
Passive, Wireless Sensor Systems for Harsh Environments

Environetix Technologies Corporation (Orono, ME) is developing wireless, passive sensors and systems for harsh environments based on microwave acoustic sensor technology. The lightweight and low-profile nature of the sensor technology is achieved by using wireless microwave acoustic devices that are less than 0.5 mm thick, a few mm² in size, and fractions of a gram in weight. Successful high temperature sensor operation results from using stable piezoelectric langasite crystals and novel, proprietary nanocomposite electrodes patented by the University of Maine and licensed to Environetix. The miniature microwave acoustic sensors can be attached to typical turbine materials such as Inconel (Figure 1) and survive g-forces in excess of 50,000g on rotating parts of turbine engines and temperature up to 1000°C. Environetix initially targeted the development of wireless temperature sensors capable of operating in harsh environments (EVHT-100), and current product development is extending the technology to also measure pressure, strain, vibration, and corrosion.

A key attribute of Environetix's sensor technology is the wireless interrogation capabilities of the sensor system. Wireless interrogation enables sensor operation in harsh environments on rotating parts. A single interrogation unit can be used for rapid sampling of multi-sensor arrays. Without wires, easier and more reliable sensor assignment to rotating parts is achieved, as is improved flexibility in assigning sensor locations. The wireless setup reduces overall weight and improves system reliability in harsh conditions, including high temperatures, high pressures, and corrosive gases. The sensors operate solely under the energy provided by the radio-frequency (RF) interrogating signal, eliminating the need for batteries or maintenance. Signal processing is performed outside the harsh environment; thus, the interrogation system is constructed from reliable commercial components that do not need to survive in the same harsh environmental conditions.

Environetix Technologies Corporation is a technology-transfer start-up company spun out from high temperature microwave acoustic technology research in the Laboratory for Surface Science & Technology (LASST) at the University of Maine. The interdisciplinary group at LASST has extensive expertise in microwave acoustic wave materials and sensor devices, electrode thin-film processing and characterization at high temperatures, microwave propagation, wireless systems, and antenna design. These integrated components are well-developed and have benefited from a wide range of basic and applied research carried out at UMaine over the past ten years.

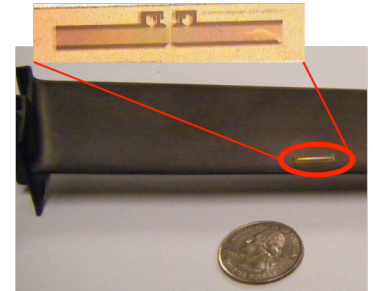


Figure 1: Microwave acoustic sensor attached to a turbine blade

Environetix EVHT-100 Wireless Temperature Sensor

- Measurement range from 150°C (302°F) to 900°C (1650°F)
- Accuracy greater than $\pm 10^\circ\text{C}$ over entire measurement range
- Resolution within 5°C
- Long term drift < 1°C / 150 hours
- Operating life > 500 hours
- Insensitive to pressure variations - vacuum to 750 psi
- Wireless interrogation of multiple sensors arrays

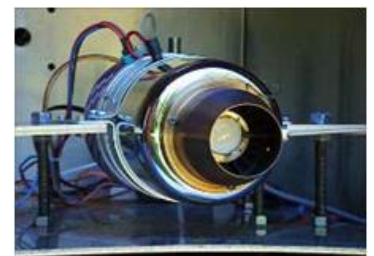


Figure 2: Environetix wireless temperature sensor being tested in a JetCat P-2000 turbine engine