Detect Gas Leaks with SAW Sensors in a Multi-sensor Network

Orthogonal Frequency Coded (OFC) Surface Acoustic Wave (SAW) sensors in a multi-sensory network to detect gaseous leaks in harsh environments with less than one second response time. This is a wireless, passive, and durable device with secure network communication and excellent for use in extreme environments.

Background
This OFC-SAW sensor technology began as a solution for NASA-Kennedy Space Center’s need for passive, wireless, and individually unique H\textsubscript{2} gas sensors for ground, space-flight, and space-exploration applications. NASA and UCF researchers have developed this multi-sensory network comprised of independently operating and uniquely identifiable sensors using OFC-SAW technology. The unique tagging allows each sensor to precisely identify leak locations. The time and location of the sensing event are reported simultaneously. This novel OFC-SAW technique has processing gain, code division multiple access, spread spectrum, and security advantages. Complex coding methods ensure greater network security.

Technical Details
These OFC-SAW sensors offer increased sensitivity, response time, and repeatability. Rapid H\textsubscript{2} detection has been proven for flow rates as low as 1ccm of a 2\% H\textsubscript{2}, 98\% N\textsubscript{2} mixture. These advantages are achieved through the unique process of gas sensing film deposition. Each device is designed to have reflector banks with multiple Bragg reflectors, each with a different orthogonal center frequency, which reduces device losses and improves device performance. The OFC-SAW sensor is built on a piezoelectric substrate which services as its power source and is activated by a wireless transmission to the device. Chemical sensing is made possible by placing a chemically sensitive film on the SAW substrate. For example, ultra-thin palladium (Pd) films and tin dioxide (SnO\textsubscript{2}) films were used for hydrogen sensing. Each device is designed to have multiple transducer / antenna pairs, each of which have a different center frequency, which reduces device losses and improves device performance. The SAW device is also durable enough to repeatedly survive large variations in temperature, which makes it an excellent candidate for a cryogenic environment.

Benefits
- Can operate in harsh environments: -270°C to 1000°C
- Rapid response - less than one second to detect and less than two minutes to return to normal
- Secure transceiver-sensor communication
- Signal loss minimized by 30-60dB
- Increase bandwidth, more efficient for longer distances

Application
- Hydrogen gas detection

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Tech Fields
Electronics, Sensors, Communications

Keywords
surface acoustic wave, hydrogen detection, gas sensor

US Issued Patents
7,623,037 | 7,642,898
7,777,625 | 7,825,805

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