

Wireless Micro-Sensors Monitor Structural Health



As buildings, bridges, and vehicles age, the cost to detect and remedy the effects of corrosion, stress fractures, and other damage can be prohibitively expensive and time-consuming. SRI International is developing wireless micro-sensors that can be embedded in these structures to continuously monitor their "health" from the inside out. The sensors provide an early-warning system for assessing damage before safety issues arise, and can help extend a structure's life by prioritizing the need for preventive maintenance.

For clients such as the National Aeronautics and Space Administration (NASA) and the Federal Highway Administration, through the California Department of Transportation (CalTrans), SRI has developed a series of wireless sensors called SensorTags™ and Smart Pebbles™. The sensors can be embedded in buildings, automobiles, and aircraft to provide critical data to monitor the integrity of these structures. Embedded sensors record events or current conditions of their surroundings. An external "reader" provides power to the wireless sensor to enable it to transmit its ID number and sensor status.

SensorTags™ Detect Over-Temperature Conditions on the Space Shuttle

SensorTags are devices that integrate radio frequency identification devices (RFIDs) with sensors to enable rapid wireless interrogation of a structure's health. For NASA, SRI developed SensorTags that monitor temperatures underneath the thermal protection system on the U.S. Space Shuttle. SRI built 12 prototype devices capable of withstanding 400° C and providing over-limit indication at a predetermined temperature less than 400° C. The goal of the research was to embed the devices in a two-millimeter gap between tiles on the Space Shuttle to record possible over-temperature conditions during atmospheric reentry, thereby identifying tiles that may need repair.

Over-temperature indication has applicability to commercial/industrial environments, as well, such as for inventory control, shipping, steam-sterilization, etc. SRI is looking for industrial partners interested in commercialization opportunities.



Smart Pebbles™ Warn of Impending Corrosion in Bridge Decks

SRI International is working with CalTrans to develop chloride threshold sensors called Smart Pebbles. These devices, literally the size of a pebble and of similar weight, can be embedded in bridge-decks to monitor chloride ingress into bridge-deck concrete — important in prioritizing steps to protect the underlying reinforcing steel bars from corrosion.

The first Smart Pebbles prototypes are under construction. These Pebbles will be embedded inside an existing California bridge to monitor its change over time. The device could be embedded when pouring new concrete, as well. A van-mounted reader could then drive past the sensor to obtain its chloride-threshold data. Using a global positioning system (GPS), the van could automatically update the health status of the bridge in the bridge database.

SRI is seeking an industrial partner for technology licensing to mass-produce these devices.

Applications of Wireless Micro-Sensors Include:

- Bridges, to monitor chloride ingress or corrosive conditions to help bridge engineers prioritize maintenance
- Buildings, to monitor temperature, motion, and cracks
- Aircraft and space vehicles, to report excessive temperatures
- Tire temperature and pressure monitors on automobiles, trucks, and aircraft to provide early warning of impending tread separation
- Child car safety seats, for programming a child's weight into an airbag system
- Microwave ovens, to monitor temperature limit and determine when food is fully cooked
- Medical equipment sterilization, to monitor temperatures and determine when sterilization has been achieved
- Medical and process diagnostics
- Shipping containers, to monitor temperature, humidity, and shock
- The pharmacist's or grocer's shelf, to monitor decomposition of chemicals, pharmaceuticals, and food (for example, to determine when milk goes sour by monitoring its pH level)
- Agriculture/gardening, to monitor soil moisture, pH and salinity
- Inventory control, to monitor environmental conditions
- Condition-based maintenance of mechanical equipment

About Us

SRI International is an independent, nonprofit research and development organization that offers unmatched depth and breadth of expertise — from applied research through the design and development of advanced applications. SRI's participation at each phase of innovation allows us to work with clients from concept to solution installation.

You Make the Call

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