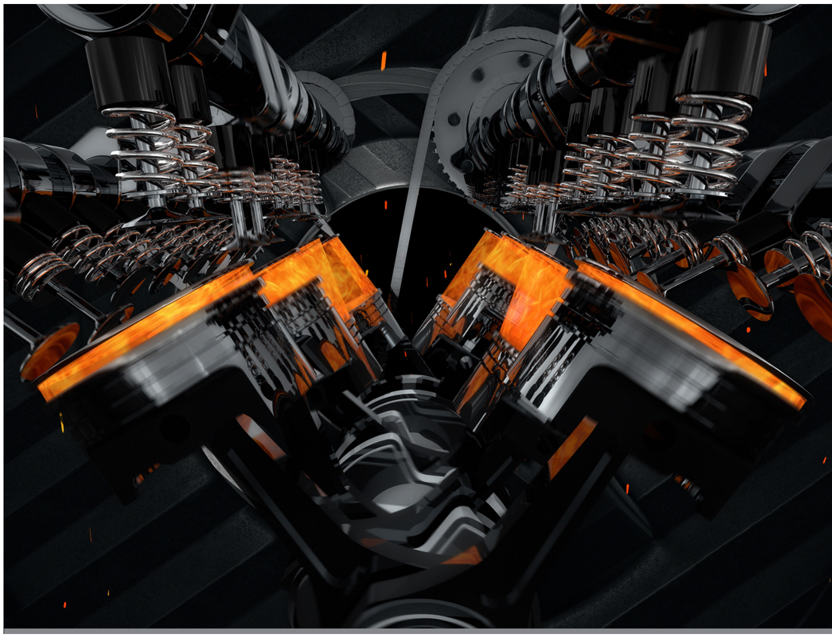


National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Sensors

SiC-Based Microstructures for Sensors

Ultra-thin SiC microstructures enable batch fabrication of MEMS, NEMS, pressure sensors, and biosensors

Innovators at NASA's Glenn Research Center have developed ultra-thin silicon carbide (SiC) microstructures that enable highly sensitive pressure sensors that are bio-compatible. The novel method of fabricating these microstructures, Dopant Selective Reactive Ion Etching (DSRIE), allows for structures as thin as 2 microns to be achieved, while allowing multifunctional sensors to be fabricated on a single SiC wafer. For the first time, it is possible to batch-fabricate ultra-thin SiC diaphragms that can sense very low pressures, enabling pressure sensors that can measure sub-psi pressures. This faster process makes it easier and less costly to produce complex, advanced semiconductors that are fully functional at temperatures greater than 600°C. This technique enables a new generation of SiC-based microelectromechanical systems (MEMS) and nanoelectromechanical systems (NEMS) such as accelerometers, pressure sensors, and biosensors.

BENEFITS

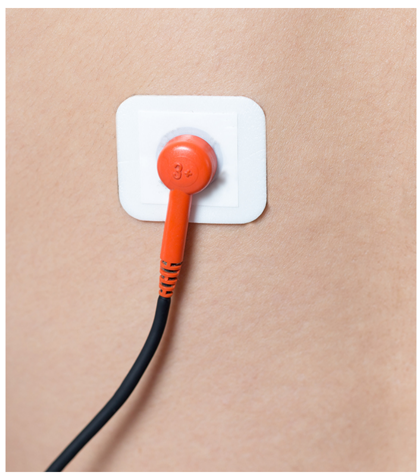
- Ultra-thin: Overcomes conventional reactive ion etching limitations that can accurately fabricate microstructures as thin as 2 microns
- Low-cost: Enables batch fabrication, reducing the complexity and thereby cost associated with conventional fabrication techniques
- High-yield: Offers precision etch control that minimizes yield loss due to defects
- Reliable: Enables SiC sensors to be placed within an engine combustion chamber, improving the fidelity and accuracy of data
- High-Sensitivity: Enables SiC-based MEMS/NEMS such as pressure sensors and biologically compatible probes and implants

THE TECHNOLOGY

Glenn's invention is game-changing in its ability to produce ultra-thin SiC-based microstructures and diaphragms that are essential for high-sensitivity pressure sensors that not only monitor engines but can also act as biosensors (monitoring bone density or brain pressure). DSRIE offers selective etching that reliably isolates conductive microstructures from the bulk material and has precision-etch control that minimizes yield loss due to manufacturing defects. Therefore, the thickness of structures, such as diaphragms, can be ultra-thin and selectively realized during dopant reactive ion etching. The ultra-thin diaphragm is a key enabler for Glenn's novel pressure sensor that can measure at low pressures in the sub-psi range.

Until now, batch fabrication of SiC sensors has been hindered by the fact that only one type of sensor per wafer could be produced at a time. Given the expense of fabrication, this limitation has greatly reduced the commercial viability of SiC sensors and electronics. Glenn's batch fabrication offers manufacturers the opportunity to simultaneously produce multiple multifunctional MEMS/NEMS products on a single SiC wafer. Such products include flow sensors, pressure sensors, biosensors, accelerometers, inertial sensors, angular rate sensors, and yaw rate sensors. By simplifying production, reducing capital equipment, and lowering production costs, Glenn's novel process makes the use of SiC-based MEMS/NEMS in sensors and electronics much more practical and attainable for countless industries.

Glenn's breakthrough ultra-thin microstructures enable the production of highly sensitive SiC pressure sensors that can withstand >600°C



Glenn's DSRIE process produces SiC sensors that have a broad range of biomedical applications

APPLICATIONS

The technology has several potential applications:

- Automotive engines
- Highly sensitive pressure sensors
- Power generation
- Oil and gas exploration
- Battery membranes
- Aerospace
- Biosensors
- High-temperature sensors
- Electronics

PUBLICATIONS

Patent No: 6,706,549; 6,769,303; 7,438,030; 9,452,926; 9,975,765

U.S. Patents 6,706,549 (or LEW-17170-1); 6,769,303 (or LEW-17170-2); 7,438,030 (or LEW-17661-1); and 9,452,926 (or LEW-18821-1) all expired.

More Information

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LEW-17170-1, LEW-17170-2, LEW-17661-1, LEW-18821-1, LEW-19360-1, LEW-TOPS-128