ECS Transactions, 3 (6) 367-367 (2006)
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Moisture resisitant nano liter packages using metallic seal wafer bonding

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Objective

Vacuum wafer bonding technology provides a number of very effective techniques to produce low-cost, hermetic sealed nano liter packages for micromachined sensors and actuators. Beside the protection of the device from outside environmental stresses, the package must also provide an interior environment compatible with the device performance and reliability demands, see figure 1. The special challenges in passing autoclave testing are discussed. Moisture tolerant nano liter packages are an enabling factor for very cost effective 1st. level packaging in open cavity or molded packages for a large variety of applications, otherwise excluded due to cost reasons.

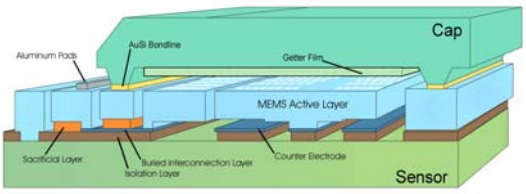

Figure 1: Surface micro mechanic inertial sensor with vacuum nano liter package. The AuSi bond line is resistant to extended autoclave testing.

Approach

The presentation reviews the characteristics of metallic seal bonding with the focus on AuSi-eutectic bonding on thick epi-poly layers [1]. Metallic seal bonding provides a portfolio of characterisitics that make it interesting for diverse micro device applications. A surface micromachined gyroscope sensor is discussed as a model system for bond interface design, bond process generation and reliability testing. A test approach with a ceramic package carrier for autoclave testing, interfacing of the sensor component and a special conditioning process prior to testing the sensor functionality have been develped. Resonance monitoring is the key to fast evaluation of package degradation during moisture exposure. The measurement methodology is described.

Results

A 100% screening test of hermeticity was developed that has a ultra-high detection sensitivty [2]. The Neon ultra-fine leak test is also used to detect seal degradation during moisture exposure tests and gives direct feedback for process optimization and bond interface formation, see figure 2. Sensors pass standard autoclave tests. Extended exposure runs show a capability to pass up to 1500 h exposure without any 1st level package.

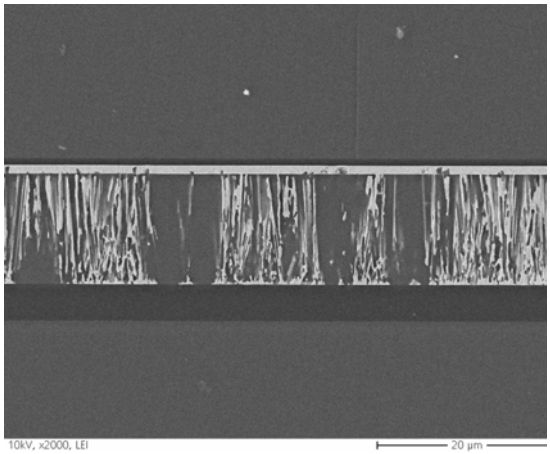

Figure 2: AuSi bond interface with gold diffusion in poly-Si layer.

Conclusion

Metallic seal bonding can achieve very narrow, strong and corrosion resistant bond interfaces that allow the use of standard plastic packages for 1st level packaging. The bond technology is especially interesting for nano liter packages. With this achievement the development of highly integrated, precision inertial sensor modules for consumer applications is free.

References

[1] W. Reinert et al., “Vacuum Wafer Bonding Technology”, IMAPS Nordic 2004
[2] In-line critical leak rate testing of vacuum sealed and backfilled resonating MEMS devices, ECS spring meeting 2005, Quebec

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