High-Frequency AIN-on-Silicon Resonant Square Gyroscopes (#6375)

A high-frequency resonant square micro-gyroscope using piezoelectric transduction

Researchers at Georgia Institute of Technology have developed a resonant square gyroscope along with a group of its inherently-orthogonal degenerate mode pairs which can be efficiently excited and sensed by thin-film piezoelectric transducers deposited on the top surface of the structure. An aluminum nitride (AIN) thin film deposited on the top surface of the structure is used to provide electromechanical transduction for drive and sense modes without requiring any DC polarization voltage for operation. Proper electrode configuration can be used for simultaneous, yet independent, transduction of these resonance pairs, enabling the operation of the silicon square resonator as a mode-matched gyroscope. Owing to highly efficient and linear piezoelectric transduction, such high frequency and high Q gyroscopes can offer very large dynamic range by simultaneously improving the full scale linear range while reducing the noise equivalent rotation rate.

Benefits/Advantages

- **Low-cost –** Straightforward manufacturing process reduces cost and complexity
- **Higher frequency operation –** Realizes higher frequency of operation for resonant gyroscopes and provides higher rotation rate sensitivity

Potential Commercial Applications

- Consumer electronics applications
- Image stabilization in digital cameras
- Smart user interfaces in handhelds, gaming
- Inertial pointing devices

Background/Context for This Invention

Miniature gyroscopes measures angular velocity, and can be used for navigation. Silicon Bulk Acoustic Wave (BAW) resonant disk micro-gyroscopes operating in mode-matched condition at high frequencies have been recently considered as a viable miniaturized solution for rotation-rate sensing. Capacitive signal transduction through nano air-gaps has been used for BAW silicon disk gyroscopes. However, since such disk resonators operate in their high-order elliptical BAW resonance modes with distortional in-plane stress fields, thin-film transverse-piezoelectric transduction is not very efficient for excitation and sensing of the drive and sense resonance modes.

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Publications

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