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ABSTRACT TITLE: BAW and SAW sensors for In-situ analysis

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ABSTRACT

In-situ analysis is a major goal in current and future NASA exploration missions. In general in-situ analysis experiments are designed to investigate chemical, biological or geological markers or properties to determine the complex history of the body being studied or for use as a pre-screening measurement to increase the scientific value of samples selected for sample return. In order to expand the number of applicable sensor schemes an investigation into piezoelectric bulk acoustic wave (BAW) and surface acoustic wave (SAW) resonators has been initiated with emphasis on applications to future NASA missions. In general, BAW and SAW sensors can be configured to directly measure mass, acoustic impedance, density and elastic property changes. Indirectly they can be designed to measure or monitor pressure, temperature, dew/melting point, curing, adsorption/desorption, viscosity and be configured with the appropriate reaction layers as chemical sensors or as Imunosensors. The various models used to describe these sensors will be presented and the measurand sensitivity and importance of cross sensitivities will be discussed. Recent advances in passive wireless RF interrogated SAW technology has increased the scope of these sensor systems to remote sensing (10m) and to applications which may have been deemed previously inaccessible [Bao et al. 1987, Varadan et al. 1997, Reindl et al. 1998]. Examples include SAW stress sensors buried in large structures that once assembled are inaccessible for measurement that can be interrogated with wireless RF signals to determine the health of the structure. In addition, this technology has recently been coupled with other sensor technology [Reindl et al. 1998] allowing for an expansion of the possibilities for remote sensing.

X.Q. Bao et al. (1987), "SAW temperature sensor and remote reading system", Proc. IEEE Ultrasonics Symposium, **1**, pp. 583-585

V.V. Varadan et al. (1997)"Wireless passive IDT strain microsensor" Smart Materials and Structures, **6**, pp. 745-751

L. Reindl et al., (1998) " Theory and Application of Passive SAW Radio Transponders and Sensors" IEEE Trans. On UFFC, **45**, pp.1281-1292

KEYWORDS: Ultrasonic, Bulk Acoustic Waves, Surface Acoustic Waves, RF interrogated sensors, microfluidics

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