

Accepted Manuscript

Title: Mechanical and electrical characterization of quartz tuning fork force sensors

Author: Bakir Babic Magnus T.L. Hsu Malcolm B. Gray
Mingzhen Lu Jan Herrmann



PII: S0924-4247(14)00550-0
DOI: <http://dx.doi.org/doi:10.1016/j.sna.2014.12.028>
Reference: SNA 9011

To appear in: *Sensors and Actuators A*

Received date: 3-9-2014
Revised date: 11-11-2014
Accepted date: 26-12-2014

Please cite this article as: Bakir Babic, Magnus T.L. Hsu, Malcolm B. Gray, Mingzhen Lu, Jan Herrmann, Mechanical and electrical characterization of quartz tuning fork force sensors, *Sensors & Actuators: A. Physical* (2015), <http://dx.doi.org/10.1016/j.sna.2014.12.028>

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.

Mechanical and electrical characterization of quartz tuning fork force sensors

Bakir Babic,^{1, a)} Magnus T. L. Hsu,¹ Malcolm B. Gray,¹ Mingzhen Lu,² and Jan Herrmann¹

¹⁾*National Measurement Institute, Bradfield Road, Lindfield NSW 2070, Australia*

²⁾*National Institute of Metrology, Beijing 100013, P.R. China*

(Dated: 11 November 2014)

The results of a systematic experimental characterization of the mechanical and electrical properties of quartz tuning forks (QTFs) are presented. Actuation efficiency and detection sensitivity are introduced as parameters for characterization of the QTF with a focus on their use as a force sensor. The spring constants, quality (Q) factors, actuation efficiencies and detection sensitivities of twelve QTFs were measured by combining heterodyne interferometry with an electrical excitation/detection set-up and found to be consistent for all twelve QTFs. Spring constants were determined using geometrical and thermal methods and were found to agree within 3 %. The Q -factor, actuation efficiency and detection sensitivity of the QTFs were measured for the first two vibrational modes. The Q -factor and detection sensitivity were higher in the second vibrational mode while the actuation efficiency was lower. We show that the QTF displacement amplitude can be determined from the detection sensitivity and the measured current through the QTF. The performance of a QTF as a force sensor is discussed based on a comparison of the mechanical and electrical parameters measured for the first and second vibrational modes. The results are relevant for QTFs used in sensing applications, especially as force sensors in scanning probe microscopes.

PACS numbers: 68.37, 06.30, 07.07, 07.60

Keywords: AFM, non-contact mode, quartz tuning fork, force sensor, interferometry.

^{a)}Electronic mail: bakir.babic@measurement.gov.au

Download English Version:

<https://daneshyari.com/en/article/7136176>

Download Persian Version:

<https://daneshyari.com/article/7136176>

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