

## Accepted Manuscript

Title: Tri-axis Convective Accelerometer with Closed-Loop Heat Source

Authors: Van Thanh Dau, Thien Xuan Dinh, Lam Bao Dang, Canh-Dung Tran, Tung Thanh Bui, Phan Thanh Hoa



PII: S0924-4247(18)30086-4  
DOI: <https://doi.org/10.1016/j.sna.2018.03.047>  
Reference: SNA 10713

To appear in: *Sensors and Actuators A*

Received date: 14-1-2018  
Revised date: 11-3-2018  
Accepted date: 30-3-2018

Please cite this article as: Dau VT, Dinh TX, Dang LB, Tran C-Dung, Bui TT, Hoa PT, Tri-axis Convective Accelerometer with Closed-Loop Heat Source, *Sensors and Actuators: A. Physical* (2018), <https://doi.org/10.1016/j.sna.2018.03.047>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

# Tri-axis Convective Accelerometer with Closed-Loop Heat Source

Van Thanh Dau<sup>1\*</sup>, Thien Xuan Dinh,<sup>2</sup> Lam Bao Dang<sup>3</sup>, Canh-Dung Tran<sup>4</sup>, Tung Thanh Bui,<sup>5</sup> and Phan Thanh Hoa<sup>6\*</sup>

<sup>1</sup>Research Group (Environmental Health), Sumitomo Chemical. Ltd, Hyogo, 665-8555, Japan

<sup>2</sup>Graduate School of Science and Engineering, Ritsumeikan University, Kyoto, 525-8577, Japan

<sup>3</sup>School of Mechanical Engineering, Hanoi University of Science and Technology, Viet Nam

<sup>4</sup>School of Mechanical and Electrical Engineering, University of Southern Queensland, Queensland QLD 4350, Australia

<sup>5</sup>University of Engineering and Technology, Vietnam National University, Hanoi, Vietnam

<sup>6</sup>HaUI Institute of Technology, Hanoi University of Industry, Hanoi, Vietnam

\*Corresponding authors: [dauv@sc.sumitomo-chem.co.jp](mailto:dauv@sc.sumitomo-chem.co.jp) ; [phanthanhhoa@hau.edu.vn](mailto:phanthanhhoa@hau.edu.vn)

## Highlights

- We developed a miniaturized tri-axis convective accelerometer utilizes closed-loop type heater.
- Closed-loop heater increases the convective flow to the central part where a hotwire is placed to measure vertical acceleration
- Device was modelled by OpenFOAM and device was prototyped by additive manufacturing.
- The results demonstrated that the closed-loop heat source could reduce the cross effect between the acceleration components

## Abstract

In this paper, we report the details and findings of a study on tri-axis convective accelerometer, which is designed with the closed-loop type heat source and thermal sensing hotwire elements. The closed-loop heat source enhances the convective flow to the central part where a hotwire is placed to measure the vertical component of acceleration. The simulation was conducted using numerical analysis, and the device was prototyped by additive manufacturing. The device, functioning as a tilt sensor and an accelerometer, was tested up to acceleration of 20g. The experiments were successfully conducted and the experimental results agreed reasonably with those obtained by numerical analysis. The results demonstrated that the closed-loop heat source could reduce the cross effect between the acceleration components. The scale factor and cross-sensitivity had the values of 0.26  $\mu\text{V/g}$  and 1.2%, respectively. The cross-sensitivity and the effects of heating power were also investigated in this study.

**Keywords:** convective accelerometer, tri-axis, closed-loop heater, hotwire, OpenFOAM.

## I. INTRODUCTION

Recently, micromachined accelerometers have undergone rapid development, and are widely used in various applications. Solid-state accelerometers have high performance, but also possess some setbacks. They are more fragile, fabricated by complicated process, and need complex packaging in order to remove the squeeze film effect between the proof mass and the accelerometer structure [1]. In Refs. [2], [3], the authors presented the first accelerometers without the proof mass, working under the principles of thermal convection heat transfer. Micro thermal convective accelerometers utilizing thermal bubble have been studied over the last two decades [4]. The operation of this type of sensor is based on the movement of a hot tiny air bubble generated from a heater. From

Download English Version:

<https://daneshyari.com/en/article/7133352>

Download Persian Version:

<https://daneshyari.com/article/7133352>

[Daneshyari.com](https://daneshyari.com)