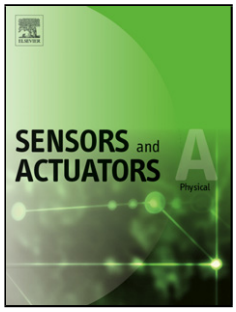

Title: “Bellows spring-shaped” ultrasensitive fiber-optic Fabry-Perot interferometric strain sensor

Authors: Pinggang Jia, Guocheng Fang, Zhe Li, Hao Liang, Yingping Hong, Ting Liang, Jijun Xiong

PII: S0924-4247(18)30211-5
DOI: https://doi.org/10.1016/j.sna.2018.04.041
Reference: SNA 10754

To appear in: *Sensors and Actuators A*

Received date: 2-2-2018
Revised date: 13-4-2018
Accepted date: 26-4-2018

Please cite this article as: Jia P, Fang G, Li Z, Liang H, Hong Y, Liang T, Xiong J, “Bellows spring-shaped” ultrasensitive fiber-optic Fabry-Perot interferometric strain sensor, *Sensors and Actuators: A. Physical* (2010), https://doi.org/10.1016/j.sna.2018.04.041

"Bellows spring-shaped" ultrasensitive fiber-optic Fabry-Perot interferometric strain sensor

Pinggang Jia [a,c], Guocheng Fang [a,b,c], Zhe Li [a], Hao Liang [a], Yingping Hong [a], Ting Liang [a], Jijun Xiong [a*]

[a] *Key Laboratory of Instrumentation Science & Dynamic Measurement, Ministry of Education, North University of China, Taiyuan 030051, China*

[b] *Institute for Biomedical Materials and Devices, Faculty of Science, University of Technology Sydney, New South Wales 2007, Australia*

HIGHLIGHTS

1. A novel fiber-optic strain sensor based on bellows spring-shaped structure is firstly proposed, which significantly enhances the sensitivity and reduces the temperature-induced error of the Fabry-Perot strain sensor.
2. The cascaded method of the bellows spring (microbubble) unit can multiply the sensitivity effectively.
3. The sensitivity of the developed sensor is reinforced by 5-to-12 folds compared with the highest level ever reported.

Abstract

All-silica fiber-optic Fabry-Perot strain sensor is rapidly gaining widespread adoption in many fields due to its compact structure, low cost and immunity to electromagnetic interference. However, the conventional configuration suffers from low sensitivity due to the limitation of its inherent structure feature. In this paper, we demonstrate an ultrasensitive fiber-optic Fabry-Perot interferometric strain sensor based on silica bellows spring structure. Utilizing the cascaded microbubbles, the sensitivity of the single-microbubble sensor is enhanced up to 203.8 pm/με and that of the cascaded two-microbubble sensor reaches 518.8 pm/με. The sensitivity is reinforced by 5-to-12 folds compared with the highest level ever reported, which could also be multiplied by increasing the microbubble number. The temperature-induced strain error is much low, less than 0.01 με/°C, showing great thermal stability and high-temperature application potential. Moreover, the strain sensor also provides high-quality spectrum, controllable free-spectral range and low cost.

Keywords: fiber-optic sensor, Fabry–Perot interferometer, strain, ultrasensitive

1. Introduction

Fiber-optic strain sensors have been proved to be useful in fields such as structural health monitoring, aerospace, and nanotechnology for their simple configuration, rapid response, low cost and immunity to electromagnetic