Three-Dimensional Wafer-Scale Batch-Micromachined Angle/Angular Rate Microshell Resonator Gyroscope

Tech ID: 20722 / UC Case 2010-231-0

BRIEF DESCRIPTION

A novel design and fabrication methods of three-dimensional, wafer-scale, batch-fabricated angle/angular rate micro-shell resonator gyroscope with on-chip actuation and detection.

FULL DESCRIPTION

One implementation of the isotropic oscillator concept, the quartz hemispherical resonator gyroscope (HRG), demonstrated the potential of rate integrating gyroscopes with inertial grade performance. HRG, however, is extremely difficult to fabricate because individual meso-scale quartz shell is manually machined with high precision. Although conventional HRG is widely used for precision inertial navigation and guidance applications, it is not suitable for man-portable application because of its size, weight and power (SWAP) metrics.

University researchers have developed wafer-level methods for a novel gyroscope design which allows batch fabrication of three-dimensional isotropic micro-shells of various geometries using extended glass-blowing technology. The gyroscope on-chip actuation and detection take advantage of proposed three-dimensional micromachining for metal patterning on the surfaces of micro-shells as well as wafer-level fabrication of multi-material structures using shell array as a three-dimensional substrate. The reported gyroscope is a three-dimensional isotropic oscillator, which measure angle/angular rate of the vehicle. The fundamental principle is the precession of the shell vibration axis in response to the inertial input, with the precession angle proportional to the rotation angle.

SUGGESTED USES

The fabrication methods and designs for the novel three-dimensional batch-fabricated angle/angular rate micro-shell resonator gyroscope are suitable for mass production, thereby enabling portable, low-cost, and high precision inertial sensors for consumer, communications systems, civil and military navigation markets.

ADVANTAGES

Previously limited by planar geometries, the implementation of three-dimensional shell resonator gyroscopes on a wafer level was not feasible. A broad class of novel three-dimensional multi-material resonant structures and instruments for inertial applications is now enabled by the following new techniques: resonant micro-shells batch fabrication of various geometries (in combination with glass-blowing technology), three-dimensional metal patterning on the surfaces of micro-shells, and multi-material structures fabrication using shell array as a three-dimensional substrate.

PATENT STATUS

Country	Type	Number	Dated	Case

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OTHER INFORMATION

CATEGORIZED AS

» **Communications**
» Other
» **Engineering**
» Engineering
» **Sensors & Instrumentation**
» Position sensors
» **Transportation**
» Aerospace

RELATED CASES

2010-231-0

United States Of America	Issued Patent	9,296,133	03/29/2016	2010-231
United States Of America	Issued Patent	8,567,247	10/29/2013	2010-231

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Micromachined Gyroscope Design Allowing for Both Robust Wide-Bandwidth and Precision Mode-Matched Operation
- 3-D Folded MEMS Technology For Multi-Axis Sensor Systems
- Prioritizable IMU Array (Prio-IMU) for Enhanced Pedestrian Navigation

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