

# AEROSPACE

engineering & manufacturing

## Commercial propulsion

Gearing toward better fuel efficiency



## Automation

Cheaper, smarter robots

## Rapid manufacturing

Powders enable component complexity

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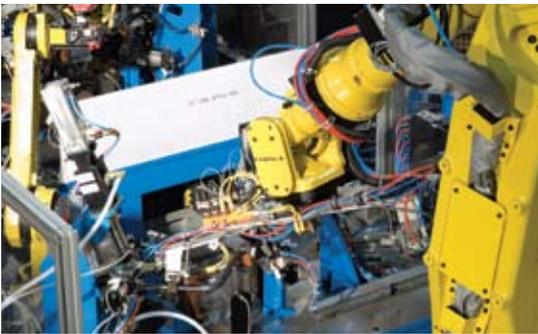
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## Electronics

### Designing silicon carbide digital sensors for outer space, and under the hood

Inprox Technology and NASA's Glenn Research Center (GRC) are developing silicon carbide (SiC)-based position sensors for potential uses in future space flight, turbine engine controls, and automotive engine applications. SiC electronics are capable of operating at temperatures as extreme as 600°C and "are poised to aid challenging on-engine, aerospace surface, automotive, and energy applications," says Inprox.

the SiC work sponsored by the Aeronautics Research Mission Directorate at GRC.

The rising costs of fuel, throughout both automotive and aerospace markets, and the drive for greater reliability at lower costs has the sensors and electronics market anticipating the capabilities of these next-generation SiC electronics and sensors. Future space missions and satellites will certainly have high tempera-

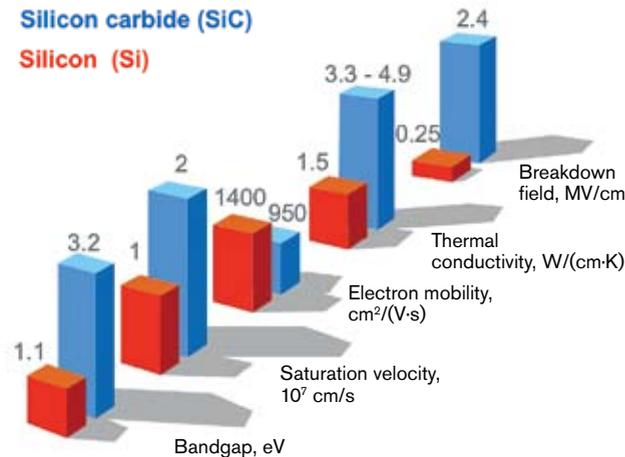
Because SiC electronics can operate at much higher temperatures than standard substrates, the mass and weight of such radiators on a given satellite could be greatly reduced or eliminated altogether. Such a feat would enable a set of substantial weight savings on satellites, or at least allow a greater degree of functionality by using up the space and weight formerly assigned to the thermal-management systems.

Also, SiC sensors and controls are less susceptible to radiation damage than similarly rated basic silicon, says Inprox. In that respect, SiC electronics could also shrink the size and weight of shielding that is normally used to protect satellite electronic components from space radiation. Given the very high per-pound costs of launching payloads into Earth orbit, the company believes the potential weight savings gained by using SiC electronics could have very large competitive implications in the satellite industry.

Many electronics and sensors on launch vehicles today monitor and control critical engine components and surfaces that operate at very high temperatures, necessitating environmentally controlled areas, the use of long wire runs between them, or the costly cooling of the electronics and the sensors residing in these high-temperature areas. With wire runs adding a significant amount of weight, fuel cooling has contributed to decreased aircraft fuel efficiency and reliability.

In automotive applications, SiC integrated sensors and electronics are currently being studied for engine controls that display improved combustion measurement and control; capabilities directly leading to lower emissions and more fuel efficient vehicles.

"Silicon carbide is one of the most exciting advances in electronics being developed today," said Derek Weber, Inprox President. "The marriage of SiC electron-



**Inprox and NASA are involved in a project that they believe will prove that silicon carbide electronics are a "significant improvement" over conventional silicon-based electronics for aerospace and automotive applications.**

Some view them as a significant advancement over conventional silicon-based electronics. Conventional electronics must be carefully housed in controlled environments shielded from higher temperatures by cooling, necessitating complicated and often costly thermal-management systems and long cable runs between critical sensor systems and the electronics that control them.

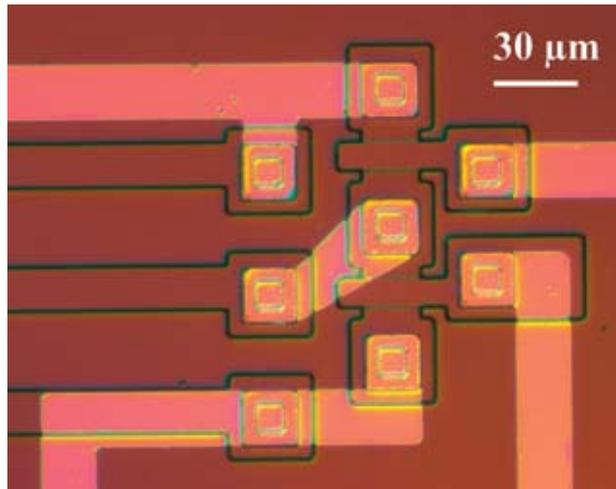
"The capability to embed electronics in a device without the need to provide cooling provides a substantial technological advantage for many applications in sensing and control," said Phil Neudeck, Electronics Engineer and Team Lead for

ture and radiation hardened requirements and will rely heavily on the breakthroughs of today. The reduction or elimination of these thermal-management systems and extended cable runs will aid in lowering weight and costs even in the more traditional commercial aviation markets in regards to turbine engine controls and flight controls.

Satellites need thermal radiators to dissipate heat generated by onboard electronics. These electronics, which are currently based in silicon or gallium arsenide, would have catastrophic failures if they were not carefully cooled by the craft's thermal radiators.

ics, which can remain operational in high-temperature, high-power, and high-radiation environments, enabled with our proprietary digital sensor technology is of great significance to us, our customers, and the aerospace and automotive communities at large. Playing this vital role in the development of [SiC] sensors with NASA is a great opportunity.”

High-temperature SiC electronics from NASA will be prototyped into Inprox’s proprietary linear position sensor technology platform. Inprox says it offers a read-only digital signal methodology using a real-time, continuous variable frequency output in the form of a square wave without the need for any signal-conditioning electronics.



**Inprox says its goals in aerospace are focused on providing weight savings, component advancements, and positive systems level impact via the implementation of its proprietary digital technology, which was advanced in part through developmental efforts in silicon carbide.**

“Our focus is on improving sensor and system performance while reducing component and system-level costs associated with previous generations of inductive

and capacitive-based sensors and controls,” said Weber.

Jean L. Broge

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