Vacuum Packaging of High-*Q* Micromachined Gyroscopes

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Vacuum packaging of micromachined gyroscopes for use in inertial navigation has been a major challenge. A wafer-level, environment-resistant package that can provide a stable, high-level vacuum has been developed and demonstrated with tuning-fork micromachined gyroscopes created at Georgia Tech. The vacuum package (Figure 1) incorporates a suspended platform, made from a thin glass layer, that supports the gyroscope and isolates it from the external environment; a silicon cap that provides vacuum; and vertical feedthroughs that transfer signals to the outside world. A thin-film getter is used to improve the vacuum pressure inside the package. Micromachined resonant gyroscopes with a quality factor Q, as high as 80,000 at room temperature, have been packaged and tested. This is the highest Q reported for any wafer-level, vacuum-packaged microgyroscope. To produce this high Q, the pressure inside the package is less than 5mTorr. The packaging technology is generic and is compatible with both die- and wafer-level processing. Any MEMS die, fabricated using any MEMS technology, can be vacuum packaged using this technology. The packaging technology can also be used with a variety of MEMS devices, including micromachined resonators used in RF-MEMS and micromachined infrared (IR) detectors. If your group is interested in utilizing this technology for prototype packaging please contact Professor Najafi. ■

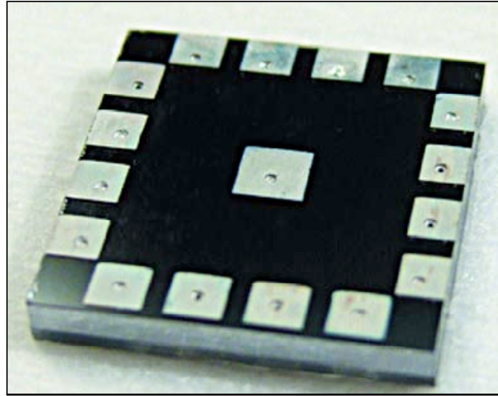

Figure 1 – Photograph of a completed vacuum package showing the vertical feedthroughs on the front side of the chip. The feedthroughs connect the gyroscope inside the package and is neither visible nor vulnerable to the outside world.

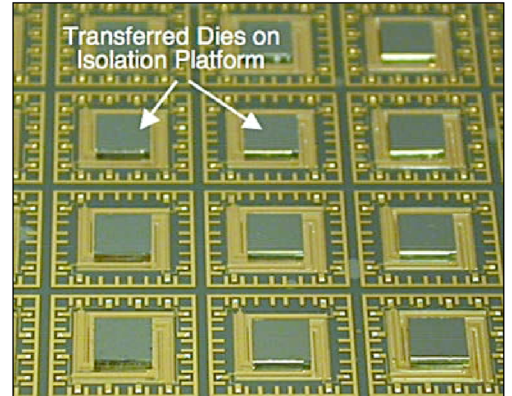

Figure 2 – Photograph showing a number of microgyroscope dies mounted on the suspended glass platform that provides environmental isolation. The cap wafer for vacuum packaging is not shown here.