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Specific absorption rate distribution evaluation in a different substrate for hyperthermia treatment

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ABSTRACT

Hyperthermia treatment procedure (HTP) is a treatment that uses high heat generated from electromagnetic (EM) waves, which is about 42 °C to 45 °C within a particular duration. However, poor focus position distance on the treated tissue has become a significant concern among the researchers since it may contribute to a wide area of unwanted hot spots, which lead to severe adverse health effects on healthy tissue. This paper presents a specific absorption rate (SAR) distribution evaluation of different microstrip antenna substrates with different electrical permittivities, contributing to different sizes of microstrip antenna patches, which then provide different attainment of the SAR distribution on the treated tissue. Operating frequencies of 434 MHz, 915 MHz, and 2,450 MHz with 10 W operating power are utilized. A SEMCAD X is used to conduct a simulation in obtaining the SAR distribution, which determines the focus position distance on different tumour (malignant tissue) sizes. Based on the results, the suitable substrate for frequency 915 MHz and 2,450 MHz is RT5880, and RT5870, while RO3210 and RT6010 performed their best at 434 MHz and 2,450 MHz. The finding of this study can be used for further research in optimizing microstrip antenna development for HTP.

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1. INTRODUCTION

Hyperthermia treatment procedure (HTP) is a treatment procedure that utilizes high heat, about 42 °C to 45 °C at a certain period, to denature cancer cells into necrotic tissue with minimal damage to surrounding healthy tissue [1], [2]. The HTP provides non-invasive and invasive techniques. The non-invasive, which is referred to as treatment, is placing an applicator on the skin. On the other hand, invasive treatment is a procedure where the applicator is inserted into the target tissue. The treatment procedure can be hyperthermia alone or a combination of radiotherapy/chemotherapy. This paper focuses on non-invasive hyperthermia techniques for breast cancer treatment, which works alone by using the microstrip antenna as a hyperthermia heat applicator.

Hyperthermia is safer if compared to other currently available treatments for cancer. However, the main concern of this hyperthermia treatment is the focusing heat on the treated tissue [3]-[10]. The