aero-online.org

SAE International

AEROSPACE engineering & manufacturing

Commercial propulsion
Gearing toward better fuel efficiency

Automation
Cheaper, smarter robots

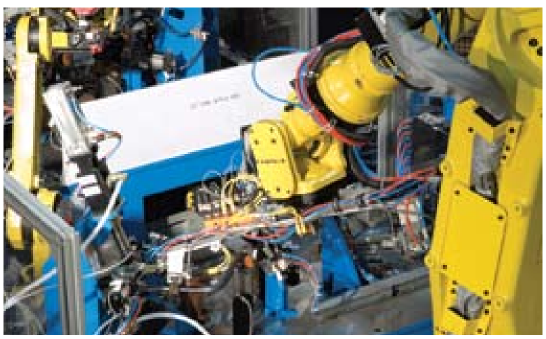
Rapid manufacturing
Powders enable component complexity

May 2008

Contents

May 2008

Features



Aerospace Engineering & Manufacturing, (ISSN 1937-5212), May 2008, Volume 28, Number 4. Published 10 times a year by SAE International, 400 Commonwealth Drive, Warrendale, PA, 15096. Printed in Shepherdsville, KY. Annual subscription for SAE members: first subscription, $20.00 included in dues; additional single copies, $26.00 each North America, $31.00 each overseas. Prices for non-member subscriptions are $88.00 North America, $149.00 overseas. Periodical postage paid at Warrendale, PA, and additional mailing offices. POSTMASTER: Please return form 3579 to Aerospace Engineering & Manufacturing, 400 Commonwealth Drive, Warrendale, PA, 15096. SAE is not responsible for the accuracy of information in the editorial, articles, and advertising sections of this publication. Readers should independently evaluate the accuracy of any statement in the editorial, articles, and advertising sections of this publication which are important to him/her and rely on his/her independent evaluation. For permission to reproduce articles in quantity, contact customersales@sae.org, and for use in other media contact aero@sae.org. Claims for missing issues of the magazine must be submitted within a six-month time frame of the claimed issue's publication date.

Aerospace Engineering & Manufacturing is indexed and abstracted in the SAE Global Mobility Database®.

AD-Q

Audited by BPA Worldwide

SAE International™

Contents

May 2008

DepartmentHighlights

Electronics

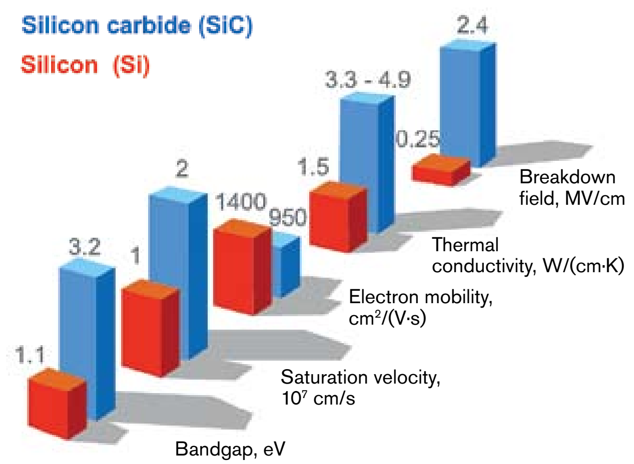
Designing silicon carbide digital sensors for outer space, and under the hood

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.

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 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 temperature 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.



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.

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.

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.

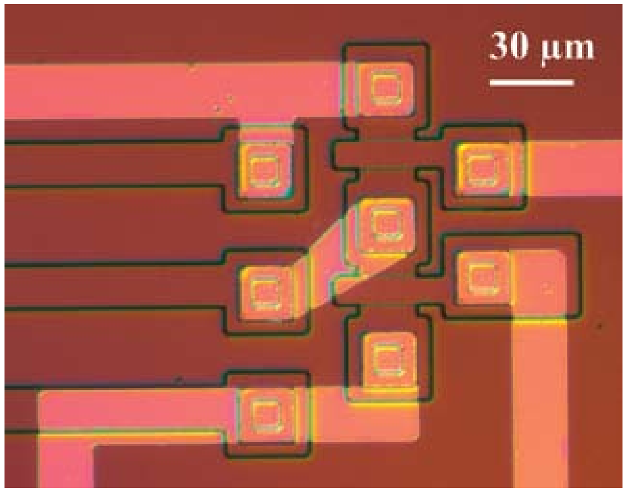
Also, SiC sensors and controls are less susceptible to radiation damage than similarly rated basic silicon, says Inprox. In that respect, SiC electronics could also shrink the size and weight of shielding that is normally used to protect satellite electronic components from space radiation. Given the 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 electronics, 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