View metadata, citation and similar papers at core.ac.uk

November 1970

brought to you by TCORE

#### Brief 70-10444

# NASA TECH BRIEF



NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Division, NASA, Code UT, Washington, D.C. 20546.

## Copper-Titanium Eutectic Alloy Improves Electrical and Mechanical Contact to Silicon Carbide

With increased requirements for electronic equipment operating at elevated temperatures, there has been considerable interest in wide bandgap semiconductors such as silicon carbide. The hexagonal (alpha) form of SiC has many desirable qualities. The semiconductor is chemically stable and mechanically rugged and its bandgap of 2.9 eV is more suitable for high temperature operation than silicon (1.2 eV) or gallium arsenide (1.4 eV). However, the chemical stability and hardness of SiC have required excessively high temperature processes to form electrical contacts which have ohmic resistance and are not rectifying. The high temperature causes the contact to penetrate deeply into the material. Also, during cooldown there is a tendency for the contact to shear or break away from the SiC surface because of the differences in thermal expansion coefficients.



Cross Section of Contact Formation on S. C. Device

After considerable research and experimentation, acceptable ohmic contacts were made with the addition of a copper-titanium (Cu-Ti) eutectic alloy between the top metal tab and the SiC surface (see fig.). An alloy composition of 71 atomic % Cu and 29 atomic % Ti (eutectic between the intermetallic compounds TiCu<sub>2</sub> and TiCu<sub>3</sub>) melts at 880°C and readily wets the semiconductor surface. An alloy layer of 5 to 10 microns, applied to the SiC surface, penetrates 300 to 500 angstroms into the SiC material. Tungsten is used as the tab because of similar thermal expansion properties and the ability to resist dissolving in the eutectic alloy.

Contacts formed with Cu-Ti alloy are ohmic on p-type SiC and rectifying on n-type. Current-voltage characteristics of a typical p-n junction device have shown that contact resistance is a few hundred ohms.

Contact preparation at low temperatures is important if metal or oxide films which are susceptible to high temperatures are present in a device structure. In addition, the shallow penetration enables this process to be used for preparing contacts on thin epitaxial films.

### Notes:

- 1. SiC devices, such as diodes, transistors and electroluminescent arrays, will have widespread application in electronics technology when acceptable performance levels and reliability have been achieved.
- 2. Requests for further information may be directed to:

Technology Utilization Officer Headquarters National Aeronautics and Space Administration Washington, D.C. 20546 Reference: B70-10444

(continued overleaf)

Government assumes any liability resulting from the use of the information contained in this document, or warrants that such use will be free from privately owned rights.

This document was prepared under the sponsorship of the National Aeronautics and Space Administration. Neither the United States Government nor any person acting on behalf of the United States

## Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: J. S. Shier Electronics Research Center (ERC-10256)

Brief 70-10444

Category 04