III-V Nitride Microcantilever based Photoacoustic Biosensor

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Technology description

TheUniversity of South Carolinais offering licensing opportunities for this novel biosensor for use in detecting cancer cells in blood samples.

Invention Description:

The subject invention is a highly sensitive and miniaturized biochip sensor capable of detecting a single melanoma cancer cell in circulating blood samples. The pre-clinical and clinical applications in detecting cancer metastasis and prognosis are extensive.

The biochip sensor utilizes the photo-acoustic detection technique to differentiate cancer cells from other cells present in blood in a label-free manner, while system miniaturization was achieved by using novel and highly sensitive gallium nitride-based piezoelectric micro-cantilever (resembling miniaturized diving boards) sensors.

Future development:

Once developed and tested successfully, the biochip can be further modified to make it implantable in humans (near the skin), so that successful monitoring of metastasized tumor cells is possible in-vivo, which would be much more sensitive (the IR excitation can be provided from outside, and the sensor can communicate the data wirelessly like implantable pressure sensor do at present).

Background:

Skin cancer is the most common form of cancer in the United States, with more than 3 million cases diagnosed annually. About 12,000 people die each year from skin cancer and nearly 9,000 of those cases are from melanoma, according to the American Cancer Society [1]. Melanoma is the fifth most common cancer for men and sixth most common for women. It is the most common form of cancer for young adults 25-29 years old and the second most common cancer in adolescents and young adults 15-29 years old. One American dies from melanoma almost every hour. Significant progress has been made in respect to detecting both the primary and the metastatic disease. After surgical removal of the primary tumor, patients are usually monitored during follow-up by clinical examination, routine laboratory tests, and ultrasound, CAT, nuclear magnetic resonance, and positron emission tomography scans. Unfortunately, the currently available imaging techniques can only detect metastatic disease when secondary tumors are at least a few millimeters in size, and altogether fail to detect micro-metastases or tumor cells in the systemic blood circulation that are believed to precede clinically overt metastases [2]. In spite of widespread research efforts, detection of circulating tumor cells (CTCs) has

been met with only limited success. Most methods, such as the real-time polymerase chain reaction (RT-PCR) technique, immune-magnetic separation, and fluorescence cytometry, use some sort of biochemical precursors. These approaches are often time consuming, complex, and of limited accuracy [3]. Therefore, there was a strong need for a rapid, label-free, and miniaturized detection system that can detect and count single melanoma cells in human blood samples. This invention addresses that need.

Application area

Pre-clinical and clinical applications in detecting cancer metastasis and performing cancer prognosis

Advantages

Simpler, more accurate, and less time consuming compared to current technologies
Rapid, label-free, and miniaturized system or compact design
Ability to detect various cancer cells, especially melanoma cells, using the photo-acoustic detection technique
Ability to identify cells, protein molecules and DNA based on photo-acoustic Spectroscopy
Ability to detect tumors through photo-acoustic microscopy and imaging

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