Chapter One: Introduction

1.1 Preface :

The Micro-Electromechanical systems or MEMS encompass the process-based technologies used to fabricate tiny integrated devices and systems that integrate functionalities from different physical domains into one device. Such devices are fabricated using a wide range of technologies having in common the ability to create structures with micro-scale and even nano-scale accuracies. The products range in size from a few microns to millimeters . These devices have the ability to sense, control and actuate on the micro scale and generate effects on the macro scale .

The interdisciplinary nature of MEMS relies on design, engineering and manufacturing expertise from a wide and diverse range of technical areas including integrated circuit fabrication technology, mechanical engineering, materials science, electrical engineering , chemistry and chemical engineering, as well as fluid engineering, optics, instrumentation and packaging. The complexity of MEMS is also seen in the extensive range of markets and applications that incorporate such devices. MEMS can be found in systems ranging from consumer electronics , automotive, medical, communication to defence applications. Current examples of MEMS devices include accelerometers for airbag sensors, microphones, projection display chips , blood and tire pressure sensors, optical switches, analytical components such as lab-on-chip, biosensors and many other products.

1.2 Literature review:

A microcantilever is a device that can act as a physical, chemical or biological sensor by detecting changes in cantilever bending or vibrational frequency[1]. It is the miniaturized counterpart of a diving board that moves up and down at a regular interval. This movement changes when a specific mass of analyte is specifically adsorbed on its surface similar to the change when a person steps onto the diving board. Microcantilevers have wide applications in the field of medicine, especially for the screening of diseases, detection of point mutations, blood glucose monitoring and detection of chemical and biological warfare agents [7; 8; 2]. The commercial cantilevers are typically made of silicon, silicon nitride, or silicon oxide and are available in a wide variety of different shapes, dimensions and force sensitivities. Recent developments combine the latest integrated circuit (IC) and complementary metal oxide semiconductor (CMOS) technologies has produced intelligent and extremely small cantilevers in the form of an array. These sensors have several advantages over the conventional analytical techniques in terms of high sensitivity, low cost, simple procedure, low analyte requirement (in 1μ), non-hazardous procedures and quick response [1 , 2]. Microcantilevers have been proven to be an outstanding sensor platform for extremely sensitive chemical and biological sensors and piezoresistive based microcantilever transducers are also becoming popular in recent years [2,5,6]. The measurement of glucose is of great importance in clinical diagnosis. This is especially essential for the continuous monitoring for example in a patient suffering from diabetes mellitus which is caused by the high levels of glucose in human physiological fluid. Even though many research have been done for glucose measurement, there are still many research in progress to develop new methods and technologies for sampling, detecting and monitoring glucose levels. This work has focused on the design simulation analysis of a Polysilicon-based CMOS micromachined Piezoresistive Microcantilever beam for glucose sensing application. In principle, adsorption of glucose on a functionalized surface of the microfabricated cantilever will cause a surface stress and consequently the cantilever bending. In this paper, the microcantilever beam is constructed and bending analysis is performed so that the beam tip deflection could be predicted. The structural variation of the piezoresistors designs on cantilever beam is also considered to increase the sensitivity of the microcantilevers sensor since the forces involved is very small[12].

1.3 Problem statement :

The measurement of glucose is of a great importance in clinical diagnosis. This is especially essential for the continuous monitoring in life scan in patients suffering from diabetes mellitus which causes high levels of glucose in human blood. Polysilicon-based CMOS Micro-machined Piezoresistive Microcantilever Beam for glucose sensing application is a newly emerging technology that needs an assessment on the view point of mechanical strength of the beam.

1.4 Research objectives :

The specific goal of this research is to perform a simulation analysis of the cantilever beam of the Polysilicon-based CMOS Micro-machined, Piezoresistive Microcantilever Glucose Sensing, in order to assess the mechanical strength of the beam. The simulation will be carried out using ANSYS package.

1.5 Research methodology :

1 Studying of the Polysilicon-based CMOS Micro-machined Piezoresistive Microcantilever Glucose Sensor in order to determine the magnitude of the force which will cause the beam to deflect.

2 Select a specific size of the sensor under study , then carry out a stress analysis on its beam using ANSYS package.

3 Making and assessment for the resulting stress.

1.6 Research Outlines:

Chapter one includes Preface, Literature review, problem statement, objectives and methodology. Chapter two includes Theoretical Background. Chapter three include methodology. Chapter four contain Results and Discussion, chapter five contain conclusion and recommendations