Rahim Esfandyarpour, J Biosens Bioelectron 2014, 5:3
http://dx.doi.org/10.4172/2155-6210.S1.019

OMICS Group Conferences
Accelerating Scientific Discovery

3rd International Conference and Exhibition on
Biosensors & Bioelectronics
August 11-13, 2014 Hilton San Antonio Airport, San Antonio, USA

Nanoneedle array: A label-free, real time and matrix independent detection platform for detection of different biomarkers

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Detection of biological analytes is useful in various applications in biotechnology and personalized medicine. The analytes of interest may range from macromolecules, such as proteins and nucleic acids to viruses and whole cells. While each of them plays a vital part in life but there is something special about the proteins. Proteins are the key link between the processes of information and replication that take place on a genetic level and the infrastructure of living features.

Detection of proteins and nucleic acids is often performed using optical fluorescence based techniques, which are more costly and timely than electrical detection due to the need for expensive and bulky optical equipment and the process of tagging. Thus, a robust label-free electrical detection technique can provide for a promising solution in lowering both reagent costs and instrumentation costs.

Thus, to overcome these various problems mentioned and to develop a more sensitive and label free platform of protein detection, we proposed and developed a novel array of electrical nano-biosensors in a microfluidic channel, called nanoneedle biosensors. A nanoneedle biosensor is a real-time, label-free, matrix independent, direct electrical detection platform, which is capable of high sensitivity detection, measuring the change in impedance modulation, due to the presence or reaction of biomolecules such as proteins, nucleic acids and cells.

Different generations of the sensors with various thicknesses and geometrical designs were developed. In order to demonstrate the utility of these sensors for label-free biosensing, electrical response of the sensors for various types of biological agents such as nucleic acids and proteins was studied. The utility of this sensor in affinity biosensing for several different biomarkers was demonstrated. As a practical example with clinical relevance, detection of Vascular Endothelial Growth Factor (VEGF) for cancer diagnosis was also demonstrated.

We believe this work provides a strong starting point for a new class of electronic biosensing devices with the capability of rapid direct large-scale integration. Our demonstration of label-free and real-time detection of cancer biomarkers with this sensor can be envisioned to allow for point-of-care cancer diagnosis.

Biography

Rahim Esfandyarpour is a PhD graduand form Stanford University (August 2014). He obtained his MS degree in Electrical Engineering (2010) from Stanford University. He joined world-renowned Stanford Genome Technology Center (School of Medicine) to lead Nanobiotechnology project to pursue his PhD in Electrical Engineering. During his PhD he has developed a novel, real-time, label-free and matrix independent array of electrical nano-biosensors, called nanoneedle biosensors, which are capable of high sensitivity biomarkers detection. He will be a Postdoctoral researcher at Stanford Genome Technology Center (September 2014). During his PhD, he has published more than 13 papers in reputed journals and conference proceedings. He is also the inventor of numerous pending patents related to biomarkers detection technologies. He is also serving as a reviewer for several reputed journals and conferences.

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