Low Temperature, Hermetic Packaging of a MEMS Electric Field Sensor

Speaker: Douglas Gauthier, Daniel Reilly, James Bickford, & Stephanie Golmon – Draper, Cambridge, MA

E-Mail: douglas.gauthier@draper.com

Abstract

The packaging of electret transducers for MEMS scale electric field sensors presents a number of interesting challenges. These electrets are formed by embedding charge into dielectric materials. In the presence of an electric field these charges will experience an electromagnetic moment, and by coupling these electrets to a physical MEMS sensor, miniature electric field sensors can be produced.

The traditional vacuum packaging techniques used in MEMS sensors present a number of challenges when used in conjunction with electrets. Principally amongst them are the tendency of electrets to depolarize during packaging and a limited material set to avoid shunting the electric field around the electret. Depolarization of the electret can occur both during vacuum pumpdown and thermal cycling. Solutions and their implementation to these challenges are presented here.

Metals and high dielectric constant materials preferentially divert flux which can increase gain or reduce performance depending upon the relative physical configuration of the structures. Alternative, low dielectric materials are used for the main package and braze material are strategically placed away from the electret to avoid shunting the electric field away from the sensor.

Electret materials have a tendency to depolarize at elevated temperatures. This material phenomenon is similar to the Curie Effect shown in permanent magnets. The critical temperature of the electrets used in this application is below the brazing temperatures used in traditional gold tin eutectic, MEMS packaging. Alternative methods for vacuum sealing and their effectiveness are presented.