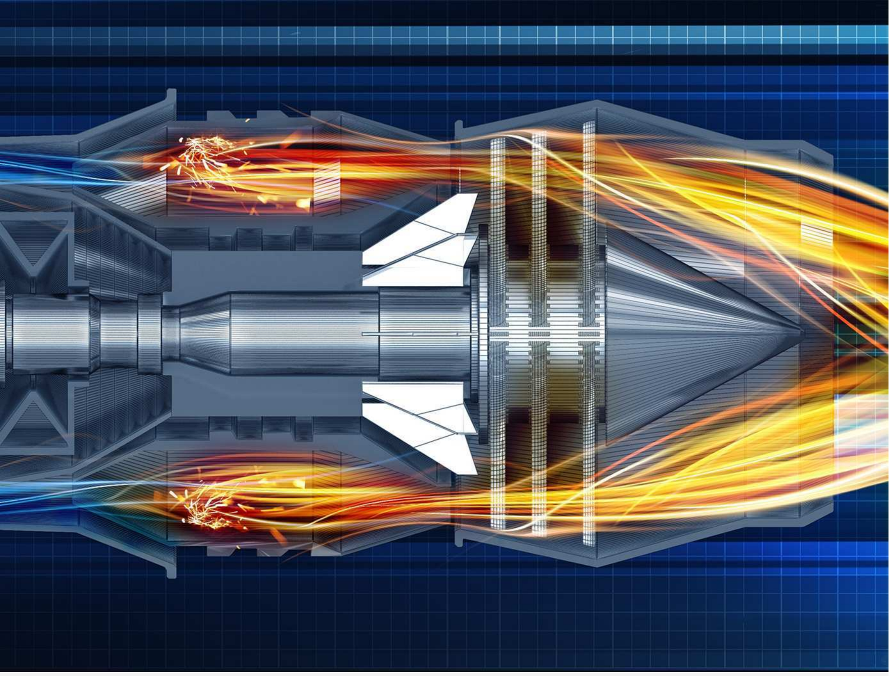


National Aeronautics and Space Administration

Electrical and Electronics

Packaging for SiC Sensors and Electronics

Protection for SiC sensors and electronics in harsh, high-temperature environments

Innovators at NASA's Glenn Research Center have developed a planar, modular package that protects electronics and sensors more effectively in high-temperature conditions than previously available methods. Lack of reliability at high temperatures, due to poor packaging, have discouraged the global application and large-scale commercialization of high-temperature electronics and sensors. Capable of preserving operations even in a 600°C environment, this innovation offers hermetic protection for silicon carbide (SiC)-based devices, such as dynamic pressure sensors, static pressure sensors, temperature sensors, acoustic impedance channels, and buried connecting wires. This patented technology is a game-changer for industries that need semiconductor-based sensors and electronics to function optimally in high-temperature, extreme-vibration, and corrosive environments - from jet engine combustion chambers to nuclear power plants, and from deep-well drilling to Venus missions.

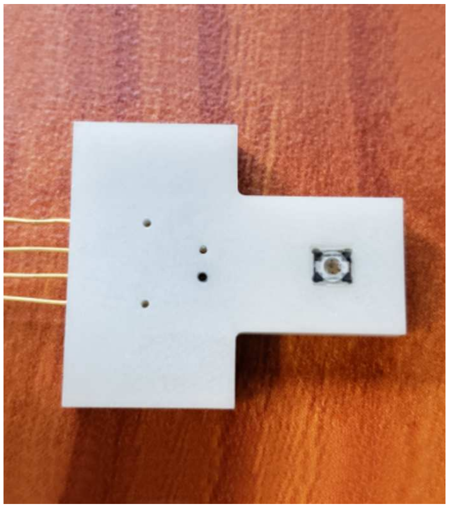
BENEFITS

- Robust: Reduces thermally induced and other types of stress
- Durable: Extends device lifetime through hermetic sealing
- Flexible: Operates on multiple devices
- Precise: Enables sensors to be placed closer to an engine's core, improving accuracy
- Low-Cost Fabrication: Uses few components in a single-stage process that can be combined with bulk manufacturing

technology solution

THE TECHNOLOGY

Prior approaches to bonding a SiC sensor and a SiC cover member relied on either electrostatic bonding or direct bonding using glass frits. The problem with the former is that its relatively weak bond strength may lead to debonding during thermal cycling, while the latter requires the creation of apertures that can allow sealant to leak. Glenn's innovation uses NASA's microelectromechanical system direct chip attach (MEMS-DCA) technology that can be bulk-manufactured to reduce sensor costs. The MEMS-DCA process allows a direct connection to be made between chip and pins, thereby eliminating wire bonding. Sensors and electronics are attached in a single-stage process to a multifunctional package, which, unlike previous systems, can be directly inserted into the housing. Additional thick pins within the electrical outlet allow the package to be connected to external circuitry. Furthermore, because the top and bottom substrates' thermomechanical properties are similar to that of the sensors, the problem of mismatch in the coefficient of thermal expansion is significantly reduced, minimizing thermal cycling and component fatigue. By protecting sensors and electronics in temperatures up to 600°C, approximately twice what has previously been achievable, Glenn's innovation enables SiC components to realize one of their most exciting possibilities - direct placement within high-temperature environments.



Glenn's novel modular package protects electronics and sensors, such as this semi-embedded SiC pressure sensor, from harsh environments

This innovative packaging can help bring SiC technology to a broad range of commercial applications, such as inside geothermal plants

APPLICATIONS

The technology has several potential applications:

- Automotive
- Pressure sensors
- Aerospace
- Deep-well drilling
- Geothermal exploration
- Chemical process plants
- Nuclear power plants
- Venus space missions

PUBLICATIONS

Patent No: 6,845,664; 7,518,234; 9,046,426; 10,067,025

More Information

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