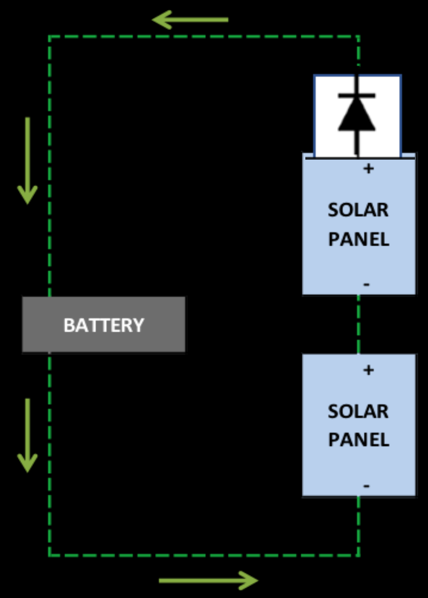
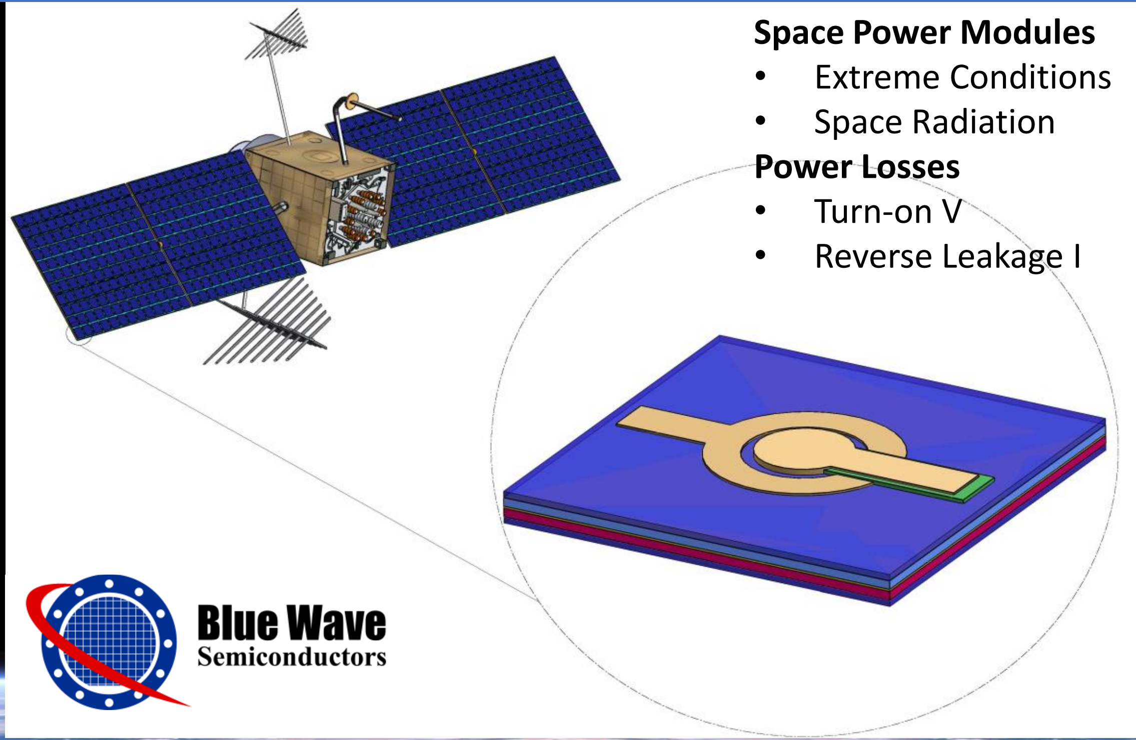
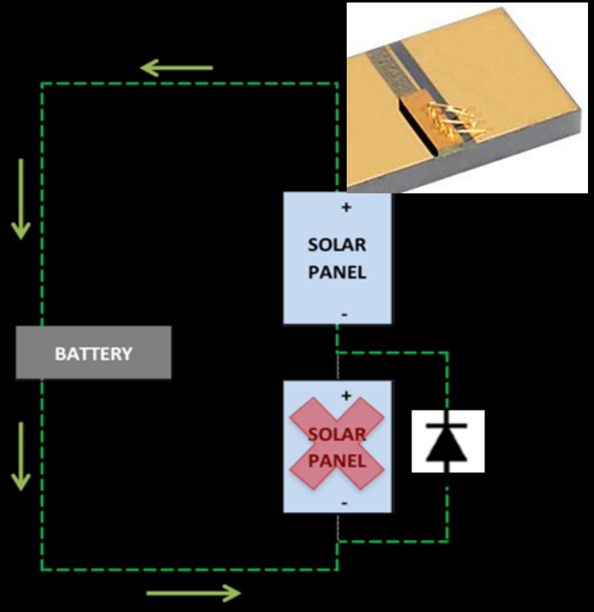
Radiation-hard low turn-on voltage diode tailorable for ease of integration in space power applications



Blocking diode in solar array



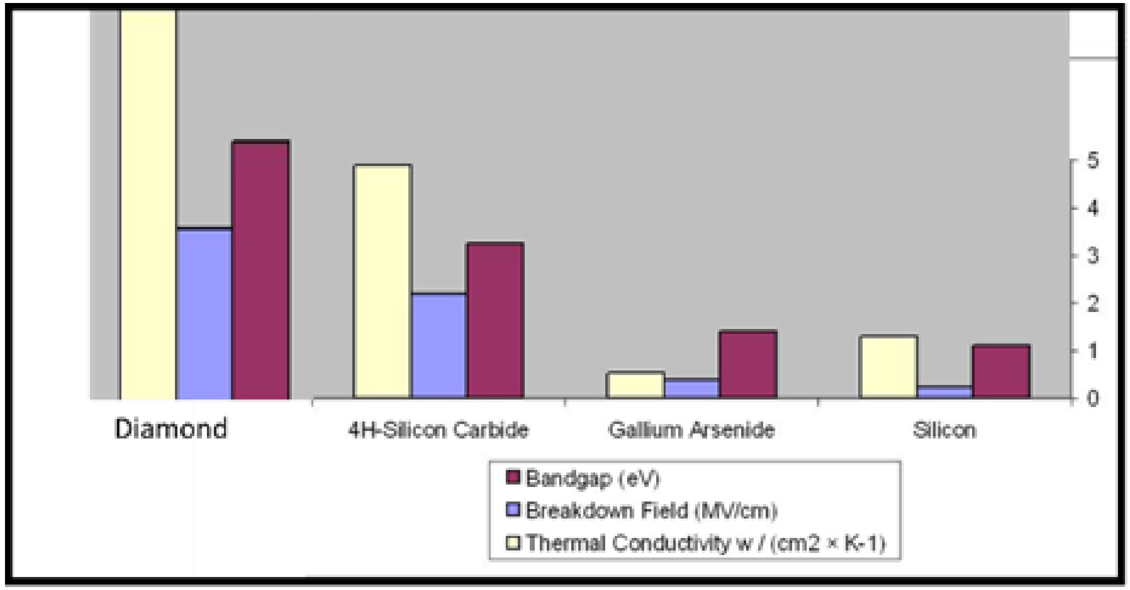


Bypass diode in solar array

Ratnakar D. Vispute, Blue Wave Semiconductors, Baltimore MD USA

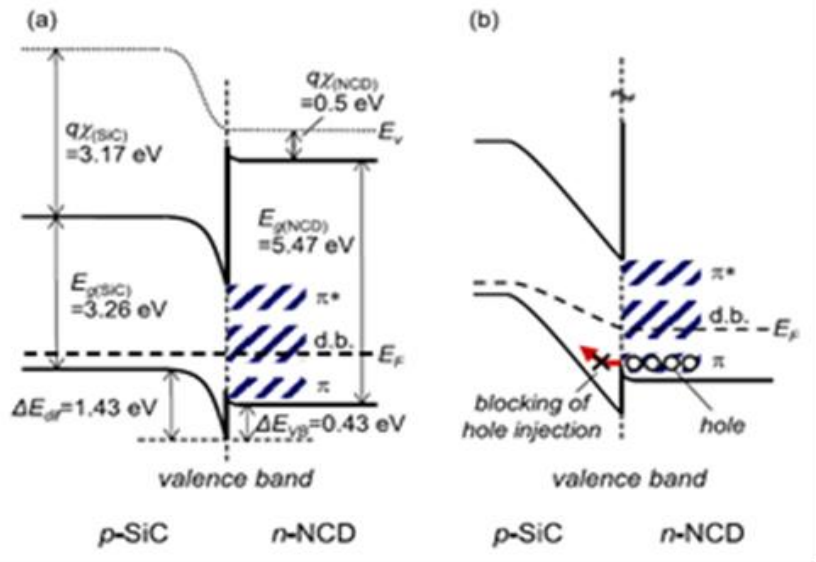
AFRL SBIR PHASE II: CONTRACT NUMBER# FA864920C0284

Radiation Hard Electronic Materials: Approach and Methodology

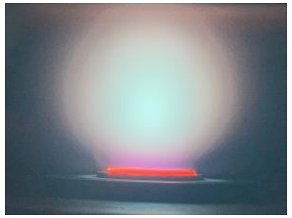


SiC and Diamond: Ideal materials for high-voltage & high-temperature operations.

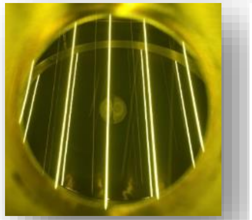
1. Diamond and SiC are wide-bandgap materials: Diodes can operate at higher temperatures than Si, Ge, GaAs.
2. Breakdown fields of diamond and SiC (ten times than Si): High-voltage Schottky diode possible.
3. High thermal conductivity of diamond and SiC than Si & GaAs: Enables fabrication of higher-current/high power diodes.



Predicted energy-band diagrams of the n-NCD/p-SiC diode in (a) thermal equilibrium and (b) reverse bias condition; qv: electron affinity, Eg: band gap, Ev: vacuum level, EF: the Fermi level [Ref. M. Goto et.al., APL 104, 153113 (2014)].

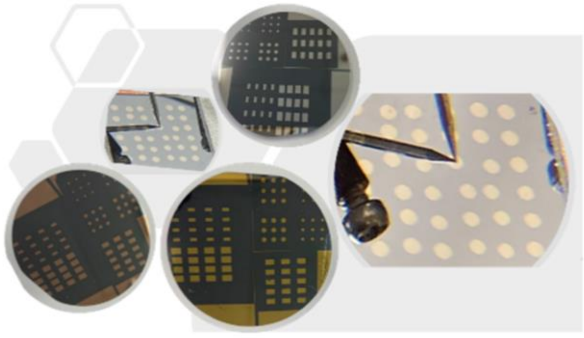


Microwave Chemical Vapor



Hot Filament Deposition

Nanodiamond 4” Si



Prototypes devices

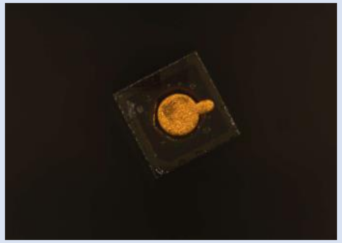
Results: Low turn-on voltage and fast reverse recovery characteristics

Metal, Si, Ge

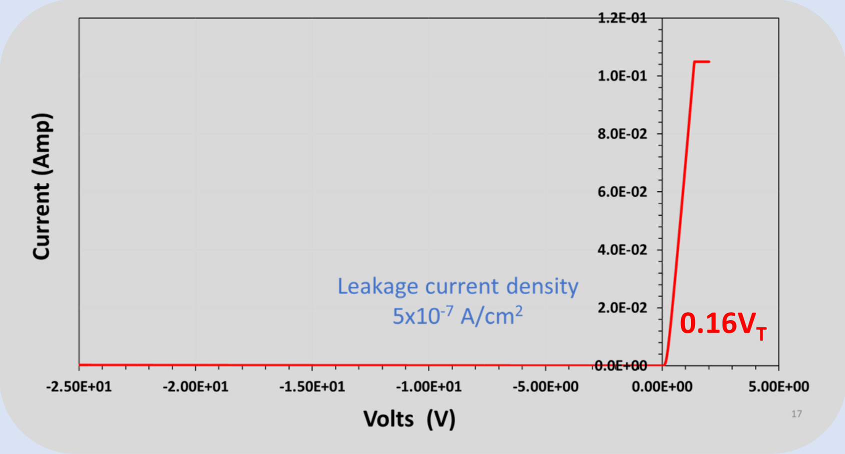
CVD Diamond, SiC

New Junctions
Hi power handling Capacity

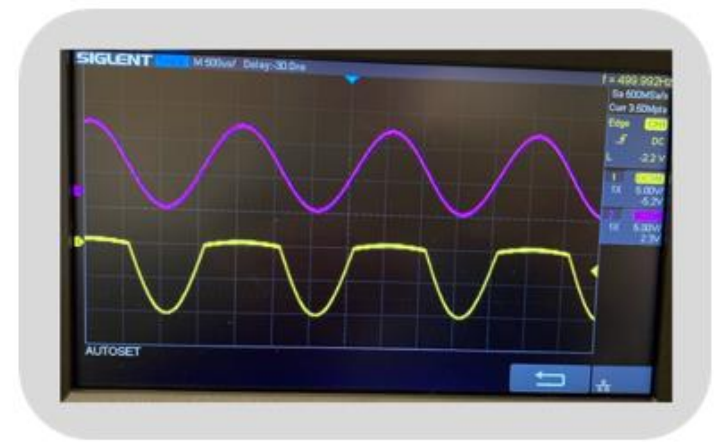
Large Area WBG Diode



Metal/WBG

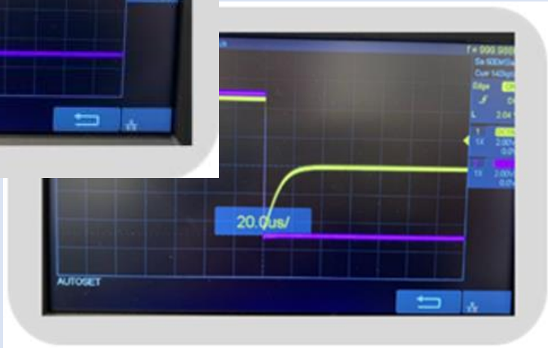


I-V characteristics of heterojunction diode



Demonstration of half-wave rectifier

Reverse recovery of Blue Wave diode



Reverse recovery of commercial Si p-n diode

Summary

- We are developing WBG materials-based heterojunction diodes suitable for space power applications: Typical characteristics are: 1) Low turn-on voltage and 2) fast reverse recovery time.
- Further advancement and performance improvements in these devices will provide AFRL enabling technology in advancing space power solar cell panels.
- Contact: RD Vispute, E-mail: rd@bluewavesemi.com, Phone 1 (301) 706 8833.