

# An overview of available metamaterial-based antenna for non-invasive hyperthermia cancer treatment

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## ABSTRACT

This paper presents the outcome of a literature review that an overview of various types of antenna and metamaterial applicator performance towards cancerous tissue or cell for non-invasive hyperthermia cancer treatment (NIHCT) procedure. From the review, it shows that when LHM lens integrated with an antenna, focusing capabilities of the antenna towards the cancerous area can be improved. However, current applicators have a poor focusing effect when directed towards the actual tumor area. In conjunction with that, this paper proposes a new design of modified applicator that is microstrip antenna integrated with left-handed metamaterial (LHM) lens. The antenna termed microstrip-LHM (M-LHM) lens antenna is proposed for use in NIHCT. It is expected to improve the focusing capabilities of an antenna which is used to kill the cancerous area and thus improve the hyperthermia cancer treatment procedure success rate. In addition, this paper provides an overview of heating techniques used in hyperthermia to enhance focusing capabilities and a few metamaterial advantages that can improve the focusing effect and reduced the hot-spots. Specific Absorption Rate (SAR) will be investigated to evaluate the focusing abilities of the proposed applicator using the SEMCAD X Solver.

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## 1. INTRODUCTION

Non-Invasive hyperthermia cancer treatment procedure (NIHCT) is a popular technique that is now used to treat cancer patients. The NIHCT procedure can be used independently. However, it is commonly used as an adjuvant therapy to support various invasive treatment procedures such as chemotherapy and radiotherapy treatment. NIHCT, sometimes referred to as thermotherapy is a type of cancer treatment in which body tissue is exposed to a relatively high temperature. It is a treatment which requires high temperature around 41°C - 45°C to kill the cancerous tissue by a denaturation process. NIHCT process induces cell death with minimal side effects [1], [2].

NIHCT artificially heats body tissue using electromagnetic (EM) waves by focusing the EM wave onto the cancerous cell area thus heating the selected cells to induce denaturation. One of the challenges in the hyperthermia treatment is to selectively heat an area where the cancerous tissues are located to elevate the cancerous cell temperature to above 42 °C while keeping the temperatures of the surrounding healthy tissue as close as possible to normal human body temperature [3], [4]. Thus, to provide a good NIHCT is to have an antenna or applicator of the EM waves that could provide a good focusing control parameter.

Hyperthermia cancer treatment can be delivered either invasive or non-invasive. According to [5], NIHCT is a promising technique which gives a safe and effective treatment with less hurt and injury to fight