the ENERGY lab

ADVANCED TURBINES

SUCCESS STORY

SBIR Program Reaches Large-Scale Turbines through Mikro Systems – An Office of Fossil Energy SBIR Success Story

Overview

Small Business Innovation Research (SBIR) is a U.S. Government program in which federal agencies set aside a fraction of their budgets for competitively based funding of research and developement (R&D) by small businesses. For example, an annual solicitation is issued by the Department of Energy (DOE) inviting small businesses to apply for grants on a wide range of topics, which typically include energy production, energy use, and fundamental energy sciences.

SBIR projects are awarded in phases. Phase I explores the feasibility of innovative concepts with awards of up to $100,000 for about nine months. Successful Phase I applicants may compete for Phase II, the principal R&D effort, with awards of up to $750,000 over a two-year period. Following a favorable outcome in Phase II, an optional Phase III award may be granted, in which non-federal capital is used to pursue commercial applications of the small business R&D effort. Phase III funding may be augmented by (non-SBIR) federal agency funds provided the work is consistent with the mission needs of the agency.

The SBIR program is positioned to leverage the agility and innovative competencies of small businesses. It is through this program that Mikro Systems Inc. (Mikro), a small company in Charlottesville, Virginia, has developed a way to revolutionize the gas turbine industry's casting process. SBIR investment in this small business will likely result in additional U.S. jobs, as well as more efficient and cost-effective gas turbines that have lower emissions of both criteria pollutants and carbon dioxide (CO_2).

Ceramic casting core with an intricate, fine-featured trailing edge produced by Mikro Systems with NETL-funded technology.

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What is Mikro Doing for the DOE Office of Fossil Energy?

The next generation of gas turbine engines must run hotter in order to provide improved performance, efficiency, and reduced emissions. To meet these goals, new turbine blade designs are needed that have improved internal cooling passages, which allow the blades to withstand higher operating temperatures.

With assistance from a DOE National Energy Technology Laboratory (NETL) Phase I SBIR award, Mikro has developed a unique ceramic core casting technology (TOMO^{sm}) that permits the intricate design and casting of enhanced heat transfer features on gas turbine blades. The Mikro approach allows new cooling surface features to be created that would not be possible with current casting processes. Further, this alternate core casting technology will seamlessly integrate into existing multimillion dollar casting processes used by the industry and quickly revolutionize the industry's ability to enhance both existing and future turbines with new blade designs.

More specifically, the Mikro approach is a breakthrough technology for both development and manufacture of ceramic casting cores. It enables faster and lower-cost development of advanced gas turbine blades, and the process can be scaled up for volume production. Further, the Mikro technology supports design features that would not be possible to produce with conventional core casting technology. Production lead time can be improved by 70 percent and development costs reduced by as much as 50 percent when compared to conventional core casting manufacturing processes. A cost advantage was also demonstrated with tooling costs amounting to $50,000-$100,000 compared to $250,000-$300,000 for conventional tooling.

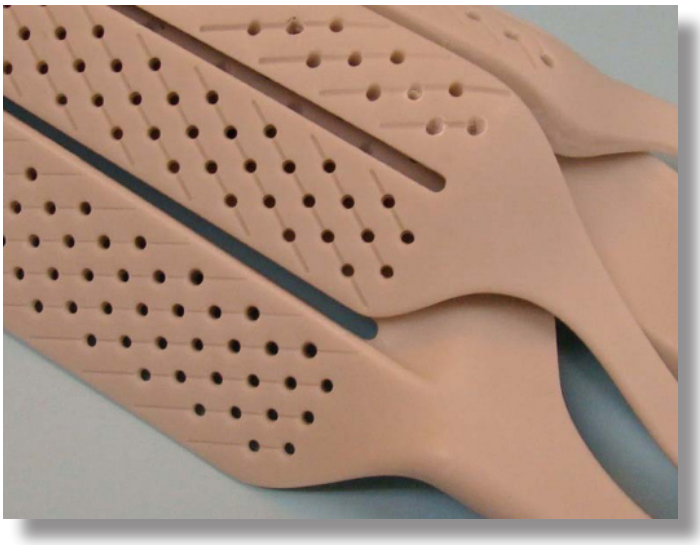
Why Turbines?

Improved heat transfer within gas turbine blades will result in increased performance, lower cost, and reduced emissions per unit of power generation. Advanced heat transfer surface designs will permit higher operating temperatures and less cooling flows, both of which will contribute to better performance. This small but significant design improvement will have significant energy related benefits for gas turbines for power generation. These same improvements in heat transfer surface designs will benefit commercial and military flight applications, natural gas fueled turbines, and turbines for coal based integrated gasification combined cycle (IGCC) power applications with CO_2 capture.

Gas turbine-based power generation currently accounts for about 19 percent of the electric power produced in the United States. Two hundred fifty gigawatts (GW) of new generating capacity will be needed from 2009 to 2035. Forty-six percent of this new capacity is projected to be natural gas fueled turbine-based power plants, significantly surpassing the added capacity from all other sources (U.S. EIA 2010 Annual Energy Outlook). The low carbon intensity of natural gas and the high efficiency of gas turbine-based power plants make this technology the lowest emitter of uncontrolled CO_2 per unit of power generation.

More on Mikro Systems Inc.

Mikro is a high-technology manufacturing company located in Charlottesville, Virginia, whose customers include international high-technology companies, as well as government and academic institutions. Mikro Systems Inc. leverages their patented TOMO^{sm} technology— a manufacturing technology that uses precision, three-dimensional, lithographically derived tooling to make complex shapes and parts from a variety of materials— to partner with organizations to develop higher-performance products and advanced product development and manufacturing processes.



Advanced cooling surface features in a multi-wall casting core that cannot be produced using conventional technology.