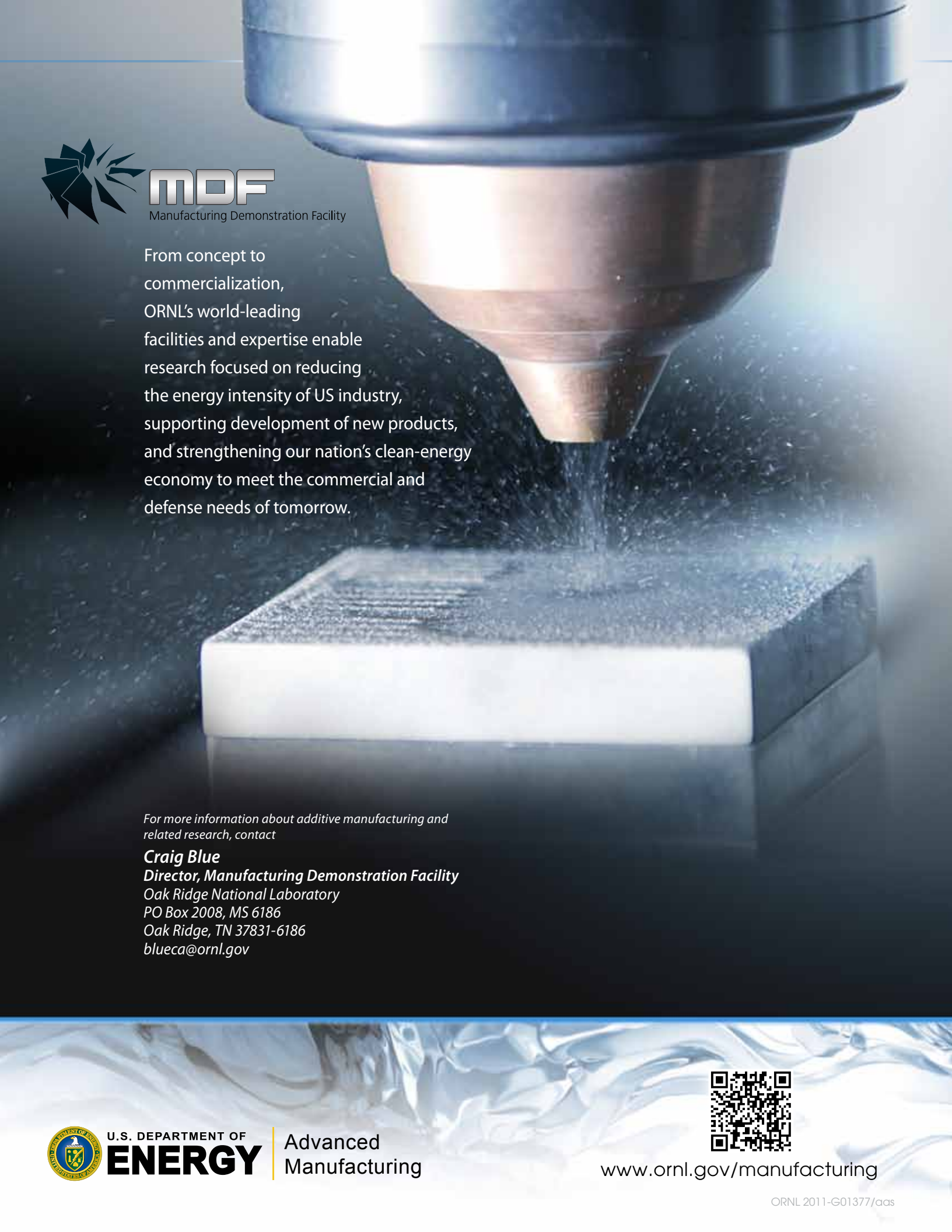
Working with ORNL

The MDF gives industries access to unique research facilities and reduces their risk for adopting cutting-edge manufacturing technologies. ORNL has decades of experience working with industry through a variety of business agreements and recognizes the importance of protecting intellectual property.

Through the MDF the Advanced Manufacturing Program at ORNL offers a fertile environment for innovation, ensuring that new technologies and design methodologies are developed in the United States and high-tech enterprises have the infrastructure to flourish here. Such critical advances in manufacturing technologies will provide the basis for high-quality jobs for Americans and sustain US competitiveness in the 21st century.

STEM Education

ORNL is introducing the next generation of engineers to the next generation of manufacturing by working with student teams from regional high schools to create prototypes, components, and working systems to support entries in the FIRST Robotics Competition, a nationwide event that promotes science and engineering among high school students.



MDF
Manufacturing Demonstration Facility

From concept to commercialization, ORNL's world-leading facilities and expertise enable research focused on reducing the energy intensity of US industry, supporting development of new products, and strengthening our nation's clean-energy economy to meet the commercial and defense needs of tomorrow.

For more information about additive manufacturing and related research, contact

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