

UNIVERSITI TEKNOLOGI MARA

**DEVELOPING A BIO-COMPOSITE
SUBSTRATE USING *BAMBUSA
VULGARIS* FOR MICROWAVE
APPLICATION**

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ABSTRACT

Antenna is one of the most important components in wireless communication systems. In line with the advancement of industrial technology, the development of antenna should also be improved to meet the needs of the industry especially in the field of wireless communication. There are many antennas used to fulfil the needs of wireless communication. One of the existing antennas is the patch antenna. Currently, patch antennas were developed using existing substrates such as Flame Retardant type 4 (FR-4) and Rogers. These substrates are good but they are expensive. Thus, the development of a new low cost substrate with good performance would really be significant to the communication field. Beside that, with the supportive intention to utilise the abundant natural resources, the novel of rectangular patch antenna fabricated using a new bio-composite material is presented in this study. The bio-composite material is used to serve as an alternative substance in microwave applications. The bio-composite material is made of a bamboo which is technically known as *Bambusa Vulgaris* and a particular polymer named as High Density Polyethylene (HDPE). In general, the bio-composite material is purposely developed as a substrate in the patch antenna application. The green composite substrate is developed through wood plastic composite (WPC) technique that involves a lot of procedures, standards, and apparatuses. 7 samples of substrates separated by different composition of elements and different filler's (*Bambusa Vulgaris*) particle size were invented. The characteristics of all developed substrates were measured using several techniques and standards. All involved equipment, samples, and procedures adhered to the certified American Society for Testing and Materials (ASTM) standards. All the developed bio-composite substrates were measured their characteristics in terms of dielectric constant, loss tangent, breakdown voltage, and tensile strength. Every fabricated substrate provides unique properties which would provide big impacts in patch antenna applications. Furthermore, a patch antenna was developed using one of the developed substrates to verify the effectiveness of the bio-composite substrate in patch antenna application. Few parameters such as S-parameter and radiation pattern were measured to observe the real performance of the rectangular patch antenna developed on the bio-composite substrates. From these two major parameters, other performances of the patch antenna could be calculated and determined. Beside that, for comparison, a patch antenna was also fabricated using a selected existing substrate which is FR-4. According to the obtained results, the patch antenna developed using *Bambusa Vulgaris* offers better performance compared to FR-4. The patch antenna using *Bambusa Vulgaris* provides higher gain, wider beamwidth, and higher efficiency. All measurement results were recorded, analysed, and discussed. Beside that, further investigations on this substrate are really needed and this was also addressed. This is because to reveal other potentials of the bio-composite material in the current industry and technology.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

In the current technology of wireless communication systems, there is possibly no component which is as important as the antenna. Without an antenna, it would be practically impossible to have any form of wireless communication. A communication could be achieved via connecting wires between every transmitter and receiver. This will, however, result in an abundance of wires which can only provide a very limited range of available communications. Obviously, this scenario is impractical in the current modern world. Thus, a wireless communication system with a good antenna quality is needed.

Moreover, developing countries are looking for the most efficient system, not leaving the wireless communication system behind, to be implemented in all sectors. Efficiency is related to the ratio of output to the input of the system [1]. It describes a process that uses the least quantity of input to generate the utmost output. Efficiency can be measured in many aspects such as production costs, data transmission, and delivered power. According to the cost aspect, developers definitely want to produce their goods or products at the lowest cost possible while still maintaining or improve the quality of the products. By having a low cost product, the developer or the manufacturer can have a wider range of profit margin. In addition, the manufacturers also want to attract potential buyers to purchase their goods via offering them a lower price compared to their competitors. Consequently, every sector wants to develop their system in the most cost efficient way.

In order to achieve a great efficiency, they should minimize the cost and waste of resources such as raw materials, energy, and time while effectively producing the required output of the products. The movement of manufacturing uprising also brought the efficient system in time. For example, in a wireless communication system, earlier antennas were designed in large sizes, consuming a lot of costs. However, due to the growth in research related to wireless communication system, especially in antenna designs, reducing the size of the antennas is a possibility.