

High-Resolution Integrated Micro Gyroscope for Space Applications

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In this paper, an integrated capacitive gyroscope fabricated by CMOS-MEMS technology is presented. The CMOS-compatibility of the fabrication process enables full integration of the sensor with interface and signal conditioning circuitry on a single chip. The entire microstructure is single-crystal silicon based, resulting in large proof mass and good mechanical behaviors. Thus, high-resolution and high-robustness microgyroscopes can be obtained. With a resolution of about $0.01^\circ/\text{s}/\text{Hz}^{1/2}$, the fabricated gyroscope chip is only as small as 1.5mm by 2mm including the sensing elements and integrated electronics. The robustness, light weight and high performance make this type of MEMS gyroscope very suitable for space navigation applications where payload is critical.

The on-chip capacitive sensing circuitry employs chopper stabilization technique to minimize the influence of $1/f$ noise. The on-chip circuits also include a two-stage fully differential amplifier and a DC feedback loop to cancel the DC offset. The CMOS fabrication was performed through MOSIS by using the 4-metal TSMC $0.35\mu\text{m}$ CMOS process. The post-CMOS micromachining processing consists of only dry etch steps and uses the interconnect metal layers as etching masks. Single-crystal silicon (SCS) structures are produced by applying a backside etch and forming a $60\mu\text{m}$ -thick SCS membrane.

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