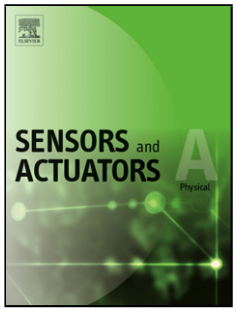

Title: Asymmetric seesaw structure of microelectromechanical systems accelerometer for sensing out-off-plane acceleration

Authors: Ching-Jui Shih, Chia-Hung Yeh

PII: S0924-4247(16)30962-1
DOI: https://doi.org/10.1016/j.sna.2017.09.037
Reference: SNA 10345

To appear in: *Sensors and Actuators A*

Received date: 21-11-2016
Revised date: 7-9-2017
Accepted date: 20-9-2017

Please cite this article as: Ching-Jui Shih, Chia-Hung Yeh, Asymmetric seesaw structure of microelectromechanical systems accelerometer for sensing out-off-plane acceleration, Sensors and Actuators: A Physical https://doi.org/10.1016/j.sna.2017.09.037

Asymmetric seesaw structure of microelectromechanical systems accelerometer for sensing out-off-plane acceleration

Ching-Jui Shih[a] and Chia-Hung Yeh[b*]

[a]Department of Mechanical Engineering, National Taiwan University, Taipei 10617 Taiwan

[b]Department of Industrial Engineering and Enterprise Information, Tunghai University, Taichung 40704 Taiwan

*Corresponding Author：Chia-Hung Yeh ; E-mail: chy@thu.edu.tw

Highlights

1. This report presents a small chip size and structure with an asymmetric proof mass were obtained in this study.
2. We reports the use of a torsional seesaw with an asymmetric beam-mass structure as the main sensing device.
3. In a system-level test, the sensitivity of the device was 11.3 fF/g. The nonlinearity was 0.62% over a range of 1 g, and the x/z and y/z crosssensitivity values were 0.06% and 2.58%, respectively.

Abstract.

A microelectromechanical systems (MEMS) accelerometer estimates the acceleration by detecting a difference in capacitance. This paper presents a small MEMS accelerometer with an asymmetric seesaw design. It was fabricated using a bulk machining process and accurately measures the applied acceleration based on a difference in capacitan ce. The large torque proof mass and chamfered structure of the torsional spring on the small chip were optimized to improve the device sensitivity and robustness of the design structure, respectively, which were the main factors in improving the MEMS sensor performance and maintaining the small chip size. After fabrication, we verified the design optimization by measuring the capacitance–voltage (C–V) curve behavior of the seesaw and making observations using scanning electron microscopy (SEM). The measured capacitance and theoretical calculation results were 249 fF and 239.9 fF, respectively. The SEM observations showed that there was no severe undercutting in the cross section of the structure. According to a finite element method analysis in just the electrical domain, the electrostatic characteristics such as the C–V measurements matched the theoretical values (within 3.6%). Moreover, the sensitivity of the fabricated accelerometer was 11.3 fF/g, and the nonlinearity was 0.62% over the typical range of 1 g. According to the system test results, the accelerometer had cross-