

New Project

Materials Compatibility of Power Electronics

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Power electronics materials compatibility addresses needs within the Propulsion Materials Program

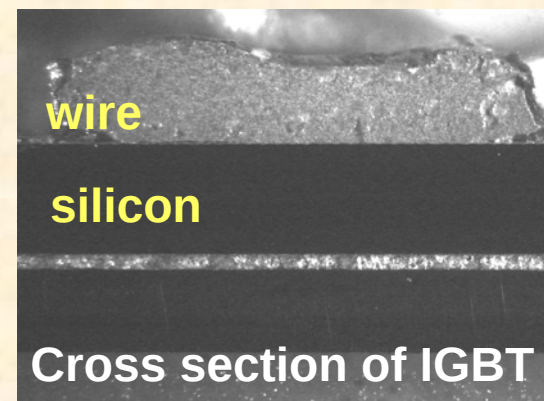
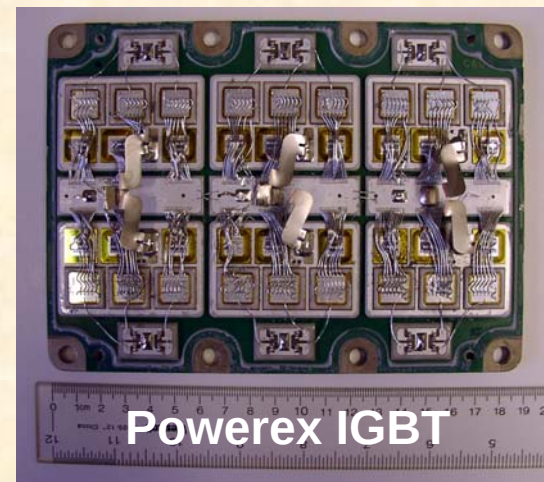
- **Materials for electric and hybrid drive systems**
 - High temperature power electronics materials
 - Solder joints
 - Materials/coolant compatibility
 - Electric drive motors
 - Thermal management



Compatibility addresses the barriers & design criteria of automotive industry

- Barriers to deployment of power electronics (PEs): weight, size, reliability and cost
- Direct cooling of PEs by side-stream cooling from existing A/C systems using R134a refrigerant
 - Reduces weight of PEs
 - Reduces size and cost by eliminating secondary cooling system
- Direct side-stream cooling necessitates evaluation of PEs compatibility with and reliability in the coolant

(Photos courtesy of A. Wereszczak, ORNL)



An integrated approach to compatibility issues is being developed

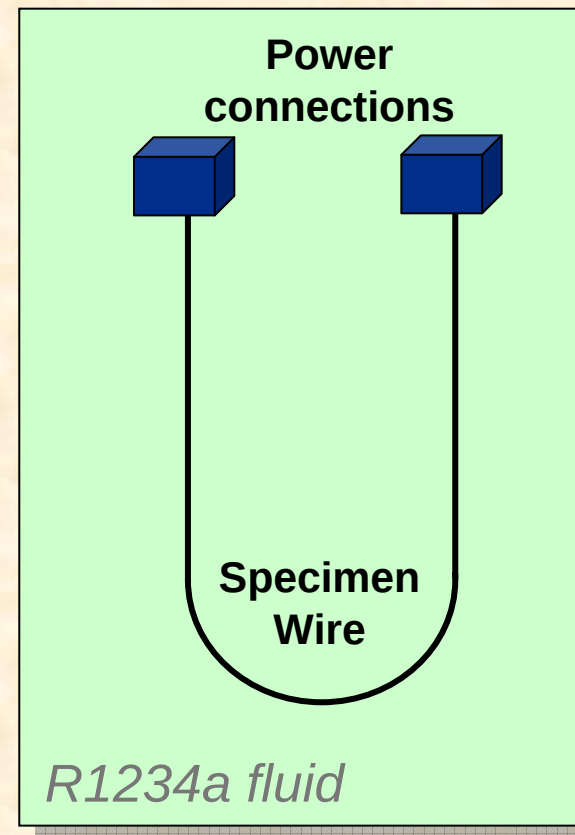
- **Effect of coolant on the PEs materials**
 - Mostly Al and Cu (general corrosion)
 - Bonds of Al and Cu (galvanic corrosion)
 - Polymeric materials
- **Effect of nucleate boiling on the surface of the metals**
- **Effect of impurities in the coolant**
 - Off-the-shelf
 - Added as a result of interaction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



Photo courtesy of A. Wereszczak, ORNL

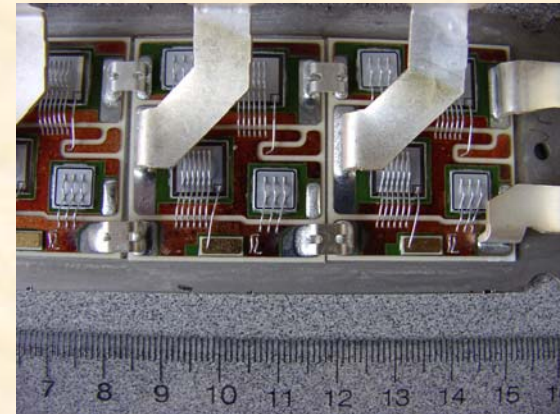
In addition, because of the anticipated low reaction rates in R134a, an accelerated test will be sought

- 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 PEs will allow...

- PEs concepts that reduce the component count and integrate functionality to decrease size, weight, and cost
- Achievement of 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.”*
- Continued testing of PEs in cooling fluids during the next FY



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