Technology Opportunity

Thin Film Heat Flux Sensor

The National Aeronautics and Space Administration (NASA) seeks to transfer the process for fabricating thin film heat flux sensors.

Potential Commercial Uses

- To measure heat flux incident on ceramic engine parts and rocket engine parts
- To measure heat flux in automotive engines and aircraft engines
- To measure furnace output
- To detect fires
- For calorimetry

Benefits

- Can measure heat flux at high temperatures—up to 1700 °F
- Can be fabricated directly on parts without cutting into the part (e.g., ceramic engine parts)
- Are minimally intrusive in engines (sensor thickness is approximately 0.0004 in.)
- Are of small mass, so high frequency measurements can be made
- Provides accurate knowledge of heat loading on critical propulsion system components
- Can measure very high heat fluxes—up to 88 Btu/ft^{2}sec

The Technology

Heat flux is measured by using temperature sensors (thermocouples) to determine the temperature difference across a test material. This is done by fabricating two thermocouples on the surface of a material (see fig. 1). One thermocouple is coated with a thin insulator and the other with a thick insulator. Heat passing through the insulators produces a different temperature at each thermocouple. The incident heat flux is directly proportional to this temperature difference.

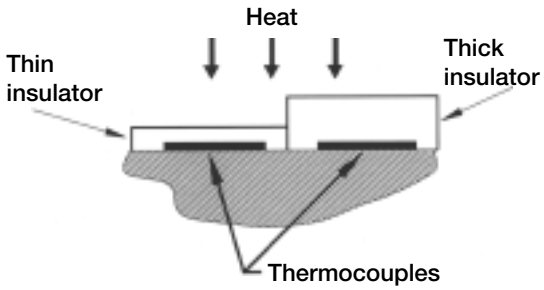

Figure 1.—Diagram of heat flux sensor operation.

The thin film heat flux sensors, being developed at NASA Glenn Research Center, are fabricated as a plug-type sensor on the surface of a ceramic material. They can also be fabricated directly on the surface of a part such as a turbine blade.

An actual sensor is fabricated by connecting many thermocouple pairs in series to form a thermopile (see fig. 2). The sensitivity is increased by adding many thermocouple pairs. The top and bottom contact pads in figure 2 are the connections to the heat flux sensor. The lower two contact pads provide a surface temperature signal.

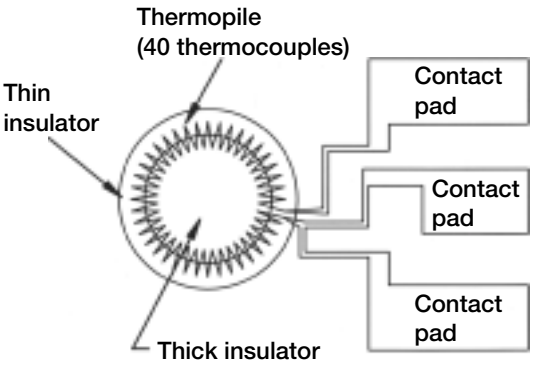

Figure 2.—Schematic of heat flux sensor fabrication.

Vacuum radio frequency sputtering technology and photolithography are used to fabricate the sensor. All the components are made into thin films, so the total sensor thickness is in the 0.0004- to 0.004-in. range. These sensors have been tested at up to 1700 °F at a heat flux of 88 Bt/ft^2sec.

Options for Commercialization

No applicable patent; none being applied for. Seeking partnership with industry for aerospace and nonaerospace applications.

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Key Words

Heat flux
Thermocouples
Thin films
Ceramic
High temperature
Vacuum sputtering
Photolithography

Reference

IC–025–1

National Aeronautics and
Space Administration
Glenn Research Center