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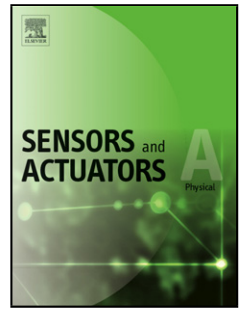

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A practical FBG pressure sensor based on diaphragm-cantilever

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Highlights

- A practical FBG pressure sensor based on diaphragm-cantilever was proposed and experimentally demonstrated.
- The measurement principle and the simulation verification were introduced. The pressure sensor consists of a diaphragm, a cantilever, a rod and a cover.
- The rod transfer the deformation of the diaphragm to the cantilever. A pair of FBGs were stuck on the two sides of the cantilever respectively.
- Theoretical relation between the wavelength shift difference and pressure had been established by theoretical analysis.
- The experiment showed the sensitivity was 258.25 pm/MPa in the range of 0 to 2 MPa, and its linearity can reach 0.998.
- The pressure sensor can be applied to pipeline pressure measurement.

Abstract
A practical FBG pressure sensor on the basis of diaphragm-cantilever was proposed and experimentally demonstrated. The measurement principle and the simulation verification were introduced. The proposed sensor is composed of a diaphragm, a cantilever, a rod and a cover. The rod transfer the deformation of the diaphragm to the cantilever. A pair of FBGs were stuck on the two sides of the cantilever respectively. Theoretical relationship between the wavelength shift and pressure had been established by theoretical analysis. The experiment showed the sensitivity was 258.28 pm/MPa in the range of 0 to 2 MPa, and its linearity can reach 0.999. The pressure sensor has potential to be applied to pipeline pressure measurement.

***Index Terms*—** Fiber Bragg Grating (FBG); pressure sensor; diaphragm; cantilever, wavelength differential measurement method.

I. Introduction

Pipeline is widely applied in industry for its advantage of economical, hence the security operation of the pipeline is of great importance[1,2]. The real-time monitoring of pipe pressure can avoid the occurrence of safety accidents. Many pressure sensors have been proposed and widely used to monitor the pipeline operating state. Optical fiber sensor has been widely researched for its merits of anti-EMI, anti-corruption, high sensitivity, etc.[3,4,5,6].

Many optical fiber sensors for pressure have been proposed and developed with the rapid development of the sensing technique, such as Fabry-Perot interferometric Fiber pressure sensor[7,8,9], Tapered optical-fiber-based pressure sensor[10], micro-structured optical fiber pressure sensor[11], FBG pressure sensor and so on. Compared with other optical fiber sensors, sensors based on FBG have the advantages of high resolution, large measurement range, easy to be cascade, small size, mature fabrication technology, and so on[4]. Thus, FBG sensor is the most widely used optical fiber sensor in engineering. However, the FBG's inherent sensitivity for pressure is about 3.04 pm/MPa[12], which leads to the pressure measurement easily disturbed by the environment. Many methods have been put forward to enhance the pressure sensitivity such as using new materials, adopting new structure. In 2008, Ahmad et al. proposed a pressure sensor embedded by the polymer, and the sensitivity is 8.7 nm/MPa[13], although the sensor is of high sensitivity, the polymer can be easily aging and influence the accuracy of the sensor. In 2009, Liu et al. designed a FBG pressure sensor on the basis of membrane, the sensitivity was 8.805 nm/MPa in the range of 0~16 MPa [14], the linearity of the sensor was not well and the structure was not stable enough.

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