Low-Power Thermal Isolation for Environmentally Resistant Microinstruments

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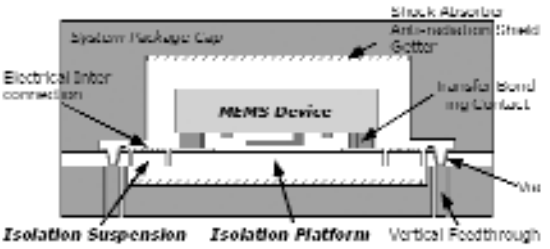

The environment has a profound impact on the performance of precision micromachined instruments increasingly needed in many applications. To realize the potential of MEMS, it is critical that the environment, especially temperature, around the instrument be controlled. The figure shows a view of a generic thermally isolated platform, which is suspended by isolation tethers made of thin glass. MEMS devices are fabricated on a separate wafer, and batch transferred to the isolation platform. Complete environmental protection is provided by encapsulating the MEMS devices mounted on the platform in vacuum and servo-controlling it at a fixed temperature. The operating temperature of the module is controlled in closed loop using integrated heaters and control circuitry. To achieve low-power consumption, the MEMS device is suspended inside a vacuum package and is supported using tethers designed to have very high thermal impedance and large mechanical spring constant. The measured thermal impedance is 3,300K/W, which corresponds to ~40mW power consumption for the oven control. A vacuum packaged Pirani gauge has been used to measure vacuum pressures as low as 30mTorr. In addition, through our collaborations with Georgia Institute of Technology, micromachined inertial grade gyroscopes have been transferred on the platform and packaged in vacuum. The environment resistant package can be used for a number of other MEMS devices and instruments. This project is supported by the Defense Advanced Research Projects Agency HERMIT program under contract number W31P4Q-04-1-R001.