ECIS® TIPS

Applied BioPhysics
Quantifying Cell Behavior

Don't Forget Capacitance

Capacitance at high frequency can be used to determine the percentage of substrate covered with cells - a very useful quantity measured using ECIS without opening the incubator door.

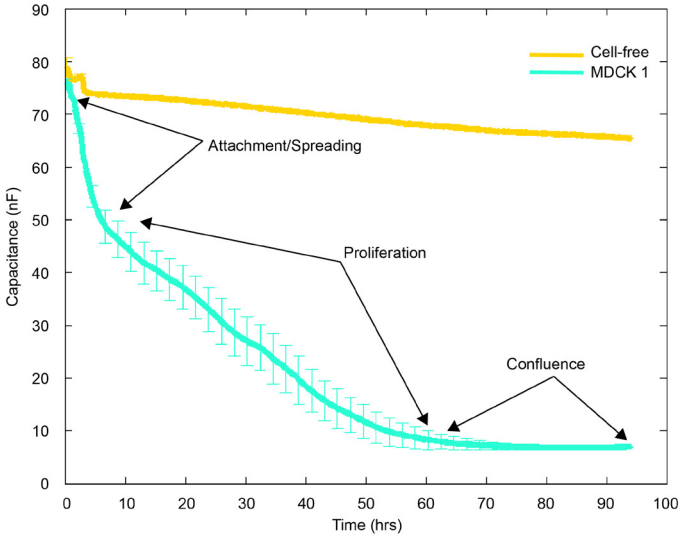
Most papers presenting ECIS data show resistance (R) and sometimes impedance (Z), but rarely present capacitance (C) data. The likely reason is that in the intermediate AC frequency range where most ECIS measurements are made, the capacitance undergoes relatively small changes. This is not true, however, at high frequencies (32,000 Hz and higher). Under high frequency conditions there is a noticeable drop in the measured capacitance that is directly related to cell coverage.

Consider the capacitance of 10E+ electrodes at 40,000 Hz. Without cells, the capacitance of a well is ~ 60 nanofarads. As cells attach and spread upon the electrodes the capacitance drops to less than 10 nanofarads. The relationship between capacitance measured at high frequency and the amount of cell-free gold open to solution is, for most cells, a linear one. In other words, the capacitance at high frequency is a direct measure of how much of the substrate is cell-free.

In the situation described above, when the capacitance of a partially cell-covered electrode is 30 nanofarads, the amount of cell-free substrate is calculated as below:

- Percent of cell-free substrate = 100% (Cmeasured - Cconfluent)/(Ccell free - Cconfluent)
- Percent of cell-free substrate = 100% (30-10)/(60-10) = 100% (20/50) = 40% or 60% cell coverage.

Knowing the degree of cell coverage is useful when doing wound healing assays and is especially important when modeling cell data. The ECIS model requires a confluent cell layer to be valid, and this can be quickly verified by checking the value of the high frequency capacitance.



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