World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:9, No:09, 2015

AFM Probe Sensor Designed for Cellular Membrane Components

Authors : Sarmiza Stanca, Wolfgang Fritzsche, Christoph Krafft, Jürgen Popp

Abstract : Independent of the cell type a thin layer of a few nanometers thickness surrounds the cell interior as the cellular membrane. The transport of ions and molecules through the membrane is achieved in a very precise way by pores. Understanding the process of opening and closing the pores due to an electrochemical gradient across the membrane requires knowledge of the pore constitutive proteins. Recent reports prove the access to the molecular level of the cellular membrane by atomic force microscopy (AFM). This technique also permits an electrochemical study in the immediate vicinity of the tip. Specific molecules can be electrochemically localized in the natural cellular membrane. Our work aims to recognize the protein domains of the pores using an AFM probe as a miniaturized amperometric sensor, and to follow the protein behavior while changing the applied potential. The intensity of the current produced between the surface and the AFM probe is amplified and detected simultaneously with the surface imaging. The AFM probe plays the role of the working electrode and the substrate, a conductive glass on which the cells are grown, represent the counter electrode. For a better control of the electric potential on the probe, a third electrode Ag/AgCl wire is mounted in the circuit as a reference electrode. The working potential is applied between the electrodes with a programmable source and the current intensity in the circuit is recorded with a multimeter. The applied potential considers the overpotential at the electrode surface and the potential drop due to the current flow through the system. The reported method permits a high resolved electrochemical study of the protein domains on the living cell membrane. The amperometric map identifies areas of different current intensities on the pore depending on the applied potential. The reproducibility of this method is limited by the tip shape, the uncontrollable capacitance, which occurs at the apex and a potential local charge separation.

Keywords : AFM, sensor, membrane, pores, proteins
Conference Title : ICBB 2015 : International Conference on Biosensors and Bioelectronics
Conference Location : Rome, Italy
Conference Dates : September 17-18, 2015