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Cellular Microarrays for Chemical Sensing

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The broad-spectrum sensitivity of cell-based biosensors offers the capability for detecting known and unknown chemical/biological agents. One cellular parameter that is often measured is the extracellular potential of electrically active cells. Membrane excitability in osteoblasts plays a key role in modulating the electrical activity in the presence of chemical agents. However, the complexity of this signal makes interpretation of the cellular response to a chemical agent difficult to determine. By analyzing shifts in the signal's power spectrum, it is possible to determine a frequency spectrum also known as the signature pattern vector (SPV) which is specific to a chemical. It is also essential to characterize single cell sensitivity and response time for specific chemical agents for developing detect-to-warn biosensors. To determine the real time sensing capability of single osteoblast sensors, multichemical sensing, also termed "cascaded sensing," is performed and the performance of the sensor is evaluated. A system is described for the measurement of extracellular potentials from cells isolated onto planar microelectrode arrays. We used a 4×4 multiple microelectrode array system to spatially position osteoblast cells, by using a gradient AC field. Fast fourier transformation (FFT) and wavelet transformation (WT) analyses were used to extract information pertaining to the frequency of firing from the extracellular potential. Quantitative dose response curves and response times were also obtained with the cultured single cell systems using local time domain characterization techniques. Future applications of this technique are also discussed.

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