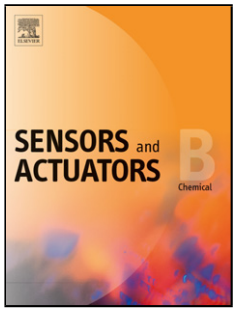

Title: Mass and force sensing of an adsorbate on a string resonator

Author: id="aut0005" orcid="0000-0001-5334-0605" biographyid="vt0005"> Yin Zhang Ya-Pu Zhao

PII: S0925-4005(15)00822-9
DOI: http://dx.doi.org/doi:10.1016/j.snb.2015.06.047
Reference: SNB 18624

To appear in: *Sensors and Actuators B*

Received date: 1-4-2015
Revised date: 4-6-2015
Accepted date: 5-6-2015

Please cite this article as: Yin Zhang, Ya-Pu Zhao, Mass and force sensing of an adsorbate on a string resonator, *Sensors & Actuators: B. Chemical* (2015), http://dx.doi.org/10.1016/j.snb.2015.06.047

Mass and force sensing of an adsorbate on a string resonator

Yin Zhang* and Ya-Pu Zhao

State Key Laboratory of Nonlinear Mechanics (LNM), Institute of Mechanics, Chinese Academy of Sciences, Beijing 100190, China

*Corresponding author. Tel:+86 01082543970

E-mail: zhangyin@lnm.imech.ac.cn (Y. Zhang)

ABSTRACT

The shift of resonant frequency is the sensing mechanism for a mechanical resonator. The adsorbate mass, position and induced force are the three dominant things responsible for the resonant frequency shifts of a string resonator. In the application of a resonator sensor, the (shifts of) resonant frequencies are the measured quantities and therefore, an inverse problem arises naturally: How to determine the adsorbate mass, position and induced force by the resonant frequencies? An inverse problem solving method on the string resonator with one adsorbate is presented and its accuracy is demonstrated. How the method can be used in a real string sensor application scenario is also discussed.

Keywords: String, Resonator, Sensing, Inverse problem, Resonant frequency

1. Introduction

Because of the high mass sensitivity and frequency stability, micro/nanomechanical resonator [1-4] is suitable for detecting tiny mass. One important technical parameter for evaluating the micro/nanomechanical resonator performance, which is also a major driving force for its development, is the minimum detectable mass [5]. The ultimate goal is to resolve a single quantum of a measured quantity [6]. With the enormous efforts on both the device fabrication and readout technologies, in 2012, a carbon nanotube based nanomechanical resonator achieved the mass resolution of less than one yocotogram (1 yg=10^{-24} g) [7].