NASA Glenn Research Center

Technology Showcase

Sensors and Electronics

High Temperature SiC Electronics

Dr. Philip G. Neudeck

High Temperature SiC Electronics

This technology/capability is…

- Integrated circuit chips and packaging that operate reliably at +500 °C for thousands of hours (unique achievement).
- Integrated circuit chips that operate from -100 °C through +500 °C WITHOUT changing input/output signal voltages (unique achievement).
- This innovation enables needed electronic sensing and control functionality to be placed directly where needed/beneficial in very harsh environments WITHOUT cooling/shielding/wiring overhead penalty.
- Chips are made using silicon carbide junction field effect transistors (SiC JFET) instead of silicon metal-oxide-semiconductor field effect transistors (Si MOSFET).

High Temperature SiC Electronics

Potential applications may include …

- Combustion engine sensing and control for improved fuel efficiency and reduced pollution (jet engines and automotive engines).
- Electrical power plant control (fossil fuel combustion & advanced nuclear)
- Deep-well drilling telemetry for energy production (oil, gas, & geothermal)
- High temperature manufacturing process sensing and control
- Harsh-environment robotics (scientific exploration and firefighting)

High Temperature SiC Electronics

Key benefits are …

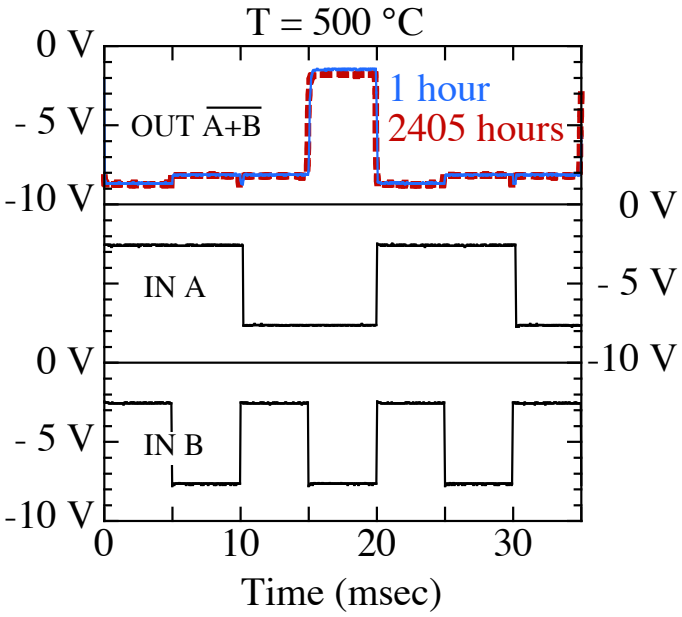
- **Capability**: provides durable integrated circuit electronics functionality to much harsher (previously unattainable 300 °C to 500 °C) environments, but also work at lower temperatures (down to -100 °C).
- **Simplicity**: eliminates active cooling hardware, wires, shielding, and/or connectors previously needed for harsh-environment electronic sensing and control implementation.
- **Small**: complex integrated circuit chips are inherently very small and lightweight which enables insertion without adverse impact to system size.
- **Customizable**: application-specific integrated circuits (ASICs) can be designed and implemented to meet specific needs of various customers.
- **Mass-fabrication**: hundreds of chips manufactured in parallel on each SiC wafer via available semiconductor industry manufacturing tools and methods.

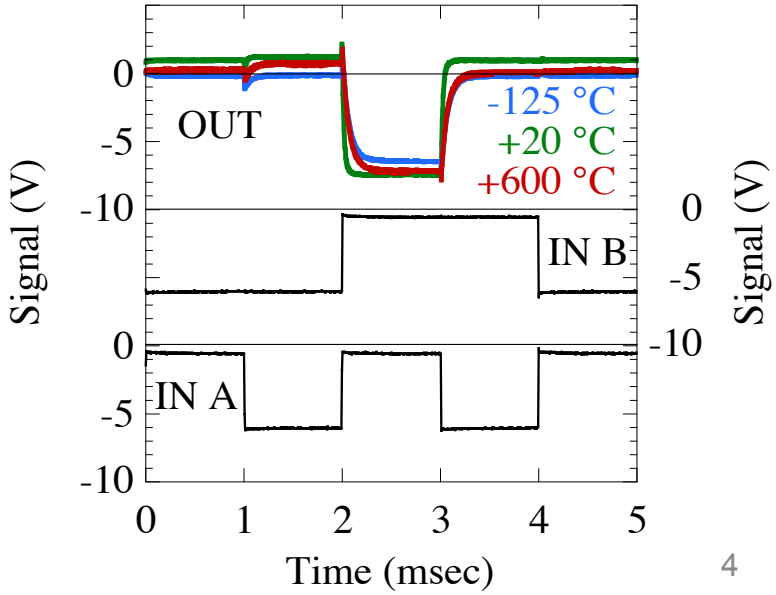
High Temperature SiC Electronics

Technical details …

State of development of the technology – Simple prototypes demonstrated (logic gates, amplifier stages), presently developing more complicated prototypes (operational amplifiers, Analog/Digital converters)

Test results – environmental chamber testing of simple logic gates





High Temperature SiC Electronics

Point of contact …

Dr. Philip G. Neudeck
Neudeck@nasa.gov
(216) 433-8902

Q&A

What questions do you have at this point?

Thank You

for your time and attention!