Process improves reliability of thin film igniters in safety devices

The pitch

A new process for fabricating the bridge wire or thermal element within a pyrotechnic igniter, which improves its reliability, has been developed by Odyssian Technology and Rose-Hulman Institute of Technology (RHIT). These igniters are used to trigger pyrotechnic devices in automotive airbags so they inflate quickly, in parachute safety devices, and by the military for initiating the chemical reaction that is the source of power for thermal batteries, which power missile navigation and control systems.

The new process replaces conventional igniter filament bridge wire with thin film patterns of heat-generating materials. Such thin film patterns can be designed to ignite (and prevent ignition) of various pyrotechnic powder formulations within specified time and energy requirements. When compared to conventional spot-welded bridge wire, thin film bridge patterns offer the advantages of reducing cost, increasing reliability, and improving design flexibility.

Pyrotechnic igniters are used in both military and non-military products. Non-military applications include automotive airbags, parachute release devices, quick deploy flotation vests, precisely controlled demolition devices, and sophisticated firework displays.

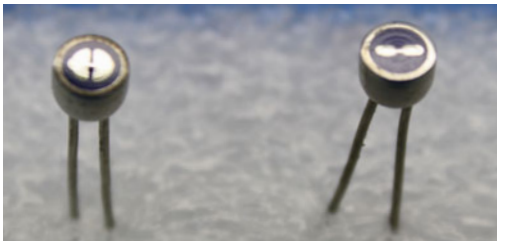
Military applications include use in missile navigation systems, smart weapons, advanced antitank weapons, aircraft ejection systems, and satellite thrusters and actuators. The military igniter business is estimated to be in excess of $100 million per year in the United States alone.

According to market analysis conducted by Global Industry Analysts, Inc., global demand for automotive airbags is expected to reach 169.4 million units by 2015, representing a potential market of $800 million to $1 billion for airbags igniters. Growth in the airbag igniter market will be driven by an increase in automobile production, growing penetration of airbags into low-end automobile models, and rising demand for new cars in developing nations.

The technology

Traditional pyrotechnic igniters include metal filaments that can develop kinks and other flaws during the manufacturing process. Such flaws can lead to uneven heating of the filament resulting in ignition failure. Manufactured flaws are difficult to detect because the filaments are so small (0.05 mm in diameter) and no inspection process can test whether the device will reliably ignite since igniting a pyrotechnic igniter is an irreversible process.

The thin film igniter technology developed by Odyssian Technology and RHIT eliminates problematic metal filaments, which will provide lower cost and more reliable igniters than currently available. Missile navigation systems often rely upon the use of igniters to initiate a thermal battery that provides the necessary power. Unlike alkaline batteries used in common consumer electronics, thermal batteries are inert, solid-state devices that do not use liquid electrolytes that 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.



Two igniter heads that have thin film bridge elements.

The battery igniters are pencil-eraser-sized devices that initiate a chemical reaction that serves as the thermal battery's source of power. 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 on top of the igniter to burn. This combustion reaction ignites heat pellets in the battery that melt an inert electrolyte that provides the chemical reaction to power the battery. Undetected flaws in the bridge wire filaments can bring the entire ignition process to a halt by making the battery useless. To solve this problem, Odyssian developed thin-film bridge pattern technology. Finite element analysis (FEA) tools were developed to predict igniter behavior and to guide the thin film pattern design process.

Various processing techniques for deposition of thin film igniter materials were evaluated and compared. The final process was developed through use of directional physical vapor deposition (PVD), a physical process that involves plasma sputter bombardment. To make the thin-film bridge patterns the igniters are placed on racks inside a specially designed PVD machine. Metals are sputtered by the machine and deposited onto a glass insulator that separates the electrodes. The result is an igniter with a thin-film bridge pattern designed to function in the same manner as a filament bridge but which eliminates the risk of filament kinking or flaws in spot welding. Odyssian's thin film igniter manufacturing technology is a batch-process, 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.

Opportunities

Odyssian Technology is seeking commercialization partners for its thin film igniter technology.

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