UNIVERSITI TEKNOLOGI MARA

PRESSURE-INDUCING PH SENSING FOR FIBER BRAGG GRATING SENSOR

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ABSTRACT

This project presents an interfacing device to allow Fiber Bragg Grating function as a chemical sensor. Instead of using chemical to light conversion, this project is developed using chemical to physical conversion. The problem with existing chemical sensing using optical sensor is the fabrication process are complicated where the cladding of optical fiber is exposed causing vulnerability. This will cause optical chemical sensors are fragile and difficult to be mass produced. The objective of the project is to develop a chemical sensing using Fiber Bragg Grating sensor. However, the principle operation of Fiber Bragg Grating sensor is based on the shifted wavelength of the returned Bragg signal with the changes in physical measurands only such as strain, temperature and pressure. Since Fiber Bragg Grating sensor cannot be used for chemical sensing, this project are introduced a gripper as a transducer to allow Fiber Bragg Grating sensor function as chemical sensor where it will convert chemical sensing to physical sensing. The project is divided into the following scope (i) electronic to photonics interfacing and (ii) Fiber Bragg Grating gripper. To illustrate the functionality, we consider when the pH sensor is immersed into pH solution, it will create different voltage signal. The voltage response is feed to servo driver to drive a servo motor that coupled with gripper. The gripper is used to interface electronics sensor to optical signal where the gripper will induce different level of pressure on Fiber Bragg Grating sensor with difference pH solution: pH 4, pH 7, pH 10 and pH 12. The shifted wavelength is characterized according to the pressure level that induced by gripper. The pH solution of 12 showed the maximum value voltage response. As a result, the gripper induces Fiber Bragg Grating sensor with higher pressure and cause higher shifted wavelength.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND AND MOTIVATION

pH value is the one of the most commonly monitored chemical parameters of a fluid. It is important to measure pH to find the chemical characteristics of the substance in order to optimize the desired reaction or to prevent unwanted reactions. The glass electrode pH sensor has been the most popular and considered as standard measuring method for the pH measurement since a long time due to its high selectivity for hydrogen ions in a solution, reliability and long lifetime [1]. However, the glass electrode also has their backward such as difficulty in miniaturization and fragile. Nowadays, there are many differences detection method for pH sensing is developed such as ion-sensitive field effect transistor (ISFET), Extended gate field-effect transistor (EGFET) and Optical fiber pH sensor [2],[3],[4]. ISFET was first introduced as an alternative to the fragile glass electrode. ISFET sensor was produced by replacing a metal oxide silicon field effect transistor (MOSFET) with the gate electrode by a chemically sensitive membrane [4]. The working principle of ISFET is the drain current [2]. It has the advantages of small dimensions, low impedance, fast response and large-scale production [3]. However, some drawbacks have limits their practical use such as larger drift rate and low sensitivity to different pH levels [3]. Then, EGFET was introduced to overcome ISFET structure where EGFET structure used to isolate FET from the chemical environment. For EGFET, this device composed of a conventional ion-sensitive electrode and a MOSFET device. This sensor does not require the fabrication of the MOSFET [4].