

3D Cellular Constructs

In any three dimensional (3D) biofabrication process, assessing the critical biological quality attributes of 3D constructs such as viable cell number, cell distribution, and metabolic activity is critical to determine the suitability and success of the process. One major limitation is the lack of appropriate methods to monitor these quality attributes in-situ in a non-destructive, label-free manner. The use of dielectric impedance spectroscopy has been investigated as a technology that fills this gap. In recent years, Aber technology has been used to measure the relative bio-capacitance of encapsulated MG63 cells in 3D alginate constructs (Narayanan *et al.*, 2017). The technology has successfully measured relative capacitance, which was linear to cell concentration. Furthermore, the β - dispersion parameters for MG63 cells encapsulated in alginate were characterised and used to distinguish between different cell types (MG63 and stem cells) using the respective cole-cole α and critical frequency values.

The results from this study demonstrate that dielectric impedance spectroscopy can be used to monitor critical quality attributes of cell-encapsulated 3D constructs. Owing to the measurement efficiency and non-destructive mode of testing, this method has tremendous potential as an in-process quality control tool for 3D biofabrication processes and the long-term monitoring of cell-encapsulated 3D constructs.

Summary of the benefits for using ABER to monitoring 3D cellular constructs:

- Measure 3D tissues in real time non-disruptively
- Monitor biological quality attributes of cells in 3D environments
- In situ quality measurements of biofabricated constructs
- Distinguish between different types of cells in the 3D tissue construct

References:

Narayanan, L.K., Thompson, T.L., Bhat, A., Starly, B. and Shirwaiker, R.A., 2017, June. Investigating Dielectric Impedance Spectroscopy As a Non-Destructive Quality Assessment Tool for 3D Cellular Constructs. In ASME 2017 12th International Manufacturing Science and Engineering Conference collocated with the JSME/ASME 2017 6th International Conference on Materials and Processing, American Society of Mechanical Engineers Digital Collection.

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