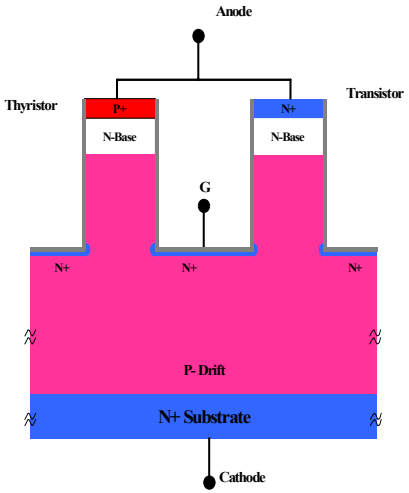
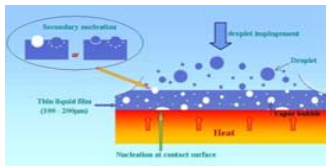
Graphic of Technology

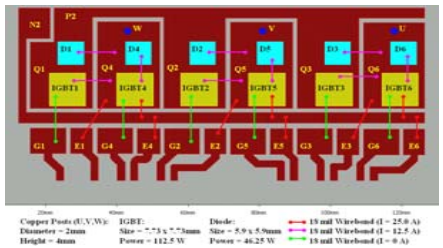
Megawatt switch: Insulated-Gate Turn-Off Thyristor



Liquid impingement cooling with high heat flux



Electro-Thermal-Mechanical ana;ysis of power module



Goals, Objectives and Main Technical Approach

Goals

Develop high voltage, high efficiency, fast switching SiC power switches for megawatt power conversion

Objectives

Develop and demonstrate 10A, 10kV SiC insulated-gate turn-off thyristors and high speed soft-recovery diodes

Technical Approach

- Thick epitaxy with low defects and low/ uniform doping
- Voltage-controlled switch with simple gate drive and low losses
- Advanced cooling with high heat removal rate

Major Technical Accomplishments

(since start of contract)

1. Computer modeling of 10 kV termination structures
2. Designed, fabricated, and demonstrated 10kV diodes
3. Evaluated SiC material quality and correlated defects with device yield
4. Designed IGTO mask and fabrication process
5. Completed advanced cooling analysis and design
6. Developed power module model and wedge wiredbond model

Major Work Remaining to Completion of Contract

1. Develop high voltage passivation process
2. Demonstrate 10 kV diode with low Vf
3. Demonstrate 10 kV IGTO
4. Deliver diodes and IGTOs to DARPA program
5. Demonstrate high heat flux removal (1000 W/cm^2) on SiC devices
6. Complete electro-thermal-mechanical model for power module

Major Impact of Technology & Technology Transition Plan

Major Impact of Technology

1. Increase system efficiency
2. Reduce system size and weight
3. Reduce components count and Improve reliability
4. Open new applications and markets presently inadequately served by Si technology

Technology Transition Plan

1. Develop manufacturable fabrication processes for IGTOs and diodes
2. Assemble IGTOs and diodes into inverter power modules and evaluate in medium voltage (4160V) drive
3. Quantify the advantages of SiC-based motor drive
4. Develop roadmap for SiC device production, power module prototyping, and Insertion into new drive products