3D Printed Microwave Hyperthermia Applicator for Chemo-Thermotherapy of the Breast

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In 2012, the Center for Disease Control reported that 224,147 women and 2,125 men in the United States were diagnosed with breast cancer out of which 41,150 women and 405 men did not survive. Unfortunately, this number is set to rise to an estimated 231,840 new cases of invasive breast cancer among women in the US during 2015; and about 2,350 new cases are expected in men. General treatments for breast cancer includes breast-conserving surgery (surgical removal of the tumor and surrounding tissue), mastectomy (surgical removal of the breast), chemotherapy and radiation therapy. In recent years, microwave hyperthermia has been used in conjunction with radiation and/or chemotherapy in several clinical studies with the result being an increase in the effectiveness of the chemotherapy and the survival rates.

Current microwave hyperthermia applicators are bulky and the amount of power required (~30W-50W) for treatment necessitates that the equipment be housed in a screen room. In order to eliminate the screen room and comply with the FCC regulated power emission requirements, we consider a microwave hyperthermia applicator that is specifically designed for breast cancer. This applicator utilizes much less power to operate (<10W). In order to achieve optimum performance, we use MRI/CT images of the breast and a 3D printer which employs both dielectric and conductive filaments (carbon nanotubes and graphene) to print an applicator that conforms to the patient's breast. In order to test the applicator, we use gels that mimic the electrical properties of the human breast. Measurements regarding antenna return loss, SAR, and temperature distribution within the breast mimicking gel will be presented.