Materials Compatibility of Power Electronics

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This is a newly started project

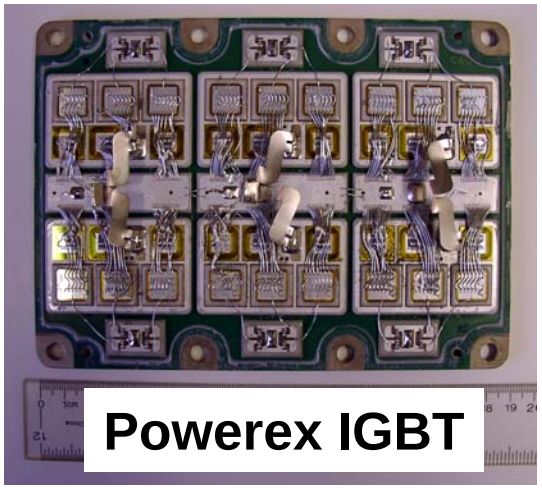
This presentation does not contain any proprietary or confidential information.

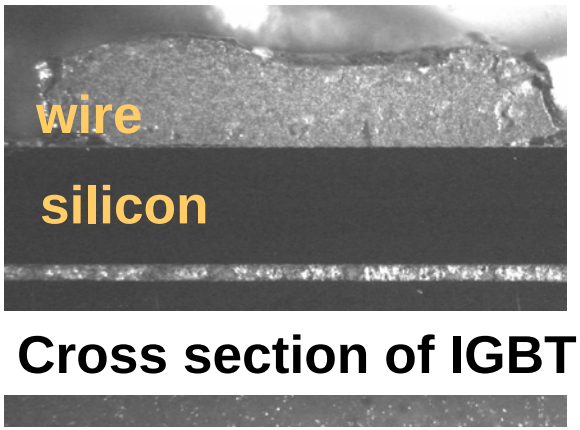
Power Electronics Materials Compatibility Addresses Needs Within the Propulsion Materials Program, Specifically:

- **Materials for Electric and Hybrid Drive Systems**
  - **High temperature power electronics materials**
  - **Solder joints**
  - **Materials/coolant compatibility**
  - **Electric drive motors**
  - **Thermal management**

Compatibility Addresses Barriers/Design Criteria of Automotive Industry

- **Barriers to deployment of power electronics (PEs) are:**
  - **Weight, size, reliability and cost**
- **Approach to decrease weight, size, and cost of PEs is to use:**
  - **Direct cooling of PEs by side-stream cooling from existing air-conditioner (A/C) systems using R134a refrigerant**
    - **Reduces weight of PEs**
    - **Eliminates secondary cooling system**
- **Direct side-stream cooling necessitates evaluation of PEs compatibility with and reliability in the coolant**





Cross section of IGBT

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An Integrated Approach to Compatibility Issues Is Being Developed

- **Effect of coolant on the PEs materials**
  - **Mostly aluminum and copper (general corrosion)**
  - **Bonds of aluminum and copper (galvanic corrosion)**
  - **Polymeric materials**
- **Effect of nucleate boiling on the surface of the metals**
- **Effect of impurities in the coolant**
  - **Off-the-shelf**
  - **Added as a result of interaction with the surfaces of the vehicular A/C system**
- **Effect of thermal stress on the PEs materials**
- **Evaluation of synergistic effects**

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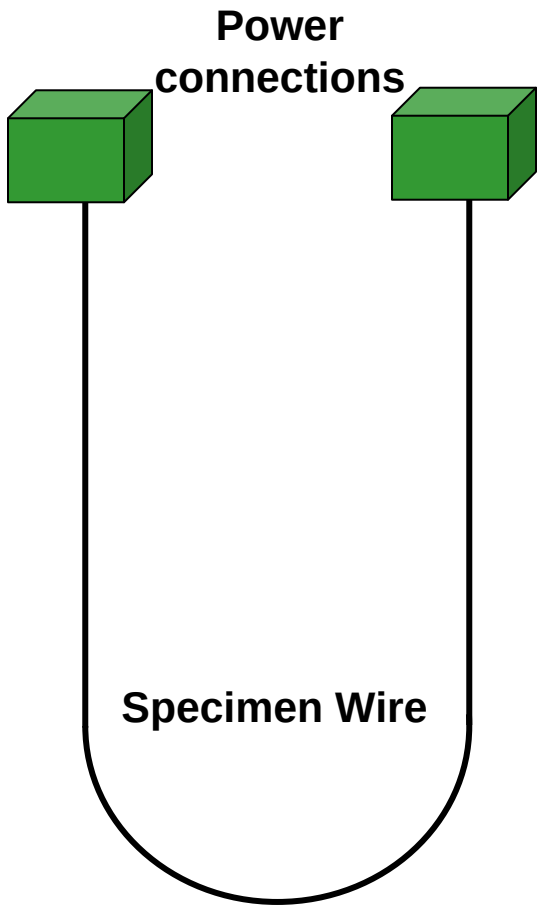
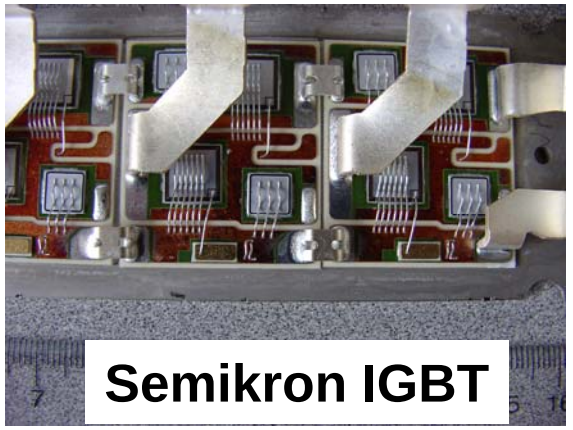
In Addition, Because of the Anticipated Low Reaction Rates in R134a, An Accelerated Test Will Be Sought

- **Mimic in service use**
- **Exacerbate nucleate boiling effects**
- **Maximize effect of impurities**
- **Aggravate thermal mechanical stress**
- **But does not change the in-service failure mechanisms**



Successful Demonstration of Compatibility of Direct Side-Stream A/C Cooling With Power Electronics Will Allow:

- **PEs concepts that reduce the component count and integrate functionality to decrease size, weight, and cost**
- **This task will achieve milestone (09/08)**
  - **Develop the methodology to examine the interaction of the electrical components with the fluids used in the evaporative cooling systems. Initiate testing of methodology.**
- **In next FY, this task will**
  - **Continue the testing of power electronics in cooling fluids**



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