Contact Development On SiC

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

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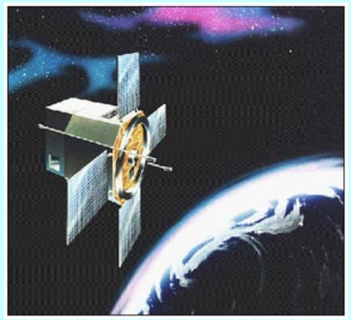
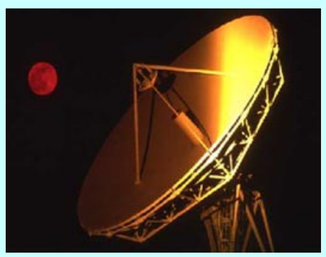
Introduction

Silicon Carbide (SiC) is a widebandgap semiconductor that can be used for high temperature, high power, and radiation hardened applications.

Electric cars are the future of the automobile industry. With SiC, a chip can function effectively on a hot engine.



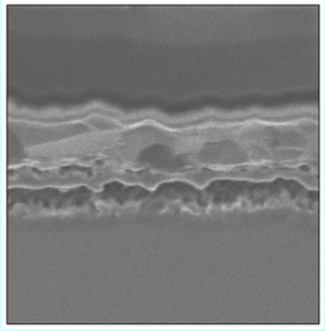
SiC is radiation tolerant and can be used in space electronics without additional hardening.



Communications is a rapidly increasing industry. SiC electronics can be made to handle high power microwaves.

Since SiC is new material, several processes need to be developed before SiC can be implemented. Making good physical and ohmic contacts to SiC is one of the major problems with this technology.

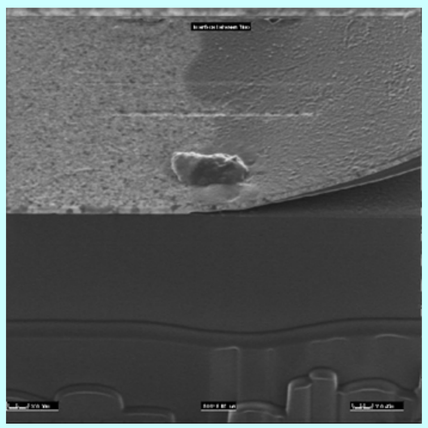
Nickel Contact Development



A commonly used contact to N-type SiC is a deposited nickel film that is annealed at 1000°C for 5 minutes, but the process is not fully understood, and the nickel forms a poor physical contact to the SiC.

The separation at the interface is due to the thermal stress of annealing, but annealing is a necessary part of processing. A specimen was made with the normal process except this time the nickel was etched back off and redeposited through evaporation.

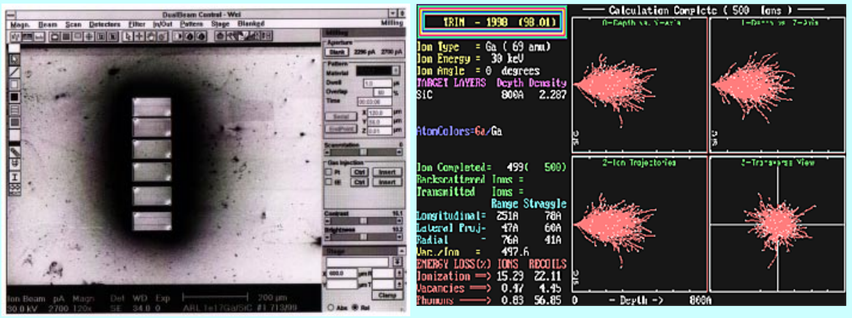
The separation no longer appears at the interface. The nickel layer, however, does not adhere well to the SiC without annealing.



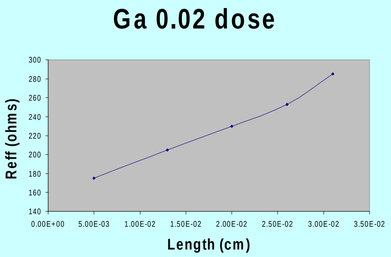
Further work:
A film with better adhesion properties must be found. Also, a cap layer to the film needs to be developed before this process could actually be fabricated.

Gallium Implantation

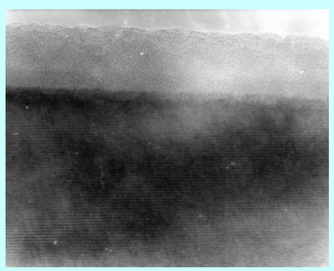
A good ohmic contact is a metal contact to a semiconductor with a small interfacial resistance and a linear I-V characteristic in both biasing directions.



Gallium ions were incorporated into the SiC lattice using Focused Ion Beam (FIB) surface-modification.



The optimal contact resistance is measured using a Transmission Line Model pattern, and calculated to be at 0.02 µm at a dose of ~10^6 cm^{-2}.



The Ga/SiC interface is analyzed by the Transmission Electron Microscope to understand amorphization and defect structure phenomena.