NEW TRANSISTOR TAKES THE HEAT

Can You Imagine . . .

. . . a new transistor that operates at temperatures over 500˚C.

Car makers would like to put electronics deeper into engines to keep a closer watch on control and exhaust functions. However, the silicon transistors used in these systems cannot operate above 150˚C, and their performance may start dropping off at around 80˚C. New transistors that operate above 500˚C would allow car makers to move electronic control systems closer to engines.

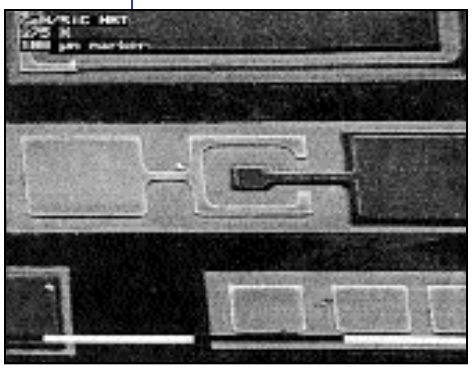
Researchers at Astralux, Inc. (Boulder, CO), have tested a new transistor up to 535˚C, as high as their equipment permitted. The transistor's much higher temperature range results from its materials: silicon carbide (SiC) and gallium nitride (GaN), two semiconductor materials particularly suited to operation at high temperatures. The BMDO SBIR program funded the research and development of this technology, which could provide high-temperature electronics for missile defense control systems.

The new transistor will have important uses in a growing number of high-temperature environments in the automotive and aerospace industries. For example, Astralux says the technology may control the power delivered to motors in future electric cars, replace hydraulic systems with electric motors, and eliminate the need for heavy, expensive cooling systems in space electronics. Future innovations, such as fabricating several transistors on a single chip, may allow high-temperature digital circuits.

The same characteristics that allow the new transistor to operate at high temperatures will also allow it to operate at high frequencies and high powers. Astralux began to address these capabilities in two recently awarded SBIR Phase I contracts. The company is also looking at high-frequency possibilities for the device.

Astralux plans to sell various high-temperature transistors when it resolves several packaging issues, the first quarter of 1997. Meanwhile, the company welcomes strategic partners or licensees to help market the device.

ASTRALUX WELCOMES STRATEGIC PARTNERS OR LICENSEES TO HELP MARKET THE DEVICE.



■ The high-temperature transistor has construction similar to silicon bipolar transistors, except that it is made of large-bandgap materials.

ABOUT THE TECHNOLOGY

The high-temperature capabilities of Astralux's heterojunction bipolar transistor (HBT) come from the materials used as the heterojunction. Generally, a material's band gap limits the transistor's operating temperature range. Silicon's band gap of 1.1 electron volts (eV) translates into a maximum operating temperature of around 180˚C. SiC and GaN, with band gaps of 2.9 eV and 3.4 eV, respectively, allow transistors to work at much higher temperatures.

The HBT uses SiC for the base and collector; GaN may also be used for the collector. Because GaN's band gap is wider than SiC's, a barrier blocks hole current flow from the base to the emitter, increasing the electron injection efficiency in the transistor. Higher emitter efficiency results in higher current gain. At room temperature, the HBTs have a current gain of over 10 million, while at 535˚C the gain is still around 100.