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FEM Analysis for Single-Chip Multiaxial Servo Accelerometer

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An FEM analysis for determining optimum vibrating element structure, as well as detection and control electrode configuration for a single-chip electrostatic servo multiaxial accelerometer, has been carried out. The multiaxial accelerometer requires high sensitivity as well as very low cross-axial sensitivity, while maintaining excellent servo control stability. The vibrating element DOF (degree of freedom) motion separation characteristics, as well as the electrode configuration, determine the sensor performance. It was possible to reduce cross-axial sensitivity to under 1% by employing a quasi-ballpoint planar suspension mechanism, as well as by using the counter modal mode capacitance electrode configuration.

1. Introduction

Accelerometers play essential roles in motion control systems. A semiconductor accelerometer makes extreme reduction of size and weight possible. Many kinds of uniaxial semiconductor accelerometers have been investigated since the late 1970's.[1-10] The increasing demand for lowering accelerometer costs requires improvement of mass-production technology. Increasing the number of devices formed on a single wafer at the same time is one of the very effective means for cost reduction. The accelerometer of the future will have such an extremely small size and weight that its existence cannot be easily detected. We previously reported on a surrounding mass accelerometer which markedly