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A Review on School Network Problem with Zone Dependent Fixed Cost and Inventory Cost

Nur Sabrina Mansor[1,*], Rozieana Khairuddin[2], Zaitul Marlizawati Zainuddin[3,4], Nozieana Khairuddin[5]

[1] Faculty of Electrical and Electronic Engineering Technology, Universiti Teknikal Malaysia Melaka, 76100 Melaka, Malaysia
[2] Faculty of Electrical Engineering, Universiti Teknikal Malaysia Melaka, 76100 Melaka, Malaysia
[3] Faculty of Electronic and Computer Engineering, Universiti Teknikal Malaysia Melaka, 76100 Melaka, Malaysia

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ABSTRACT

This research investigated evanescence field effect using a microfiber as a sodium hypochlorite sensor. The microfiber was built using the "tapering" approach, which transformed silica fiber SMF-28 into a micro size with the diameter is 10micro. The microfiber is then employed as a sodium hypochlorite sensor with a range of sodium hypochlorite concentrations ranging from 50% pmm to 100% pmm. The microfiber performance is clearly excellent, as measured by sensitivity based on wavelength shift. The linearity defined more than 99% is defined as a performed sensor. This microfiber repeatability makes them promising as sodium hypochlorite sensors.

1. Introduction

Optical microfibers are thin strands of glass or another transparent material with a diameter of a few micrometers or less [1]. They are designed to steer and alter light waves within their core, allowing for a wide range of optical and photonics applications [2]. Typically, heat tapering or chemical etching are used to create these microfibers [3]. The final structure is composed of a central core surrounding by a cladding layer that aids in the confinement and guidance of light along the fiber. Optical microfibers provide a number of advantages over traditional optical fibers. Because of their small size, they have significant light confinement and can steer light very efficiently [4]. This property makes them suitable for a wide range of applications, including sensing, telecommunications, and nonlinear optics [5,6]. Sensing devices are one of the significant applications of optical microfibers. Microfibers' small size and high sensitivity allow them to detect changes in temperature, pressure, refractive index, or chemical composition [2]. They can be used as small sensors for environmental monitoring, biomedical diagnostics, and fiber optic gyroscopes, among other things. Optical microfibers have also been used in nonlinear optics and photonics

[*] *Corresponding author.*
E-mail address: ashadi@utem.edu.my

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research. Because of the high confinement of light in these fibers, nonlinear processes such as four-wave mixing, stimulated Raman scattering, and supercontinuum creation are increased [7]. These phenomena are used in wavelength conversion, frequency comb production, and the generation of broad-spectrum light sources [8]. Because of their small size, high sensitivity, and effective light guidance properties, optical microfibers provide a versatile platform for a wide range of optical applications. Ongoing research investigates innovative fabrication techniques and applications in order to maximize their potential in the realm of photonics [9]. Because of their small size, great sensitivity, and capacity to interact with the surrounding environment, optical microfibers can be employed as sensors in a wide range of applications [10]. Microfibers can be coated or functionalized with compounds that interact with specific chemicals or gases selectively. When the target analyte interacts with the coated microfibre, it causes changes in optical characteristics such as refractive index or fluorescence emission [11]. Microfibre sensors able to detect and quantify several gases and chemicals, make it useful in environmental monitoring, industrial safety, and medical diagnostics. They can be employed for biosensing applications by functionalizing the surface of optical microfibers with biomolecules or particular receptors [12]. When a target biomolecule or analyte attaches to the functionalized microfibre, the optical characteristics change, allowing for sensitive and selective detection of biological molecules [13]. Medical diagnostics, biosecurity, and biotechnology research all benefit from microfiber-based biosensors. Sodium hypochlorite (NaClO) is a chemical compound that is commonly used as a disinfectant, bleaching agent, and oxidizing agent [14]. It's a transparent, pale-yellowish liquid with a distinct chlorine odor [15]. Bleach, or liquid bleach, is another name for sodium hypochlorite.

As shown in Figure 1 of this research, we argued for the use of microfiber for sodium hypochlorite sensing. Previously, microfiber of various numbers and sizes were employed to detect humidity, temperature, and formaldehyde by evaluating sensor sensitivity. The microfiber designed the "tappering" technique using SMF-28 silica fiber [16]. As a result, the microfiber diameter were influenced by a different wavelength used, which resulted in the microfiber absorption capability of sodium hypochlorite particle [1,12]. According to theoretical research, the microfiber size will boost the sensitivity while performing liquid sensing. The experiment is carried out in a sealed room with concentrations of sodium hypochlorite ranging from 50% to 100% ppm. During the trial, the microfiber demonstrated good sensitivity, consistency repeatability, and stable functioning [17].

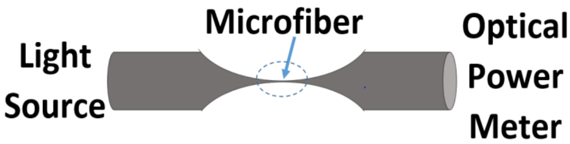


Fig. 1. The microfiber after tapering procedure

2. Performance of Microfiber Sodium Hypochlorite Sensor

Figure 2 depicted an experiment setup for a sodium hypochlorite concentration sensor with microfiber. The microfibre was immersed in sodium hypochlorite liquid, with one end of the fiber linked to the tunable laser source (TLS) and the other to the optical power meter (OPM) for wavelength supply and power measurement. The TLS was set to a wavelength of 1310nm and 1550 nm. The sodium hypochlorite liquid concentration was then varied from 50% ppm to 100% ppm, and the transmitted output power was measured for each concentration level. FIGURE 3 depicts the sensitivity and linearity of microfiber with different wavelength of light source with the different liquid concentrations. The results are obtained due to the adsorption principle, in which the microfibre interaction with the liquid particle varies with liquid concentration percentage. It has been demonstrated that microfiber is an excellent sodium hypochlorite concentration sensor.

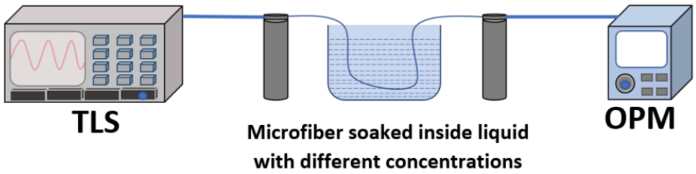
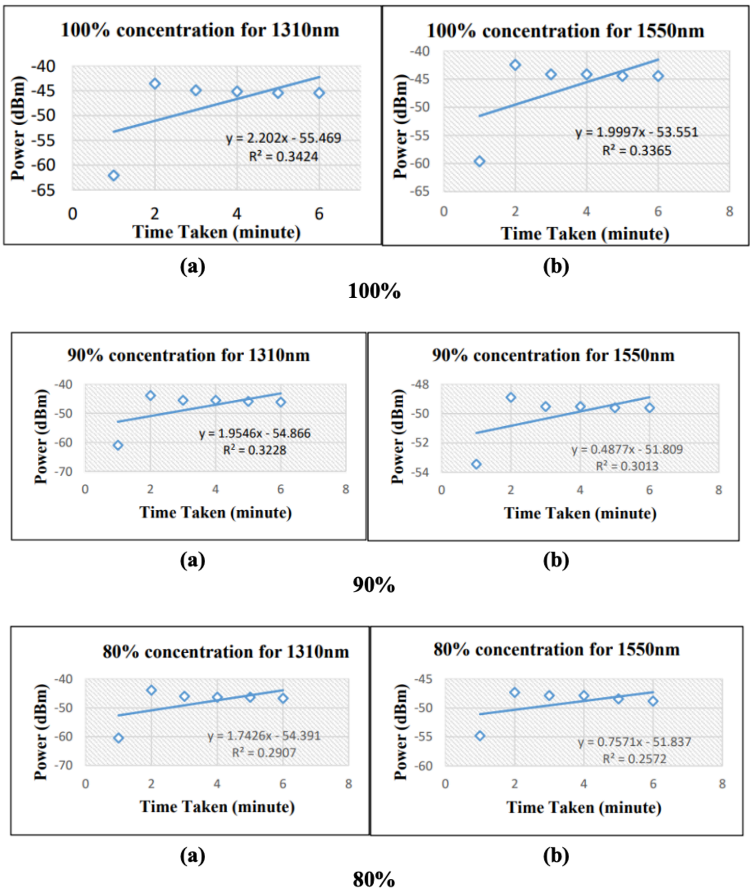


Fig. 2. The tapered microfiber for sodium hypochlorite sensing experiment setup. Tuneable laser source connected to supplied wavelength, optical power for final data collection

Figure 3 depicted the sensitivity and linearity established in each wavelength source. To eliminate random error during data collecting, all taper microfibre underwent certain repetition cycles. The transmitted power changed as the time observed increased. This is due to the adsorption of the taper microfibre, which increased power losses per unit rise in liquid concentration level. The microfiber with 1310nm wavelength at 50% liquid concentration achieves the maximum sensitivity and linearity values, with sensitivity greater than 3.0 dB/%ppm and linearity greater than 81%, respectively. In comparison, microfiber sensor with 1550nm inside of 70% liquid concentrations achieve sensitivity greater than 3.2 dB/%ppm with overall linearity greater than 73%.



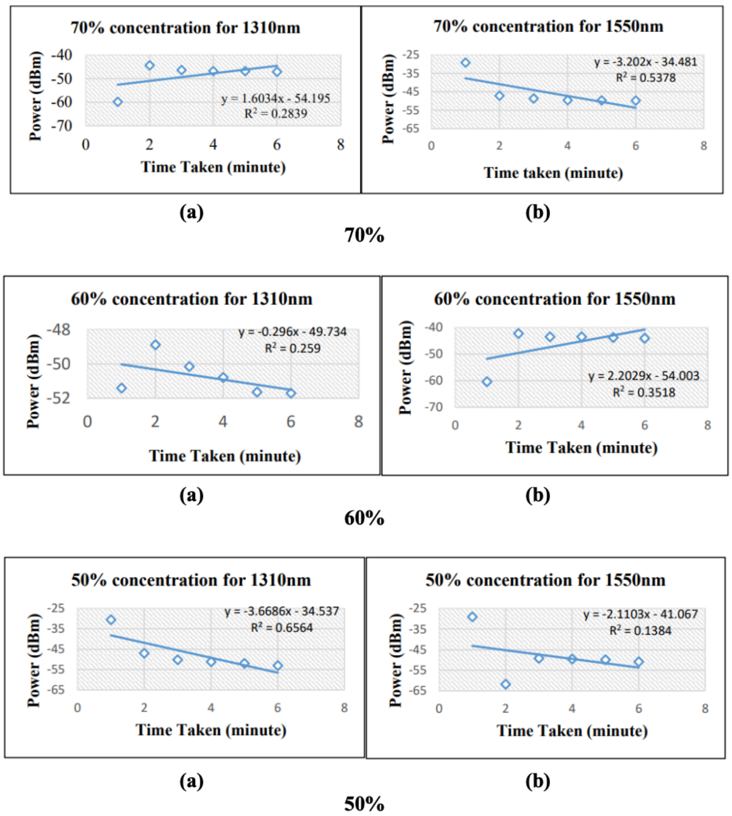


Fig. 3. The sensitivity and linearity of microfiber with different wavelength of light source with the different liquid concentrations

3. Conclusion

In this study, the evernasence field effect was studied by employing a microfibre as a sensor for sodium hypochlorite. The "tapering" method was used to create the microfiber, which shrank a silica fibre SMF-28 to a diameter of 10 micrometres. The microfibre is then used as a sensor for concentrations of sodium hypochlorite between 50% and 100% pmm. The microfiber's sensitivity based on wavelength shift clearly demonstrates its superior capability. An executed sensor has linearity of more than 99%. These microfibers show great promise as sodium hypochlorite sensors due to their high reproducibility and stability.

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