

Chip Scale Bias Drift Compensation for Integrated MEMS Gyroscopes



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Bias (offset) characterization of microelectromechanical systems (MEMS) gyroscopes involves understanding of the device behavior under variations in temperature and external stress. Today these tests are performed on the printed-circuit board level, and the actual temperature and stress state of the on-chip MEMS structure is generally not well known. The ultimate goal of this project is to characterize and compensate the bias drift of the MEMS gyroscopes in response to temperature and stress variations by using on-chip temperature and stress sensors. These sensors can be implemented in a CMOS-MEMS process efficiently. Sensors located at the anchor points will provide a better understanding of how the actual mechanical element is affected from the temperature and stress effects. Finite-element analysis of stress and temperature interactions in the device substrate, when coupled with system simulations at these anchor points, will provide appropriate numerical analysis to predict the interaction between the gyroscope and environment.

To initiate validation of this approach, gyroscopes are first being prototyped in an in-house two-mask SOI-MEMS process that has a relatively fast fabrication turn-around time. Fig. 1 shows an SEM of a triple-fold symmetric gyroscope designed for this process. A Si resistor on each edge of the device is used to heat the device to create temperature gradients. A gold resistor monitors the temperature through the gold temperature coefficient of resistance. A future gyroscope with the environmental sensors will be fabricated in a CMOS-MEMS process after verification of the basic device operation in the SOI process.

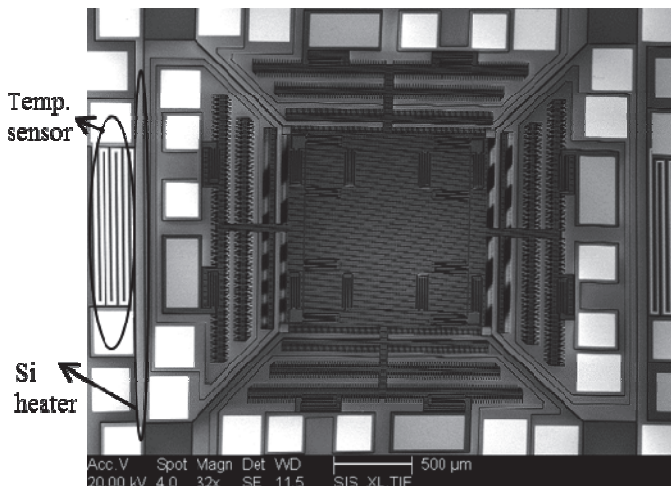


Fig. 1: SEM of the triple fold symmetric gyroscope.