Thin Film Sensors for Harsh Environments

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ABSTRACT

Advanced thin film sensors that can provide accurate surface temperature, strain, and heat flux measurements have been developed at NASA Glenn Research Center. These sensors provide minimally intrusive characterization of advanced propulsion materials and components in hostile, high-temperature environments as well as validation of propulsion system design codes. The sensors are designed for applications on different material systems and engine components for testing in engine simulation facilities. Thin film thermocouples and strain gauges for the measurement of surface temperature and strain have been demonstrated on metals, ceramics and advanced ceramic-based composites of various component configurations. Test environments have included both air-breathing and space propulsion-based engine and burner rig environments at surface temperatures up to 1100^{o}C and under high gas flow and pressure conditions.

The technologies developed for these sensors as well as for a thin film heat flux gauge have been integrated into a single multifunctional gauge for the simultaneous real-time measurement of surface temperature, strain, and heat flux. This is the first step toward the development of smart sensors with integrated signal conditioning and high temperature electronics that would have the capability to provide feedback to the operating system in real-time.

A description of the fabrication process for the thin film sensors and multifunctional gauge will be provided. In addition, the material systems on which the sensors have been demonstrated, the test facilities and the results of the tests to-date will be described. Finally, two new thin film flow sensors and a new thin film heat flux sensor will be discussed.