Determination of Design Parameters of a Biosensor for Human Artery Pulse Wave Detection

K. Hasikin, F. Ibrahim[1] and N. Soin

Introduction

Blood pressure is one of the most frequently measured parameters in clinical practice and cardiovascular research. Blood pressure measurement is most commonly performed using pressure sensor external to the body or using a direct measurement at the location inside the coronary artery [1]. The blood pressure pulse originating at the heart travels through the vasculature, due to elastic and geometric nonuniformities in the arterial system. [2]. In addition to systolic and diastolic blood pressure, the waveform of the pressure pulse provides valuable information on the elastic properties of the vessels in the propagation path.

The development of high-performance diaphragm is critical importance in the successful realization of the devices. In particular, diaphragms that capable of linear deflection are needed in many pressure sensors [3-7]. The diaphragm thickness should be thin and diameter of the diaphragm should be large enough in order to achieve high sensitivity and maximize the load-deflection response [3].

Optical fiber-based have been shown to be attractive devices which measure a wide range of physical and chemical parameters. The ability to guide signals to and from a measurement site has made the optical MEMS technology attractive for use in biomedical pressure measurements [1,3,5-7]. Furthermore optical MEMS sensors offer several advantages over traditional electrical sensors. These include immunity to electromagnetic interference, inexpensive and ability to measure a wide range of physical and chemical parameters [1, 3, 7].

Recently Micro-Electro-Mechanical System (MEMS) has enabled the implementation of a complete sensor with signal conditioning circuits for better accuracy and reliability [8,9]. For biomedical application, sensors requirements are small size, very low power consumption and easy telemetry [10,11]. However, the development of a biosensor for human artery pulse wave detection by using MEMS technology is still new. The sensor is required to operate in the range of 0 to 300 mmHg. This paper discusses the modeling of a microdiaphragm biosensor by varying the diameter and thickness of the diaphragm to optimize the sensor.

Diaphragm modeling

Diaphragm deflection under pressure

The load-deflection method is a well known method for the measurement of elastic properties of thin films [3,12]. In this technique, the deflection of a fixed edge diaphragm is measured as a function of applied pressure. A circular diaphragm clamped rigidly at its edges is shown in Fig. 1.

The diaphragm will be deflected under a uniform pressure, P. The out-of-plane deflection of the diaphragm, *y* is a function of the pressure difference and the radial distance [12-15]:

Full text is available at :

http://link.springer.com/chapter/10.1007/978-3-540-69139-6_176