Diagnosis of breast cancer tissues using nonlinear microscopy techniques

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ABSTRACT

Nonlinear imaging microscopy modalities comprise powerful tools for biomedical diagnosis. These technologies provide several advantages compared to other optical techniques such as high resolution, label-free imaging capabilities, increased penetration depths and intrinsic three dimensional sectioning without any phototoxicity phenomena and energy deposition onto the biological sample. The investigation of both cells and tissues during inflammation and cancer was achieved via the application of these non destructive techniques [1].

The experimental apparatus of our nonlinear imaging system is consisted of a femtosecond laser source emitting at 1068nm and a modified upright Nikon microscope. A high numerical aperture objective lens is used for the tight focusing of the beam and laser scanning procedure is performed with a pair of galvanometric mirrors. Nonlinear signals are collected simultaneously from two PMTs in reflection and transmission mode.

Figure 1 depicts a nonlinear multimodal image of human breast tissue by simultaneously detection of two signals. Second Harmonic Generation (SHG) signal (in green) depicts collagen organization in tissue and is collected in backward detection. Third Harmonic Generation (THG) signal (in blue) is generated through optical inhomogeneities of the tissue and is recorded in forward direction. Previous studies of our group indicated that THG can demonstrate the density and size of cells and could be used as a diagnostic tool for cancer prognosis in malignant tissues [2].

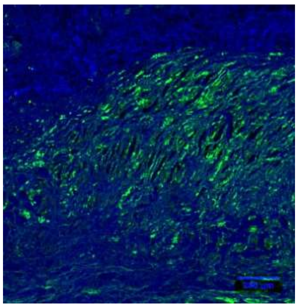

Figure 1: Merged image of SHG (green) and THG (blue) from a human breast tissue.

Quantitative information about structure and directionality of the SHG emitters is provided by polarization sensitive SHG experiments (PSHG) [3]. The development of an accurate objective diagnostic tool based on the aforementioned PSHG information is our main future target.

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