Advances of Implantable Electrochemical Biosensors based on Nanotechnology

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ABSTRACT
An implantable biosensor consisting a sensing element an electronic circuits receiving signals from sensing elements to produce data. The innovative development process which concludes implantable biosensors for continuous analysis of metabolites is an area of sustained, quantitative and technological interest. Nanotechnology is the promising field of research because of its tendency to revolutionize its novel properties in biomedical area of research A combination methodology wherein nanotextured surface using composite electrospun nanofibers are used as coating for implantable devices. Nanotechnology based advances in implantable devices field have opened up a lot of opportunities as biocompatibility of nanomaterial.

Keywords
Implantable biosensor, Nanotechnology, Nanofibers

1. INTRODUCTION
Biosensor is an analytical device which stimulate a biological active element with an appropriate physical transducer to generate a measurable signal proportional to the concentration of chemical species in any sample. The first experiment to mark the origin of biosensor was done by Leyland C. Clark. For his experiment he used platinum electrodes to detect oxygen concentration in which he placed enzyme glycooxidase very close to the surface of platinum by trapping it against the electrode with a piece of dialysis membrane. The enzyme activity was modified according to the surrounding oxygen concentration. It basically consists of a biological component for sensing the presence and concentration of a substance and a transducer device which work according to principle. In biosensor the suitable transducer is desire for having specific interaction with the analyte and biological element. A different variety of substance may be used as the bioelement in a biosensor such as nucleic acid, pro including enzymes and antibodies etc. Biosensors can be classified based upon their biotransducer type. The most common among them are used as a biotransducer in biosensors are electrochemical biosensor.

For the management of chronic illness such as cardiovascular disorders require maintenance of glucose and cholesterol level. Therefore there is a need of proficient approach that efficiently involves the integration of biosensor similarly electrochemical biosensor provide an attractive means to analyze the content of biological sample [1-5]..

2. IMPLANTABLE ELECTROCHEMICAL BIOSENSOR
Implantable biosensor comprising a sensing element, an electronic circuit receive signal from sensing element and producing sensing data. Implantable biosensor are used to determine physiochemical changes in the body with high sensitivity and tremendous specificity. So, hereby the advances of integrated biosensors, wireless communication and power harvesting techniques are enticing researchers [6].

2.1 Implanted electrochemical Biosensor for retinal prostheses
Retinal pro. provides a platform for incorporation of biosensors in biosensing of eye. Blindness has a devastating impact on peoples quality of life, ultimately it result from disease or injury during visualization process. The act of implanting an intraocular prosthetic device to electrically stimulate the retina lacks in retinal surgery. Implantable neural stimulators such as visual prosthesis must be inductively link to on outside source of power and data .Visual pathway constitute manly of the eye, optic nerve and visual cortex. Retinal prosthesis provides a scientific way for incorporation of biosensor for neural stimulation and biosensing in human eye. Signals are processed by cells in the retina structure, send to brain along the optic nerves and perceived as a visual prospects. The success in retinal prostheses and advanced in biosensor research bring hope for a fully implantable biosensing system by combining technology. The retinal prostheses during implantation constitutes high density thin film electrode array provides a platform to integration of multianalyte approach[7].

3. NANOTECHOLOGY IN MEDICAL DEVICES
Nanotechnology involves creation and successful utilization of materials during experimental purpose at nanometer scale [8]. This field is tremendously undergoing dynamic development on many ages. Nanotechnology involves the manipulation of materials at molecular level or atomic level by making change in its physiological properties such as physical, chemical and biological properties. Biomedical application of nanotech has developed an ability to enable early detection treatment and its cure against many threatening disease which include detection at nanoscale of the disease. Many of them are including as cancer, cardiovascular disease, glucose biosensing etc [9]. Nanotechnology exhibits higher activity during chemical reaction of metabolites, faster electrical and magnetizing response owing to surface to its volume ratio.

Nanotechnology constitutes its advance impact of research in biomedical area by providing a platform to perform the process at nanoscale and its dynamic results are the contributions possess significant approaches during whole biosensing process

3.1 Nanobiosensors

Nanobiosensors are tremendously used in medical diagnosis to detect the specific biomarker for early diagnosis . A successful nanobiosensors based on nanomaterial such as nanoparticles, nanotubes , nanowires etc involves its sensitivity, stability and reproducibility & its treatment with high degree of accuracy in severe diseases.[10] Types of Nanobiosensors based upon identification of the element:

3.1.1 DNA nanobiosensors

This biosensors involved conversion of base pair recognition event into measurable electrical signal. The formation of DNA duplex enhance the bases of electrochemical signal detection and induce by covalent binding materials to probe [11].

3.1.2 Immunononanobiosensor

Biosensors which demonstrate antigen antibody interaction are referred as immunosensor. Immunosensor monitor interaction of antigen and antibody in which either antigen or antibody is immobilized on a solid state surface of electrode and participate in biospecific interaction with other component [12].

3.1.3 Enzyme nanobiosensors

Enzymes are used authentically in biomedical research for treatment of various diseases. Some enzymes that are employed in diagnosis and treatment of many diseases but one of its limitation which could affect its stability by change in the factor involving temperature , ph and buffer etc. The basic requirement for an enzymatic nanobiosensor are enzyme acts on its substrate to produce a molecule which is capable of being reduced or oxidized on electron surface [13].

4. APPLICATION OF ELECTROCHEMICAL BIOSENSORS

The utilization of electrochemical biosensor based on nanotechnology could be understood by the exemplary facts of nanotechnology.

4.1 Implantable Glucose biosensor

At molecular level the nanotechnology company especiallising in microelectromechanical systems (MEMS). In future subcutaneously implanted electrochemical glucose sensor will be available to provide frequent or continuous information on which timely treatment decisions, such as insulin injection or glucose source intake . Concentration of glucose is quantified by measuring oxygen concentration or hydrogen peroxide by a electrochemical oxidation or reduction occurring on the surface of working electrode. In this procedure the novel portable device for patient does not only displays the glucose levels from the implant to patient but also conveys automatically in real time the information to glucose dynamics.[14]

4.2 Implantable cardioverter defibrillators

The nanopressures sensor can monitor pressure within cardiovascular system while the data is transmitted to a wrist watch like data collection device. The data is transmitted through external device to a central remote monitoring station. The implantable cardioverter defibrillators have transformed treatment of patient at risk for sudden cardiac death because of ventricular tachyarrhythmia. The initial application of this innovative technology involves pharmaceutical companies which could use biological chips to test potential drug more precisely and scientifically. A wireless defibrillators pacemaker or an insulin pump to take action to correct a detected abnormality.[15]

5. NANOTECHNOLOGY IN CANCER TREATMENT

According to U.S National Cancer Institute nanotechnology will change the very foundation of cancer diagnosis, treatment and prevention. Cancer is genetically rooted disease that involves the occurrence of cellular malfunctions. In general the best way to eliminate the problem is to eliminate the cause. To determine the viability of nanotechnology based treatment for example Melanoma a form of skin cancer is caused primarily by ultra violet radiation from sun. The latest method of preventive treatment against bombardment with this kind of harmful radiation involves suspending the substance that either absorbs or scatter ultra violet radiation in a thick emulsion. The use of this emulsion called sunscreen to coat our skin prior to prolonged exposure to sunlight. With this nanotechnology preventive method efficiently laminate most of the problems. Some recent work have explored cancer treatments from nanotechnology some of them are as follow.

a) *a)*The first method involves nanoparticles loaded with paclitaxel. The research compares the efficacy of paclitaxel loaded nanoparticles. A currently used colloidal suspension of drug in which paclitaxel was originally used by simply flooding the system

b) The second potential treatment involves absorption of light by gold nanoparticles . This method involves gold coated nanoparticles conjugated to recognition ligand. Gold nanoparticles are frequently used in microscopy due to their high electron density.

c) Finally the third nanoparticle for direct cell destruction to be described as magnetic nanoparticle known as hyperthermia method. It is predicted that the relatively old concept of hyperthermia can be combined with methods in nanotechnology to achieve previously unequal positive results. [16]

6. FUTURE PROSPECTS

Nanotechnology for medical diagnosis is one of most tremendous and highly specific field which involves the straight forward diagnosis for the diseases. The innovation in nanotechnology is continued to appear and produce new opportunities for medical diagnosis. The development field of nanotechnology together with the elegant and multidisciplinary research involving new sensing concepts is well suited to provide an emerging platform for innovative inventions. Clearly the most current disease time nanotech based treatment methods involves detection & prevention of disease through nanotechnology which provide the effective means of treatment in several disease. Cancer is one of the more lethal disease & its early detection is crucial. There has been a significant improvement largely due to breakthrough, both in bottomup & in topdown nanotechnology. Developing in such areas as in nanoarrays, nonsenses, liposomes, monoclonal antibodies, improve nanoparticles, magnetic nanoparticles are making early detection through implantation process and involving high degree of accuracy. More ever emerging technology of implantable biosensor constitutes lab

on a chip micro devices & nanosensor offers tremendous opportunities for construction of new generation biosensors with much better performances.

In this paper emerging role of advances of implantable biosensor based on nanotechnology are extremely focusing upon the ultimate ways to treat several diseases. Achievement of this goal in battle against we have made an effort to provide comprehensive overview on several fatal diseases seems to be mostly due to potential success of dealing with diseases through nanotechnology. Different discoveries & invention in nanotechnology are suggesting its application for future aspects of certain diseases & its vital role during the treatment process provides a exquisite treatment to cure to diseases..

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