P240 - A STUDY ON USING A LIQUID CRYSTAL POLYMER PRESURE SENSOR FOR INTRACRANIAL PRESSURE MONITORING

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INTRODUCTION

Based on the Global Status Report on Road Safety 2015 from the WHO, Thailand has the second-highest road fatality rate in the world [1]. Traumatic brain injury (TBI) is found to be a common consequence of car crashes. TBI patients require the pressure in the skull to be measured namely the intracranial pressure (ICP). A pressure greater than 15 mmHg is considered harmful to the patient. Conventional techniques include the wired system which consists of a catheter connected to a bedside monitoring unit such as an epidural transducer and ventriculostomy etc. However, these catheters initiate many problems e.g. they are invasive to brain tissue, high risk of infection and blood clotting [2]. Therefore a minimally invasive technique is desirable.

A minimally invasive wireless ICP sensor is proposed to address these aforementioned problems. The sensor consists of three main units; pressure sensing unit, telemetry unit and power unit. In this paper, the biocompatible pressure sensing unit is presented, namely its design, fabrication and characterization. The sensor is fabricated from Liquid crystal polymer (LCP), this material is chosen for its biocompatibility, low moisture absorption and flexibility, these characteristics make it suitable for biomedical application [3].

METHODS

The LCP pressure sensor is designed to operate in the pressure range of 0-50 mmHg. The design and fabrication of the pressure sensor is based on MEMS technology. The piezoresistive concept is applied to simplify both the design and fabrication. The LCP pressure sensor is designed and fabricated into 8x8 mm^2 and is 100 µm thick membranes. The 2x2x0.05 mm^2 sensing membrane is situated on the middle of the membrane. Four strain gauges are placed and connected to the contact pads for the measurement.

When pressure is applied to the top of the membrane, the sensing membrane deflects and changes the resistivity of the sensor. This operation is tested in a hydrostatic environment to study the feasibility of the fabricated sensor. The LCP pressure sensor is packaged with glass using adhesive epoxy. A 3V DC input voltage is supplied to the sensor and measured by using a National Instruments NI-DAQ 6289 data acquisition card.

RESULTS AND DISCUSSION

The resistances of LCP pressure sensor is ~300 Ω. The sensor can be immersed in the water and operated in the pressure range from 0-30 mmHg. The experimental results show the linearity of the sensor. The average sensitivity is approximately 48 µV/mmHg. The proposed sensor does not reach the requirement of the intended application (0-50 mmHg), this work does however show feasibility for the sensor to operate in a moist environment.

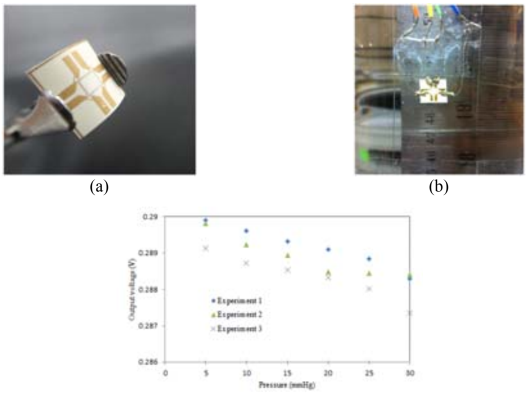

Figure 1: Experiment and Results of LCP pressure sensor (a) a fabricated LCP pressure sensor (b) LCP pressure sensor in the water tank (c) Output voltages of three experiments versus the pressure at 0-30 mmHg.

CONCLUSIONS

The proposed LCP pressure sensor is shown to operate in the required pressure range for ICP measurement. MEMS fabrication offers benefits of low manufacturing cost and mass productivity compared to conventional ICP measurement approaches. The proposed wireless LCP pressure sensor has the potential to improve the treatment of TBI patients in Thailand.

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