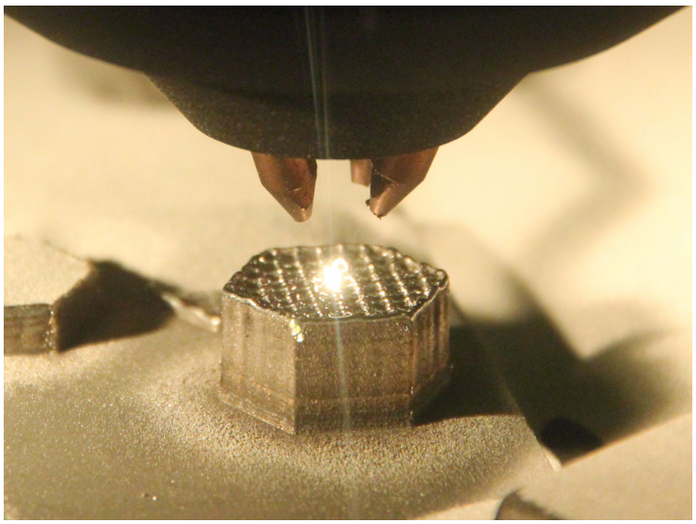
Manufacturing Innovations for U.S. Economic Competitiveness

U.S. DEPARTMENT OF ENERGY

President Obama's National Network for Manufacturing Innovation consists of regional hubs that will accelerate the development and adoption of cutting-edge manufacturing technologies for making new, globally competitive products. Consistent with that vision, the U.S. Department of Energy (DOE) is establishing Manufacturing Innovation Institutes.

Recent technology advances provide DOE and its National Laboratory System with unique opportunities to help industry develop next-generation solutions to this century's manufacturing challenges. DOE investments focus on technologies and practices to improve the competitiveness of U.S. businesses through increased energy productivity and manufacturing of clean energy products.

By supporting high-tech manufacturing, National Lab expertise is also helping to create high-paying jobs, strengthen national security, and accelerate product development. Industries from automotive to aerospace are already benefitting.

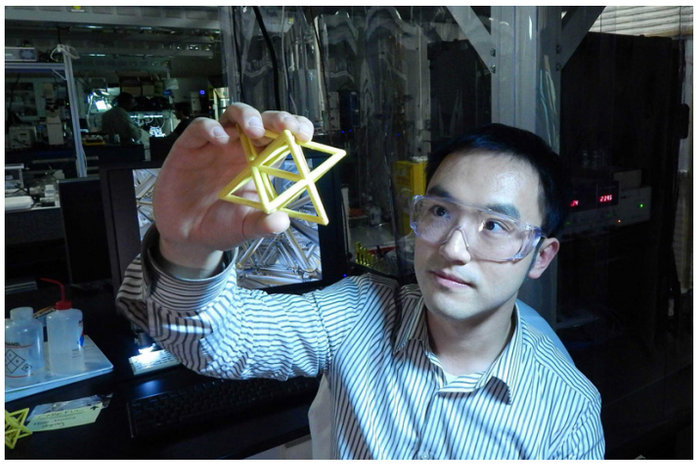


DOE laboratories are using 3D printing to create new alloys from powdered metals. The 3D printer allows rapid prototyping of samples with slightly different compositions so that scientists can determine which alloys offer the best characteristics for a particular purpose.

SUBTRACTIVE-TO-ADDITIVE MANUFACTURING

Additive manufacturing is a disruptive technology that has recently exploded on the manufacturing scene as leading companies transition from "subtractive" production methods, such as machining from cast or bulk material, to digital methods that use "additive" technologies. Often referred to as 3D printing, additive manufacturing is a way of making products and components of almost any shape directly from a digital model. Additive manufacturing is deeply rooted in the National Lab System, which played a significant role in many of the specific breakthroughs needed to advance this technology. Ongoing work at the National Labs is focused on further innovations that will help U.S. manufacturers improve design, reduce inefficiencies in material use and energy consumption, and reduce the time required to advance from concept to part fabrication.

- DOE established a Manufacturing Demonstration Facility to help industrial clients rapidly adopt additive manufacturing technologies. More than 400 companies have visited the facility within the last year to learn about this state-of-the-art process and how it might affect their industry.
- DOE is forming a National Additive Manufacturing Innovation Institute to help U.S. companies increase their capabilities and strength in additive manufacturing by fostering collaborations among industry and research leaders.



New discoveries in additive manufacturing at DOE laboratories have led to ultralight and ultrastiff materials that can be used to advance the automotive and aerospace industries.

SUSTAINABILITY AND RESOURCE STEWARDSHIP

For more than 30 years, the National Labs have been at the leading edge of efforts to research and develop renewable fuels and bioproducts. In 2000, DOE created the National Bioenergy Center to promote collaboration in this area across the National Lab System. Several labs have been working for more than a decade to develop cost-competitive alternatives to conventional fuels and chemicals that can be used to manufacture clothing, plastics, lubricants, and other products.

Another area of manufacturing that is poised for transformational change involves composites made from recyclable, renewable raw materials. The chemistry currently used to produce composites makes them non-recyclable, posing a very significant waste disposal issue. In collaboration with industry, researchers at the National Labs are exploring alternative chemistries for glass and carbon fiber composites that will allow components made from these materials to be recycled at the end of their service life. Similar innovative manufacturing methods are being used to develop advanced ceramic armor for the U.S. military.

Bioenergy research facilities at the National Labs are developing ways to sutainably transform biomass into fuels, electricity and other products.

- DOE supports the emerging U.S. biomanufacturing industry with a network of unique facilities that are available to industry partners. These include process development facilities involved in biochemical biomass conversion research, thermochemical bioprocess development facilities, biomass feedstock harvesting and processing facilities, and bio-based carbon fiber manufacturing facilities.

- DOE is working to develop biomass-based carbon fiber composites. These composites are strong and very light, with applications in technologies that improve energy efficiency. The ability to produce carbon fiber composites from biomass-derived materials could open the door to sustainable, cost-effective, high-performance, renewable carbon fiber products.

ACCELERATED QUALIFICATION OF MATERIALS: SIMULATION, SENSING, AND PROCESS CONTROL

High-technology manufacturing in the U.S. will be built on a growing foundation of advanced fabrication methods, producing a rapidly expanding list of materials with specialized functionality that are made with sustainable components. New materials are being designed in laboratories to address projected shortages in critical materials – such as rare earth elements and certain precious metals – that are widely used in batteries and renewable energy applications. The flexibility of new manufacturing methods opens the door to layered structures and composite materials with unique properties that cannot be produced using conventional casting processes. High-performance computer modeling and simulation, process monitoring, and sensing tools are also accelerating the development of these new processing methods.

- DOE's Energy Systems Integration Facility is developing in-line diagnostic methods to perform 100 percent inspection for defects during processing of polymer membranes for hydrogen-powered fuel cells.

- National Lab scientists and engineers are developing metal powder bed additive manufacturing modeling in an effort to gain insights on process optimization and accelerated process qualifications.

Using state-of-the-art transmission electron microscopes, National Laboratory researchers take images of specimens that can be as small as a few billionths of a meter, revealing their atomic structure and chemical "fingerprints." Scientists use this information to develop new and improved materials to address fundamental energy challenges.

For more information about our National Laboratory System:

DOE Website: energy.gov/science-innovation/national-labs

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