PHOTOACOUSTIC DETECTION OF CIRCULATING TUMOR CELLS

Sagar Kishore Gupta

Dr. John A Viator, Dissertation Supervisor

ABSTRACT

Photoacoustics is one of the sunrise sectors in the field of biomedical diagnostics, based on the conversion of photons into ultrasound waves. It has been explored in cancer detection and imaging only in recent years. This dissertation throws light on development of rapid in-vitro photoacoustic sensor to detect metastatic cells in stationary and flow systems. Metastasis is a life threatening complex physiological phenomenon involving the movement of cancer cells from one organ to another by means of blood and lymph. American cancer society, estimates 76,690 new cases and 9,480 deaths due to melanoma, in the United States for 2013. Yet prognosis of the metastatic patients is poor. There is an immediate need for a diagnostic tool to detect the spread of metastasis before tumors are large enough to be imaged by conventional methods.

An optical photoacoustic sensor with high sensitivity and resolution to detect the presence of extremely low number of metastatic (melanoma and gold nanoparticles tagged prostate cancer cells) in suspension containing a million white blood cells was developed based on the change in the refractive index of water.

Single cell detection of both injected and induced metastatic melanoma in mice was successfully obtained by using the probe of an ultrasound machine as the photoacoustic transducer. Finally, the new two phase-flow system to capture the metastatic cells was developed and integrated to the detection system, to isolate the metastatic cells and also enhance the photoacoustic detection to be an effective tool for physiological and genetic analysis for effective drug development.