Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF OPTICAL MICROFIBER SENSOR FOR SODIUM ALGINATE DETECTION

MOHAMMAD ASYRAF ZAKWAN BIN LAJIM

Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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DEVELOPMENT OF OPTICAL MICROFIBER SENSOR FOR SODIUM ALGINATE DETECTION

MOHAMMAD ASYRAF ZAKWAN BIN LAJIM

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DR. MD ASHADI BIN MD JOHARI
Pensyarah Kanan
Jabatan Teknologi Kejuruteraan Elektronik Dan Komputer
Fakulti Teknologi Kejuruteraan Elektrik & Elektronik
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I declare that this project report entitled "DEVELOPMENT OF OPTICAL MICROFIBER SENSOR FOR SODIUM ALGINATE DETECTION" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

Signature : 

Supervisor Name : DR. MD ASHADI BIN MD JOHARI

Date : 27/01/2023

Signature :

Co-Supervisor :

Name (if any)

Date :

DEDICATION

This project is dedicated to God Almighty, my creator, my strong pillar, and my wisdom. I owe a special debt of gratitude to my parents, who have always been supportive of me and continue to speak to me about encouragement and tenacity. Next, I assigned the project to my supervisor, who has provided guidance throughout the project's duration. Last but not least, I must acknowledge my coworkers who have always been mentally supportive of my efforts to complete this project.

ABSTRACT

Fiber optic cables are capable of delivering large amounts of data at high speeds. As a result, internet connections typically use this strategy. Fiber optic cables are smaller, lighter, and more flexible than copper lines, and they convey more data. Fiber optics are widely employed in the fields of health and research. Endoscopy, which is a non-interruptive surgical method, relies heavily on optical technologies. In some circumstances, a small, bright light is used to illuminate the operation area inside the body, allowing for a reduction in the number and size of incisions. Fiber optics are used in both microscopy and biological research.

The most important and prevalent uses of fiber optics in medicine are the imaging and illumination components of endoscopes. Apart from it, Standards The medical industry requires higher measurement accuracy, along with lower radio frequency interference (radiation) to obtain patient information accurately without environmental interference.

ABSTRAK

Kabel gentian optik mampu menyampaikan sejumlah besar data pada kelajuan tinggi. Akibatnya, sambungan internet biasanya menggunakan strategi ini. Kabel gentian optik adalah lebih kecil, lebih ringan dan lebih fleksibel daripada talian tembaga, dan ia menyampaikan lebih banyak data. Gentian optik digunakan secara meluas dalam bidang kesihatan dan penyelidikan. Endoskopi, yang merupakan kaedah pembedahan tanpa gangguan, sangat bergantung pada teknologi optik. Dalam sesetengah keadaan, cahaya kecil dan terang digunakan untuk menerangi kawasan operasi di dalam badan, membolehkan pengurangan bilangan dan saiz hirisan. Gentian optik digunakan dalam kedua-dua mikroskop dan penyelidikan biologi.

Penggunaan gentian optik yang paling penting dan lazim dalam perubatan ialah komponen pengimejan dan pencahayaan endoskop. Selain itu, Piawaian industri perubatan memerlukan ketepatan pengukuran yang lebih tinggi, bersama dengan gangguan frekuensi radio (radiasi) yang lebih rendah untuk mendapatkan maklumat pesakit dengan tepat tanpa gangguan persekitaran.

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δ	-	Voltage angle
	-	
	-	
	-	
	-	
	-	
	-	
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LIST OF ABBREVIATIONS

V	-	Voltage
	-	
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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter will offer a concise discussion on the history of the project, as well as the issue statement that elucidated the reasons why this project needed to be carried out. In this section of the research, we also elaborate on the project's overall goal and the breadth of its coverage.

1.2 Project Background

To create microfibers, optical fibers are heated and stretched to submicron dimensions. A Micro Fiber geometry is made up of a thin, uniform waist connected on either side to a transition area with a steadily increasing slope. Sub-wavelength dimensions and negligible operating losses may be found in these Micro Fiber, which are frequently referred to as nanowires. In the ever-expanding realm of nanotechnology, Micro Fiber have emerged as a suitable building block for a wide range of products. Additionally, Micro Fiber may be employed well in sensing applications because of their quick reaction time, broad evanescent field, compactness, and tailorable modal area. Many studies have been conducted on the optimal form and shape of these Micro Fiber in order to customise their output to the specific application.

Fiber optics is a technology that is widely acknowledged as an alternative to coaxial cable as a communication medium. Over great distances, light pulses (information) can be transferred via strands made of glass or plastic that are probably about the size of human

hair. Since they are non-metallic, they are immune to electromagnetic interference. Also, this technology is said to be safer as they do not carry current that may cause sparks. Their uniqueness makes them capable of transmitting faster over longer distances than other medium does.

There is a pretty simple and inexpensive way to make Micro Fiber . The first method for making low-loss, sub-micron diameter Micro Fiber used a two-step process, where the optical fiber was first drew to a micron size using a flame, and the resultant taper was subsequently drawn down to submicron dimensions by drawing the taper around a heated 80 nm sapphire rod. Using this technology, a taper with a radius of 440 nm and loss of 0.3dB/m at the telecom wavelength of 1.55 nm was created. The so-called flame brushing approach yielded lower losses, on the order of 0.001 dB/mm at 1.55 m. An electric microheater or flame brushing method is used to warm up the little section of the fiber before pulling it back through the translation phases (modified flame brushing technique).

The adaptability of Micro Fiber transmission to various sensing applications is one of the property's aspects that makes it one of the most fascinating for use in those applications. By simply tweaking the MF design, it is easy to get optimal performance in terms of the sensor's sensitivity, detection limit, and dynamic range.

Alginic acid's linear polysaccharide derivative sodium alginate (NaC6H7O6) is composed of 1,4-d-mannuronic (M) and -l-guluronic (G) acids. Marine brown algae cell walls include sodium alginate, which contains 30-60% alginic acid. When alginic acid is converted to sodium alginate by a chemical reaction, it becomes more water soluble, making it easier to extract. To attach to surfaces and protect themselves from the environment, bacteria create bacterial alginates, which are exclusively found in Pseudomonas (the most common) and Azotobacter (the most common) These bacteria can create alginates with a

well-defined monomer composition, which may lead to the creation of "tailor-made" alginates.

Sodium alginate is a polymer derived from brown algae that is used in the food industry. -d-mannuronic acid (M) and -l-guluronic acid (G) are the two connected anionic monomers in this structure. Homopolymeric G (G blocks) and M (M blocks) units are interspersed with areas of mixed monomers in the polymer structure (MG blocks). In the presence of divalent cations, such as Ca2+, sodium alginate is able to convert into a hydrogel and retain more than 98% of the water it contains. Encapsulated cells need an aqueous environment to be active, and this is essential for that purpose. The Ca2+ binds to the G residues during hydrogel formation. Structures of neighbouring alginate chains are transformed from random coils to ribbon-like structures when G residues are folded and stacked via bond contact.

1.3 Problem Statement

Liquid sensors have been used in the medical industry for a long time to monitor human health. As in Malaysia, the number of patients with headache and heartburn is higher, it make people that have symptom take medicine that contain sodium alginate to reduce pain faster without properly take that can cause another side effect such as heart attack and sodium alginate is use in ice cream that some of their take after meals. Due to electromagnetic interference, the readings from recent liquid sensors are constantly uncertain. ' Biomedical usage of fiber optics is possible because of the fiber's unique characteristics and excellent sensor performance. As a result, this research will be experimenting with optical microfiber in various concentrations of Sodium Alginate (N6H7NaO6) to find the sensitivity and linearity.

1.4 Project Objective

There are several objectives that will be achieved in this project;

a) To observe the operation, sensitivity and linearity of the Optical MicroFiber.

b) To develop Optical MicroFiber Sensor in different development of Sodium Alginate.

c) To analyze the performance of the Optical MicroFiber Sensor in Sodium Alginate detection.

1.5 Project Overview

There are five chapters in this report. In Chapter 1, the backdrop of the project, the problem statement, the project objectives, and the project scope will be explained. Chapter 2 is a literature review that uses references from books, journals, the Internet, and past projects to acquire a better understanding of the project before it is developed. These materials are the primary source of information for the entire project. After that, Chapter 3 contains descriptions of the project methodology, methodology flowchart, and project process flow. This chapter is very important in order to run the project smoothly. In Chapter 4, the results of the experiments done during PSM 2, will be presented. Finally, the conclusion in Chapter 5 will provide the conclusion of the entire project, the final decision of choosing which optical fiber loop sensor function very well in detecting Sodium Chloride concentration. A few suggestions for future works also included at the last chapter of the project report.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This part of the project included both a study of the literature for the whole project and the development of the project. The extra materials for this project, like journals, papers, and books that are related to the project's topic, would be the primary sources. This chapter will go into detail about all the related research, from the basics to how it can be used. Before the next step, which is to design the Microfiber Optic Sensor for sodium alginate detection, it's important to understand what fiber optic is and how it works, and this process helps with that.

2.2 Anatomy of Fiber Optics

An optical fiber is a flexible, cylinder-shaped dielectric waveguide made of low-loss materials like silica glass and sometimes plastic. With the plastic covering, the core is a little bigger than a human hair. The sizes are the same across the country and around the world. Figure 2.1 shows that it has a light-guiding core in the middle and an outer layer with a slightly lower refractive index. The reason to make microfiber optics is it take up less room and be more lightweight by shrunk the fiber optic to a narrower diameter.