Laser Patterned Self-Aligned Electrodes For Hemispherical Resonator Gyroscope

Tech ID: 34538 / UC Case 2025-819-0

BRIEF DESCRIPTION

A novel laser-based method to create self-aligned electrodes with increased capacitance for improved performance of hemispherical resonator gyroscopes.

FULL DESCRIPTION

This technology introduces a laser patterning technique to form electrodes directly from the fused silica material of hemispherical resonator gyroscopes (HRGs). Unlike traditional methods requiring separate electrode fabrication and precise assembly, this approach utilizes femtosecond laser induced chemical etching (FLICE) which has been demonstrated to achieve electrodes with an aspect ratio >60:1. The self-aligned electrodes eliminate assembly errors, allow for more intricate electrode geometries, and deliver substantially increased capacitance and sensitivity. Additionally, the method enables direct access to the resonator for laser balancing while electrodes remain attached, streamlining the tuning process.

SUGGESTED USES

- Precision inertial navigation systems for aerospace and defense.
- High-performance gyroscopes in satellites and spacecraft.
- Advanced navigation equipment for autonomous vehicles and drones.
- Industrial motion sensing and control systems.
- Applications requiring high sensitivity and stability in rotational measurement.

ADVANTAGES

- Eliminates the need for separate electrode substrate fabrication.
- Removes requirement for precise bonding and alignment, thereby removing assembly errors.
- Enables complex, laser-patterned electrode geometries for greater capacitance.
- Supports online tuning of anisoelasticity and anisodamping during operation.
- Significantly increases capacitance, enhancing sensitivity.
- Increases effective mass at the rim for improved gyroscope performance.

RELATED MATERIALS

- Parrish, A. R., et al. (2025). Laser patterned self-aligned electrodes for dual-shell hemispherical resonator gyroscope. IEEE.

CONTACT

Alvin Viray
aviray@uci.edu
tel: 949-824-3104.

OTHER INFORMATION

CATEGORIZED AS

- **Security and Defense**
  - Other
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  - Design and Fabrication
- **Sensors & Instrumentation**
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5270 California Avenue / Irvine,CA
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