Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF MICROFIBER OPTIC SENSOR FOR SODIUM HYPOCHLORITE CONCENTRATION DETECTION

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Bachelor of Electronics Engineering Technology (Telecommunications) with Honors

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DEVELOPMENT OF MICROFIBER OPTIC SENSOR FOR SODIUM HYPOCHLORITE CONCENTRATION DETECTION

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I declare that this project report entitled “Development of Microfiber Sensor for Sodium Hypochlorite Concentration 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.

Signature	:	
Student Name	:	MUHAMMAD DANISH BIN KHAIRUL HISHAM
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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.

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DEDICATION

I dedicated this project to Allah S.W.T my creator, my strong pillar and wisdom. To my family, I owe a particular debt of gratitude to my parents Khairul Hisham Bin Kahar and Azlina Binti Yusoff, who always supporting me and continue to speak to me about encouragement and tenacity.

Next, I devoted the project to my supervisor Dr. Md Ashadi Bin Md Johari that have been show his guidance throughout the process of this project. Finally, not to be forgotten to my fellow friends that always supporting in mental to finish this project.

ABSTRACT

Fiber optics can transfer enormous amounts of data at extremely rapid rates. Consequently, this approach is widely used in Internet connections. Copper lines are larger, heavier, less flexible, and convey less data than fiber optic cables. In the fields of medicine and science, fiber optics are widely employed. Endoscopy is a non-interruptive surgical technique, and optical technology is essential to its success. In such instances, a small, bright light is used to highlight the surgery site within the body, thereby reducing the number and size of incisions. Biomedical research and microscopy both utilize fiber optics. The imaging and illumination components of endoscopes are the most significant and widespread applications of fiber optics in medicine. Aside from that, the research outlines the underlying theory, evaluates the current state of the art, and anticipates the future applications of fiber-optic sensors in home appliances.

ABSTRAK

Gentian optik boleh memindahkan sejumlah besar data pada kadar yang sangat pantas. Oleh itu, pendekatan ini digunakan secara meluas dalam sambungan Internet. Talian tembaga adalah lebih besar, lebih berat, kurang fleksibel, dan menyampaikan kurang data daripada kabel gentian optik. Dalam bidang perubatan dan sains, gentian optik digunakan secara meluas. Endoskopi ialah teknik pembedahan tanpa gangguan, dan teknologi optik adalah penting untuk kejayaannya. Dalam keadaan sedemikian, cahaya kecil dan terang digunakan untuk menyerlahkan tapak pembedahan di dalam badan, dengan itu mengurangkan bilangan dan saiz hirisan. Penyelidikan bioperubatan dan mikroskopi kedua-duanya menggunakan gentian optik. Komponen pengimejan dan pencahayaan endoskop adalah aplikasi gentian optik yang paling ketara dan meluas dalam bidang perubatan. Selain itu, penyelidikan menggariskan teori asas, menilai keadaan seni semasa, dan menjangka aplikasi masa depan penderia gentian optik dalam peralatan rumah.

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FOS	-	Fiber Optic Sensor
COD	-	Coefficient of determination
dB	-	Decibel

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CHAPTER 1

INTRODUCTION

1.1 Background of project

Microfibers are made by heating and stretching optical fibers to submicron diameters. A transition section with a constantly increasing slope connects either side of a slim, uniform waist in a Microfiber geometry. These Microfibers, which are commonly referred to as nanowires, have sub-wavelength diameters and low operating losses. For a wide range of goods, Microfiber has emerged as a suitable building block in nanotechnology. The rapid response time, wide evanescent field, compactness, and tailorable modal area of Microfiber make them ideal for sensing applications. In order to tailor the output of these Microfibers to a given application, numerous experiments have been carried out to determine their ideal form and shape.

Fiber optics is the transmission medium for light pulses over a glass or plastic strand or fiber. Fiber optics is utilized for high-performance, long-distance data networking. In addition to the Internet, television, and telephones, fiber optics is frequently utilized in telecommunications services. Fiber optics transmit information in the form of photons through a fiber optic connection. The different refractive indices of the core and cladding of the glass fiber bend incoming light at a specific angle. The phenomenon of light signals bouncing off the core and cladding of a fiber optic cable in a pattern of zigzags is known as total internal reflection.

The optical fiber or sensing device is utilized by optical fiber sensors, also known as fiber optic sensors. These sensors detect temperature, pressure, vibrations, displacements, rotations, and chemical concentration. Ideal for conditions including sensitivity, intense vibration, extreme heat, excessive humidity, and unstable environments, fiber optic sensors are highly effective. These sensors can easily be installed in small areas where flexible fibers are needed. Intrinsic fiber-optic sensors and extrinsic fiber-optic sensors are the two types of fiber optic sensors. Intrinsic fiber-optic sensors conduct their sensing within the fiber itself. The sensors rely on the characteristics of the optical fiber to convert an environmental action into a change in the light beam passing through it. For extrinsic fiber-optic sensors, the fiber could be utilized to transmit data pointing to a black box. It emits a light signal based on information received from the black box. The black box could consist of mirrors, gas, or another optical signal-generating device. These sensors monitor rotation, vibration velocity, displacement, twisting, torque, and acceleration.

In Fiber Optics, total internal reflection occurs when light travelling through an optically dense material contacts a boundary at a steep angle (more than the critical angle for the barrier). This phenomenon is used to confine light in the core of optical fibers. Light travels through the fiber core and is reflected between the core and cladding. Refraction in Fiber Optics is the departure of a light beam or energy wave from a straight path when crossing obliquely from one medium (such as air) into another medium (such as glass) with a different velocity. Sodium hypochlorite (NaOCl) is a solution created by combining chlorine with sodium hydroxide. These two substances are the primary byproducts of the majority of chlor-alkali cells. Bleach, or sodium hypochlorite, has numerous applications and is an effective disinfectant/antimicrobial agent.

The objective of this study is to examine the performance of the Microfiber optic sensor in various concentrations of Sodium Hypochlorite. In addition, this project requires SMF28 optical cable, a laser source with a wavelength of 1550nm, an Optical Spectrum Analyzer (OSA), and five different concentrations of Sodium Hypochlorite at 100%, 90%, 80%, 70%, 60% and 50%. At the conclusion of the project, a sensitive optical concentration sensor is created.

1.2 Problem Statement

Since so exceedingly long ago, liquid sensors have been employed in the medical field. In general, liquid sensors enable medical personnel in making an accurate diagnosis of a patient's condition. Accidents and injuries occur on a near-daily basis in our society, and those affected are sent to the hospital or clinic for further evaluation. In general, the effects of occurrences or operations will cause internal or external bodily harm. Doctors may be able to give the patient a second chance at life by performing a successful procedure on the patient. Consequently, an inaccurate reading can result in life failure or death. On the other hand, medical applications of optical fiber, such as endoscopes, produce images of the interior of the body. The performance of the fiber optic Sodium Hypochlorite sensor will be monitored throughout the duration of this study.

1.3 Project Objective

This project will be based on those three objectives mentioned:

a) To study the operation of the Microfiber Optic in liquid form.

b) To develop Microfiber Optic Sensor that can sense different concentration for Sodium Hypochlorite.

c) To observe and analyze the performance of the Microfiber Optic Sensor detection in Sodium Hypochlorite.

1.4 Scope of Project

This project's scope is described as follows:

- This experiment will employ OpticFiber SMF28
- The detection measurement must be made on the bare fiber (without cladding).
- The light source utilized has two wavelength, 1310nm and 1550 nm. Preparing the liquid concentration of Sodium Hypochlorite.
- Measurement is taken from the spectrum reading from the Optical Time Domain Reflectometer (OTDR).
- Repeat the method to generate additional graphs

1.5 Overview Of the Report

In chapter 2, the literature review is discussed. The literature review consists of locating an article about the project's title. The usage of optical fiber in this research necessitates a review of literature pertinent to optical fiber. This chapter will examine single-mode optical fiber and multi-mode optical fiber optic sensor types. In this chapter, reflective and refractive literature reviews will also be examined. Finally, the literature about various types of fiber optic sensors, including intrinsic optical fiber and extrinsic optical fiber, will be examined.

In chapter 3, we shall discuss the methodology of the experiment. This chapter describes the flowchart for the project, which displays the experiment's progression. This chapter describes how fiber optic sensors are manufactured. This chapter specifies the stripping, splicing and tapering procedures as needed procedures. Before beginning the experiment, it is vital to know the characteristics of the fiber optic sensor. Finally, the testing technique should be described in detail.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Optical fiber is a sort of data transmission technology that functions by delivering light pulses down a long glass or plastic fiber. Metal wires are preferred for transmission of signals over optical fiber because they cause less damage. The interference of electromagnetic waves has no effect on optical fibers. Light's total internal reflection is utilized in fiber optic cables. Depending on the required power and transmission distance, the optical fiber's fibers are constructed to facilitate the propagation of light.

2.2 Dissection of Fiber Optic

The operation of an optical fiber is governed by the total internal reflection concept. Light beams are capable of transmitting vast volumes of data. Therefore, unless we have a straight wire with no bends, we cannot utilize this benefit. In contrast, the optical cables are designed to bend all light rays' inwards (using TIR), as depicted in Figure 2.1. Light beams travel eternally, bouncing off fiber optic barriers and passing data between ends. Despite the fact that light signals degrade over time based on the purity of the material employed, the loss is far less than when using metal wires.

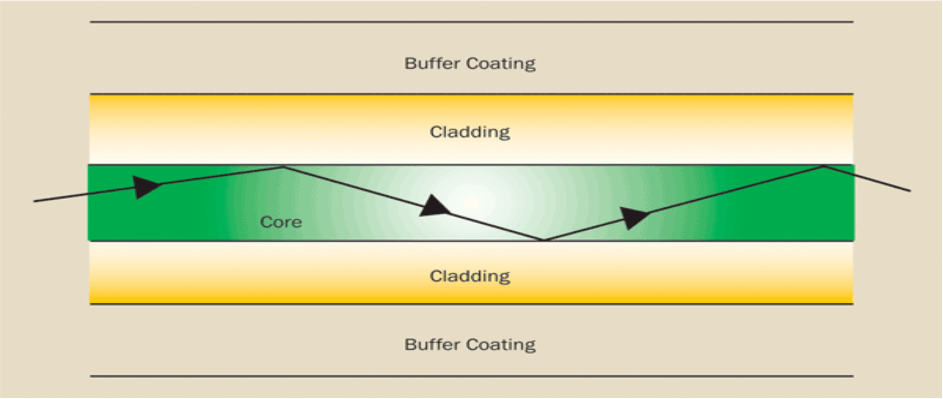

Figure 2.1: Fiber optic Total Internal Reaction (TIR)

2.1.1 Types of fiber optic

2.1.1.1 Fiber Optic (Singlemode)

By forming a tiny segment of single-mode [1] optical fiber into a closed ring to generate a low-loss cavity, it is possible to create an optical resonator with a high degree of precision. Due to recent developments in single-mode fiber directional couplers, such a fiber ring can now be closed with minimal loss. Single-mode fiber is a typical variety of optical fiber used for long-distance transmission. It is one of two types of optical fiber, the other being multi-mode fiber. Figure 2.2 depicts a single-mode fiber as a glass strand that transmits only one mode or light beam. Single-mode fiber possesses a single transmission mode. It has single-mode fiber has a greater bandwidth capacity than multi-mode fiber. However, a light source with a narrow spectral breadth is required. Single-mode strands have evolved into more mysterious forms, such as coordinated clad, discouraged clad, and other odd shapes.

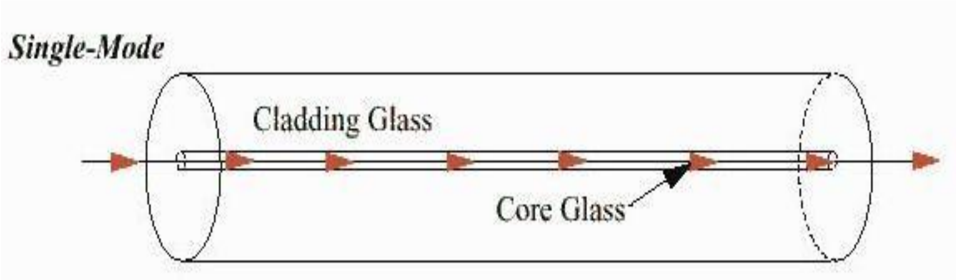

Figure 2.2 Fiber Optic Single Mode

2.1.1.2 Fiber Optic (Multimode)

Light goes through the core of multi-mode fiber in many beams, hence the name (or modes). This indicates that light can propagate through the fibers via a multitude of ray paths. It has a five to six times larger diameter core than single mode, allowing it to capture more light. Core sizes range from 50 to 1,000 micrometers (m) and are typically used for short-distance communication, such as between dwellings or buildings. Multi-mode connections typically support data rates between 10 Mbit/s and 10 Gbit/s at connection lengths of up to 600 meters, which is sufficient for the majority of premises applications. In addition, mechanical vibrations are applied to a single location on a Multi-mode fiber. When multipoint vibrations are present, we can only evaluate the image at the fiber end, where the impacts of all vibration sites conflict. The graphic below illustrates the relationship between the aggregate inward reflection standard and Multi-mode step-file fiber. Because the center index of refraction is greater than that of the cladding. Therefore, light that enters the fiber at a position other than the fundamental point is guided along the fiber.