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Getting the Kinks Out: Film Instead of Filaments

Use of thin film addresses problem with igniters for thermal batteries.

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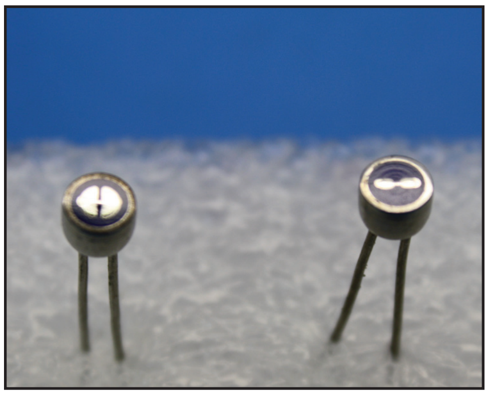
Power supplies used in missile navigation and control systems stand to become more reliable with help from a new process for manufacturing thermal battery igniters.

Unlike alkaline batteries used in common consumer electronic items, thermal batteries are inert, solid-state devices that do not rely on liquid electrolytes, which can corrode or leak from their casings over time. Long shelf life and reliability make thermal batteries the most common device to power missile navigation and control systems.



▲ Odyssian Technology's thermal battery igniters (shown here) could lead to offerings for use in products such as specialized parachutes and automobile airbags.

Though thermal batteries have a long shelf life, Defense agencies such as MDA have desired improved reliability of the battery igniters. Such igniters generally are pencil-eraser-sized devices that initiate a chemical reaction serving as the thermal battery's source of power.

The igniters include metal filaments that can sometimes develop kinks and other flaws during the manufacturing process. Such flaws can lead to uneven heating of the filament and result in battery ignition failure.

Manufactured flaws are difficult to detect because the filaments are so small (0.002 inches in diameter), and no inspection process can test whether the device will reliably ignite—because igniting a thermal battery is not a reversible process that can simply be switched off and then back on again. With assistance from a 2005 MDA SBIR Phase II contract, Odyssian Technology, LLC (South Bend, IN), developed a means to provide the spark needed for battery igniters, while altogether eliminating the problematic metal filaments. The approach also could lead to more reliable igniters for potential use in products such as parachute safety devices, as well as devices to deploy automobile airbags. In most thermal batteries, the ignition system is electrical, consisting of two electrode posts onto which the filaments have been welded. Applying a current to the ignition system heats the filaments, causing a pyrotechnic charge atop the igniter to burn. This combustion reaction ignites heat pellets in the battery. And those heat pellets melt an inert electrolyte that provides the chemical reaction to power the battery. Undetected flaws in the filaments can bring the entire ignition process to a halt, rendering useless the battery and, ultimately, navigation and control systems.

To solve the problem, Odyssian developed a thin-film technology, made using a physical vapor deposition (PVD) process, to replace the metal filaments that bridge the electrode posts. To make the thin-film replacements, Odyssian places igniters on racks inside a specially designed PVD machine. Metals—generally the same type as used in filaments—are vaporized by the machine and then deposited onto a glass insulator that separates the electrodes. The result is an igniter with a thin-film bridge that can function in the same manner as a filament bridge, minus the threat of flaws.

Odyssian claims reliability is the technology's biggest advantage. Laboratory tests have demonstrated the thin films can greatly diminish the failure rate. The technology also is batch-processed, which means hundreds of igniters can be made at the same time in a PVD chamber, resulting in a shorter manufacturing process and increased production output.

Beyond Defense, Odyssian has considered approaching the automotive and sporting goods markets with its igniters. Company president Barton Bennett said the primary automotive application is airbags, which are triggered by pyrotechnic devices to quickly inflate. He added that skydivers could also benefit from this technology, as an advanced parachute uses igniters to sever a secondary chute so it does not deploy and get tangled in the primary chute. In general, company officials believe the technology stands to show promise for applications that require reliable igniters or fuses.

Odyssian plans to patent its process and explore the possibility of licensing its thin-film manufacturing process. If interest in the technology increases, the company could build larger PVD machines, allowing for possibly thousands of igniters to be batch-produced at once, according to Bennett.

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