This research was born from NASA Kennedy Space Center's (KSC) need for passive, wireless and individually distinguishable cryogenic liquid and H2 gas sensors in various facilities. Constant monitoring may minimize the risks of catastrophic accidents, associated with the storage and use of cryogenic fluids. Accidents involving the release of H2 gas or LH2 were responsible for 81% of total accidents in the aerospace industry. These problems may be mitigated by the implementation of a passive (or low-power), wireless, gas detection system, which continuously monitors multiple nodes and reports temperature and H2 gas presence. Passive, wireless, cryogenic liquid level and hydrogen (H2) gas sensors were developed on a platform technology called Orthogonal Frequency Coded (OFC) surface acoustic wave (SAW) radio frequency identification (RFID) tag sensors. The OFC-SAW was shown to be mechanically resistant to failure due to thermal shock from repeated cycles between room and liquid-nitrogen temperatures. This suggests that these tags are ideal for integration into cryogenic Dewar environments for the purposes of cryogenic liquid level detection. Three OFC-SAW H2 gas sensors were simultaneously, wirelessly interrogated while being exposed to various flow rates of H2 gas. Rapid H2 detection was achieved for flow rates as low as 1ccm of a 2% H2, 98% N2 mixture. A novel method and theory to extract the electrical and mechanical properties of a semiconducting and high conductivity thin-film using SAW amplitude and velocity dispersion measurements were also developed. The SAW device was shown to be a useful tool in analysis and characterization of ultrathin and thin films and physical phenomena such as gas adsorption and desorption mechanisms.

Approved for distribution by Donald C. Malocha, Committee Chair, on June 12th, 2012.

The public is welcome to attend.