Pulsed Terahertz Spectrometry of Excised Breast Cancer Tissue

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This research involves the use of a terahertz imaging and spectroscopy system to conduct spectrometry on excised breast tissue. Breast cancer lumpectomy is the process of removing a malignant tumor from breast tissue. During the procedure, a portion of the surrounding tissue, known as the margins, is also removed. The margin tissue undergoes examination by a pathologist in order to determine whether there are any cancerous cells remaining in the healthy tissue. Should any additional cancerous tissue be found in the margin, it is considered a positive margin and an additional surgery is required to remove the remaining cancerous tissue.

Previous research has shown that the electrical properties of healthy and cancerous tissue from the breast are distinctly different under terahertz frequency illumination, as reported in (P. C. Ashworth, E. Pickwell-MacPherson, E. Provenzano, S. E. Pinder, A. D. Purushotham, M. Pepper, V. P. Wallace, *Optics Express*, vol. 17, no. 15, July 2009). These results were obtained up to 2 THz.

This research will utilize a pulsed terahertz system at the University of Arkansas in order to examine the electrical properties of excised tissue samples. The system is capable of producing radiation in the 0.06 – 4THz spectral range for the applications of terahertz spectroscopy and imaging. Three types of excised breast tissue will be examined using the terahertz spectrometer: fresh, frozen and formalin fixed paraffin embedded (FFPE). The freshly excised tissue will be obtained from the medical breast surgeon collaborator at the University of Arkansas of Medical Sciences, while the other two types will be obtained from tissue banks (e.g. BioServe Company).

The selected tissue types have different percentage of water content, therefore the real and imaginary part of their permittivity are expected to differ significantly. The goal of this work is to examine these three types at various regions of tissue ranging from the middle to the margins of the sample. A comparison of the electrical properties of the three types will be conducted across the available frequency range. The outcomes of this research will enable more accurate modeling of the interaction of terahertz waves with breast tissue and hence will lead to better understanding of the terahertz technology in imaging breast tumor margins.