# HOT TOPICS

## SBIR SUPPORTS A NEW FRAMEWORK FOR ADVANCED MATERIALS DEVELOPMENT

Divert and attitude control systems (DACS) are fast-acting propulsion systems that control the positioning of missiles, satellites, and other spacecraft. Essentially, DACS are small rocket thrusters mounted on a space vehicle that, when fired in very short bursts, rotate, or slightly shift the vehicle's orientation angle (attitude). DACS tend to be hypergolic—injecting two chemicals that spontaneously combust on contact—sending the hot gasses in one direction and the vehicle in the other. In a military setting, this provides enhanced agility that is essential for successful target interception.

When the U.S. Department of Defense (DoD) Missile Defense Agency (MDA) formally announced, via the Small Business Innovative Research (SBIR) program, the need for new lightweight, erosion resistant, high performance (temperature and pressure), domestically sourced materials to use with liquid gel for DACS components, Maine-based Fiber Materials, Inc. (FMI) answered the call. A material solutions company, FMI develops and manufactures high temperature materials and composites for industrial, commercial, and aerospace applications.

According to Keith Meiler, FMI's Senior Development Engineer, "The project meshed with our core strength and equipment capability. It was a good fit for us in that it was not too different from what we were already doing. Because of our history and working relationships with MDA and prime propulsion suppliers, it was like being in the right place at the right time—it was three entities coming together to conceive a pathway forward."

The technological innovation sought by MDA was for space vehicle control, interceptor systems, and improved missile hit probability. Of critical concern was the ability to transition away from higher-density, rare, internationally mined metal construction to a domestically sourced ceramic matrix composite with pressure capability of 1000 pound-force (lbf)—greater than the state-of-the-art at the time. And the material had to be engineered for use with systems operating in the 3000˚F temperature realm.

Working in collaboration with prime suppliers allowed FMI to evaluate their innovative materials in a hot gas/hot-fire testing environment, simulating a real-time run through of what would happen during an actual deployment. While Meiler believes FMI "could have gone off and done materials development in a vacuum, working alongside the prime contractor provided us the opportunity to demonstrate the capability. We couldn't have afforded that on our own. No small business could."

The technology under SBIR development incorporated pre-ceramic polymer with carbon fiber woven preforms resulting in a reinforced composite technology. FMI developed the capability

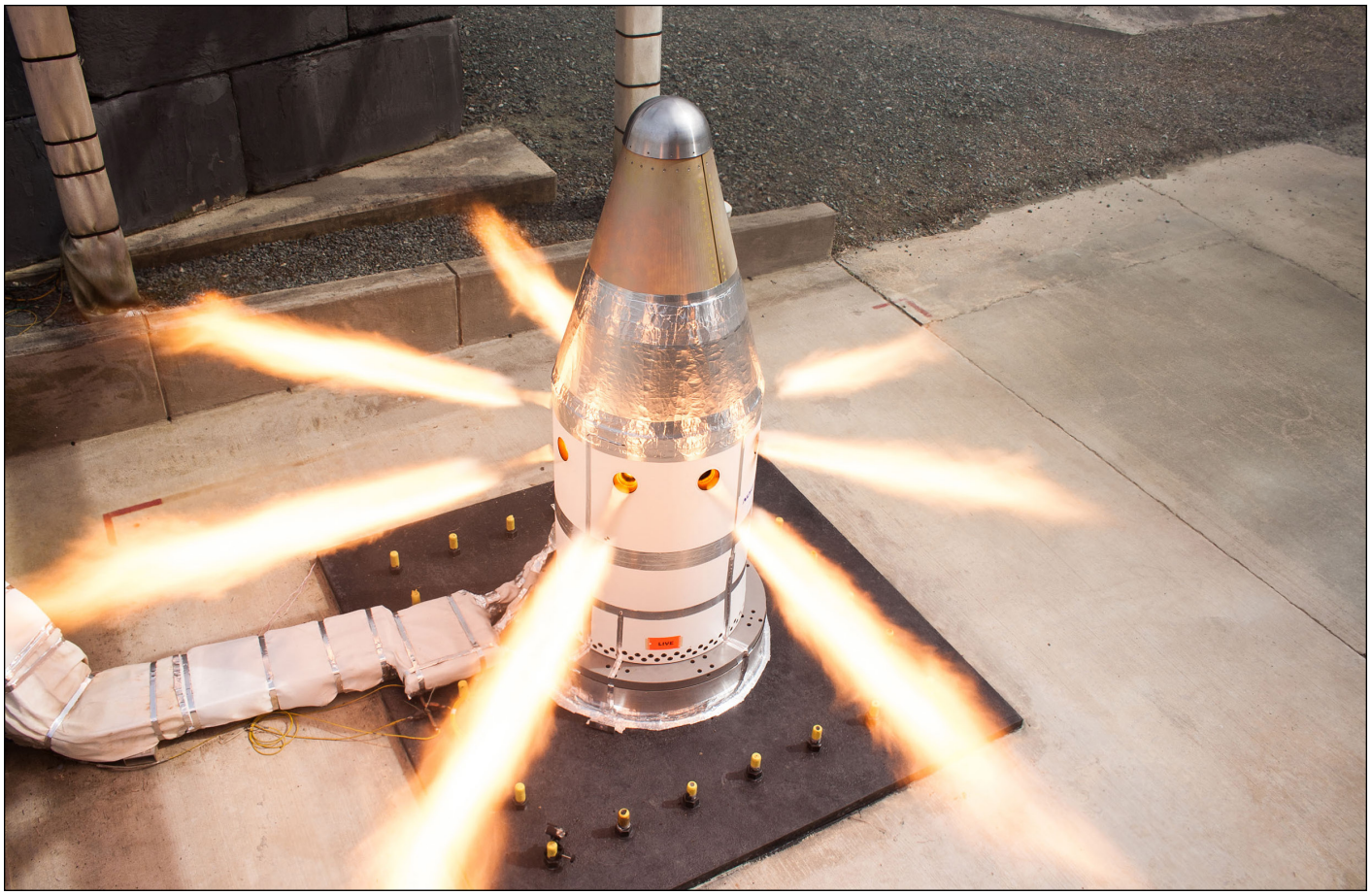

Photo courtesy NG/NASA

An Attitude Control Motor Hot-Fire Test is performed on an Orion Launch Abort System. Materials that enabled this test were created by Fiber Materials, Inc., with help from DoD's Small Business Innovation Research program.

to produce near net-shape components made to a specific design. This capability results in reduced mass, enabling the manufactured parts to fly further on less fuel, with higher temperature capability, reduced part count, and enhanced erosion resistance.

While FMI delivered materials for prototyping that advanced the art, nothing was immediately incorporated into an end production system. Instead, the technological innovation served as the foundational building block for demonstrating processes that the company still relies on today for developing componentry solutions.

FMI leveraged their SBIR experience to provide components for other projects. Mark Lippold, Applications Engineer, stated, "The SBIR allowed us to move up the Technology Readiness Level (TRL) and Manufacturing Readiness Level (MRL) scales, making everyone happy. And while the direct benefit was the eventual development of durable, high performance, lighter weight, lower cost composites for utilization with advanced DACS and interceptor missile defense systems; ultimately, it's about the relationship. The relationship is what made it all work."

Lippold credits this SBIR with "setting FMI up for the future." He couldn't overstate how important it was to the company. According to Lippold, the incubator type thinking that resulted from this SBIR not only allowed FMI to advance technology and engineering with systems to protect the American public, it also catapulted materials science from its humble origins to lunar exploration and beyond.

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Biddeford, ME (Wichita, KS)
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