For Reviewer 3:

Dear Expert:

Thank you for taking the time to read this article and giving specific and inspiring suggestions. We have revised this article after carefully reading your comments.

Now, we would like to answer your comments and questions one by one, and the red color is the comments, the black content is our responses, the yellow parts are the revised content in the paper.

1.There are multiple formatting errors, English grammar and sentence structuring errors that must be improved.

Dear expert, you are quite right. We are sorry for the spelling and grammatical errors caused by our carelessness, so we used sensors' editing service to correct syntax and spelling errors in the article.

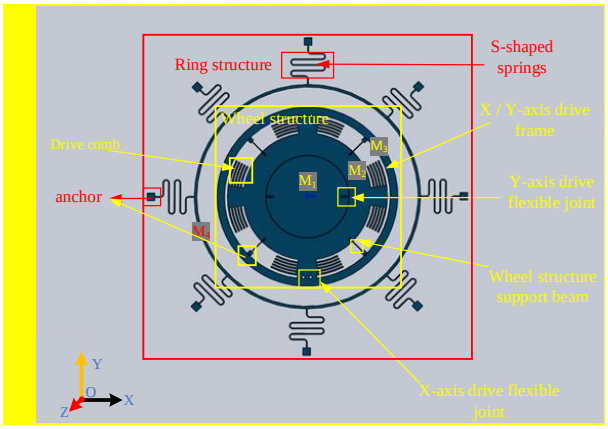
2.In the Introduction section, authors should include a discussion for the need of a new ring type MEMS gyroscope structure. What are current limitations of the existing MEMS gyroscopes that the proposed design can overcome?

Dear expert, you are quite right. We have highlighted the advantages of our gyro structure.

This paper proposes a new three-axis gyroscope to provide ideas for future gyroscope design. The design has a tiny size, simple structure, excellent resistance to overload and high sensitivity. The two mutually independent parts also avoid coupling problems. In this paper, the structure is firstly analyzed in detail, and the corresponding theoretical equations are derived. Then the structure is further simulated to verify its sensitivity and impact resistance. Finally, the detailed fabrication is introduced, and the finished product diagram after processing is given.

3.Figure 1(b) should be enough to explain the proposed MEMS gyroscope design. Moreover, the labeling of the MEMS gyroscope should be clear.

Dear expert, thank you so much for your suggestion, and we have modified the image annotation to ensure that it is more accurate and more precise.



(b) structure description diagram.

4. Some of the equations (Eq. 7, 12, 13 etc) seems to be included as picture which should be properly written.

Dear expert, thank you so much for your suggestion. We checked all formulas and ensured they were edited by MathType 7.0 equation.

5. In the FEM analysis, authors should mention the material properties used.

We have carefully considered the expert's suggestion and made some changes. We have added

the specific material and its properties to the paper

Table 2. The material parameters of gyroscope.

Property	Value
Density	2330 kg/m^3
Young's Modulus	169 GPa
Poisson's Ratio	0.27

6.The harmonic response of the MEMS gyroscope is strongly dependent on the air damping. Authors must perform air damping analysis first and then include the damping coefficients in the FEM analysis to analyze the frequency response.

Dear expert, thank you so much for your suggestion. We perform the harmonic response simulation in the ideal case, where there is a vacuum, and the presence of air damping is not considered.

7.Authors must mention the actuation force estimation and corresponding values used in the FEM based harmonic analysis.

Dear expert, you are quite right, and we give specific values for actuation force.

The electrostatic force and torque are 0.15μN and $6.7*10^{-12}$N/m respectively,so harmonic force with amplitude of 0.1μm is applied to the gyroscope,and the displacement of the structure sensing mode is observed.

8.How the drive and sense mode resonance frequency matching will be achieved in the presence of microfabrication process uncertainties and environmental variations like temperature and pressure.

Dear expert, your comments are pretty valuable! We have revised the fabrication section to make the process more detailed.

A: After cleaning and drying the glass wafer, the glass substrate was spin-coated with AZ4620 photoresist and baked. After baking, the mask was aligned with the glass substrate and irradiated with a UV light source to pattern the glass substrate.

B: The electrical connection layer was formed by sputtering Cr/Au on the glass substrate to a thickness of 200nm.

C: Photoresist was removed with an organic solvent (usually ethanol and acetone).

The desired shape of the electrode layer was obtained after three steps: A, B, and C.

D-E: A 4-inch, 400-μm-thick <111>silicon wafer was used, and AZ4620 was coated and patterned on the back side of the wafer.

F: DRIE was used to etch a 2μm depth for preparing the anchor of the gyroscope. The residual photoresist was removed at the end of the etching process.

G: The silicon and metallized glass wafers were anodically bonded on an EVG510 bonding machine with a bonding temperature of 400°C and a bonding voltage of 800V.

H: After step G, the silicon wafer thickness was thinned to 100 μm.

I: Photoresist was applied on the front side of the silicon wafer and a second etching is performed with an etching depth of 100μm.

J: Finally, etching was completed and the structure is released.

9.Authors must include a comparison of the results obtained through the FEM simulations and developed mathematical model.

We appreciate it very much for this good suggestion. We added a part of the results of matching the mathematical model with the simulation, and another part of the results of the mathematical

model will be matched in the subsequent experiments.

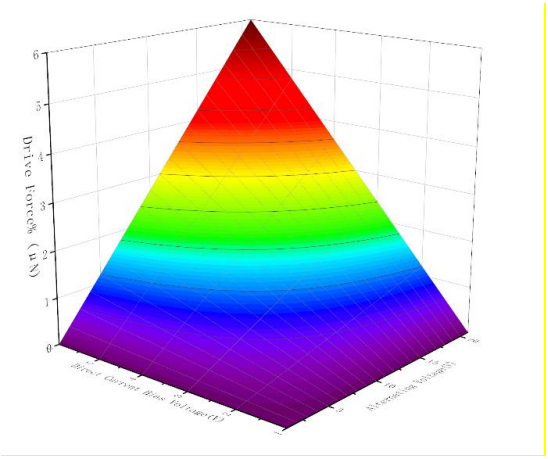


Fig.12. Electrostatic driving force curve.

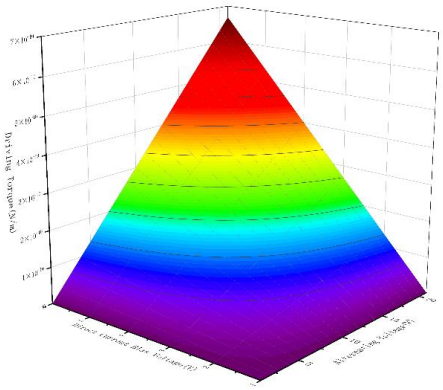


Fig. 13. Electrostatic driving torque curve.

We wish our answer can clear your confusion and meet your satisfaction, and please do not hesitate to let us know if there is still some question in the revised version.

Thank you again for your help!

Best wishes!

Tianqi Guo