

Bioreactor for Cell-Based Impedance Measuring with Diamond Coated Gold Interdigitated Electrodes

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Abstract : Cell-based impedance spectroscopy is suitable method for electrical monitoring of cell activity especially on substrates that cannot be easily inspected by optical microscope (without fluorescent markers) like decellularized tissues, nano-fibrous scaffold etc. Special sensor for this measurement was developed. This sensor consists of corning glass substrate with gold interdigitated electrodes covered with diamond layer. This diamond layer provides biocompatible non-conductive surface for cells. Also, a special PPFC flow cultivation chamber was developed. This chamber is able to fix sensor in place. The spring contacts are connecting sensor pads with external measuring device. Construction allows real-time live cell imaging. Combining with perfusion system allows medium circulation and generating shear stress stimulation. Experimental evaluation consist of several setups, including pure sensor without any coating and also collagen and fibrin coating was done. The Adipose derived stem cells (ASC) and Human umbilical vein endothelial cells (HUVEC) were seeded onto sensor in cultivation chamber. Then the chamber was installed into microscope system for live-cell imaging. The impedance measurement was utilized by vector impedance analyzer. The measured range was from 10 Hz to 40 kHz. These impedance measurements were correlated with live-cell microscopic imaging and immunofluorescent staining. Data analysis of measured signals showed response to cell adhesion of substrates, their proliferation and also change after shear stress stimulation which are important parameters during cultivation. Further experiments plan to use decellularized tissue as scaffold fixed on sensor. This kind of impedance sensor can provide feedback about cell culture conditions on opaque surfaces and scaffolds that can be used in tissue engineering in development artificial prostheses. This work was supported by the Ministry of Health, grants No. 15-29153A and 15-33018A.

Keywords : bio-impedance measuring, bioreactor, cell cultivation, diamond layer, gold interdigitated electrodes, tissue engineering

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