World Academy of Science, Engineering and Technology
International Journal of Biotechnology and Bioengineering
Vol:9, No:08, 2015

Streptavidin-Biotin Attachment on Modified Silicon Nanowires

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Abstract : Nanotechnology is revolutionizing the development of biosensors. Nanomaterials and nanofabrication technologies are increasingly being used to design novel biosensors. Sensitivity and other attributes of biosensors can be improved by using nanomaterials with unique chemical, physical, and mechanical properties in their construction. Silicon is a promising biomaterial that is non-toxic and biodegradable and can be exploited in chemical and biological sensing. Present study demonstrated the streptavidin–biotin interaction on silicon surfaces with different topographies such as flat and nanostructured silicon (nanowires) surfaces. Silicon nanowires with wide range of surface to volume ratio were prepared by electrochemical etching of silicon wafer. The large specific surface of silicon nanowires can be chemically modified to link different molecular probes (DNA strands, enzymes, proteins and so on), which recognize the target analytes, in order to enhance the selectivity and specificity of the sensor device. The interaction of streptavidin with biotin was carried out on 3-aminopropyltriethoxysilane (APTS) functionalized silicon surfaces. Fourier Transform Infrared Spectroscopy (FTIR) and X-ray Photoelectron Spectroscopy (XPS) studies have been performed to characterize the surface characteristics to ensure the protein attachment. Silicon nanowires showed the enhance protein attachment, as compared to flat silicon surface due to its large surface area and good molecular penetration to its surface. The methodology developed herein could be generalized to a wide range of protein-ligand interactions, since it is relatively easy to conjugate biotin with diverse biomolecules such as antibodies, enzymes, peptides, and nucleotides.

Keywords : FTIR, silicon nanowires, streptavidin-biotin, XPS
Conference Title : ICNB 2015 : International Conference on Nanotechnology and Biosensors
Conference Location : Venice, Italy
Conference Dates : August 13-14, 2015