

Non-Destructive Quality Assessment of 3D Bioprinted Constructs via Dielectric Impedance Spectroscopy

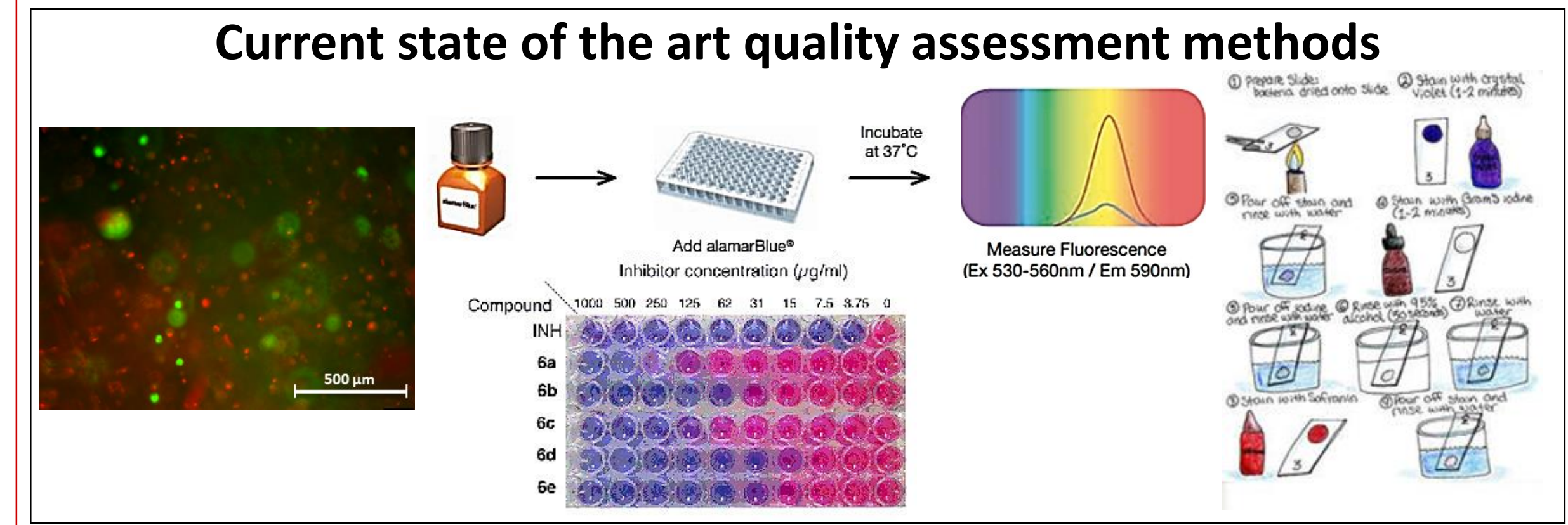
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BACKGROUND

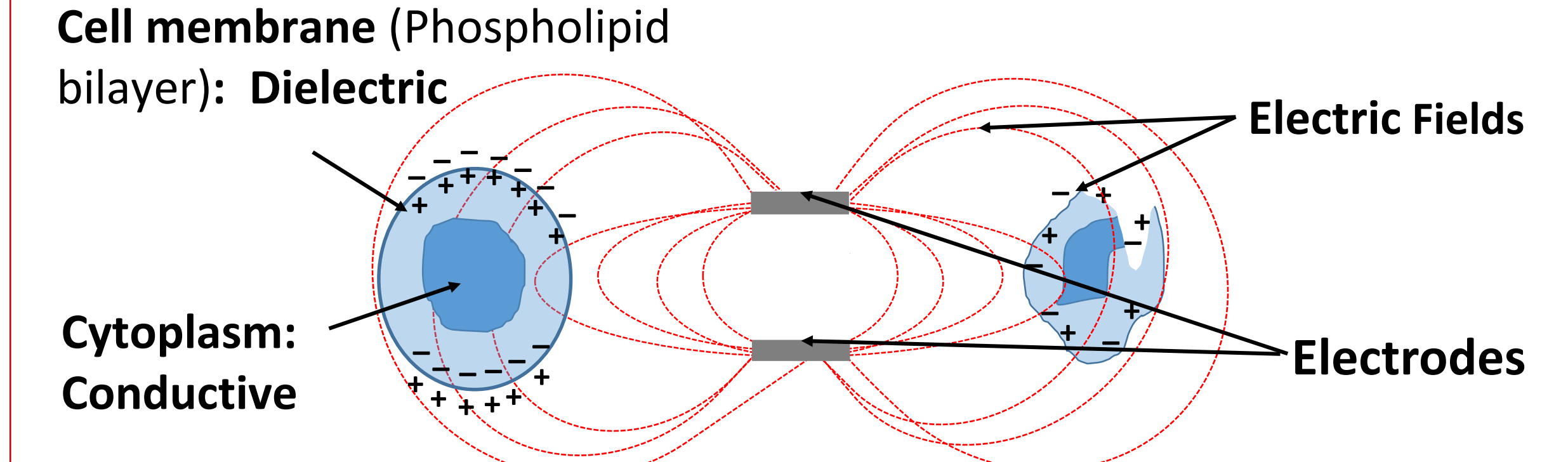
- 3D-Biofabricated constructs:** Biological substitutes that can restore, maintain, or improve function of a host tissue¹.
- Quality requirements:** In-process and post-process control of critical quality attributes (CQA) such as cell viability and cellular morphology.
- Current state of quality testing:** Destructive chemical label-based methods (eg, LIVE/DEAD, MTT, aB) that may require sectioning and fixing. A majority of these methods were developed for monolayer cell culture.



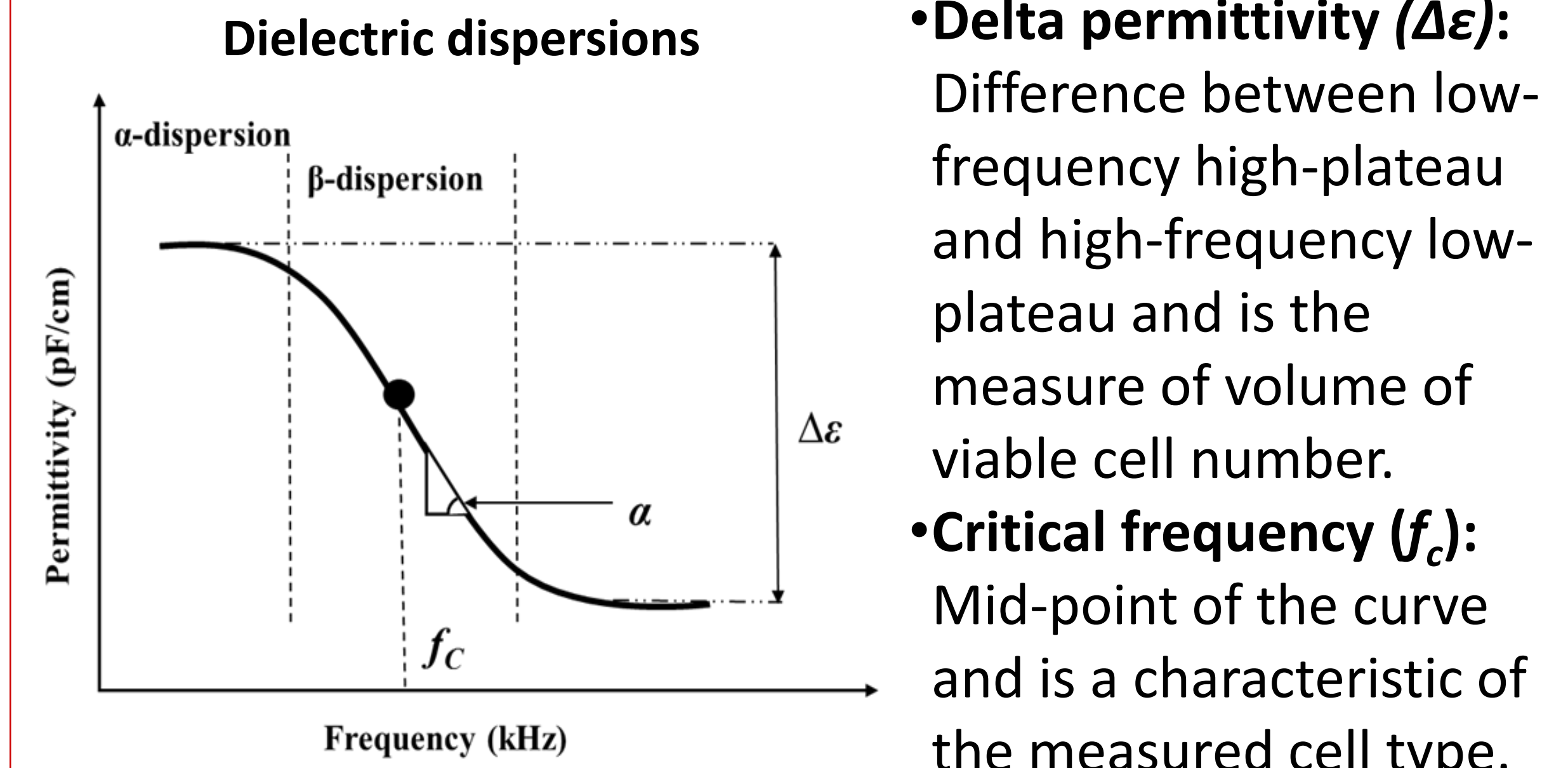
- Dielectric impedance spectroscopy (DIS):** A technique that can address the current shortcomings, utilizing the dielectric properties of cells to characterize viable cell concentration.
- Primary objective:** Determining the relationship between DIS parameters and CQA of 3D biofabricated constructs and feasibility of using DIS in process monitoring of bioprinting.

DIELECTRIC IMPEDANCE SPECTROSCOPY

- In presence of electric field at radio frequencies (50 to 20000 kHz)²:

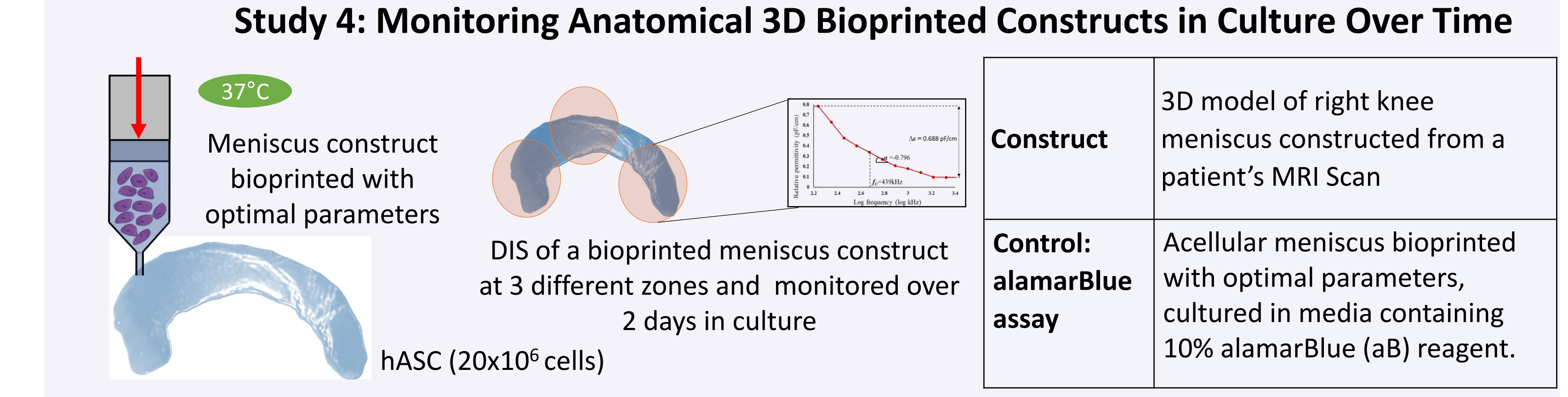
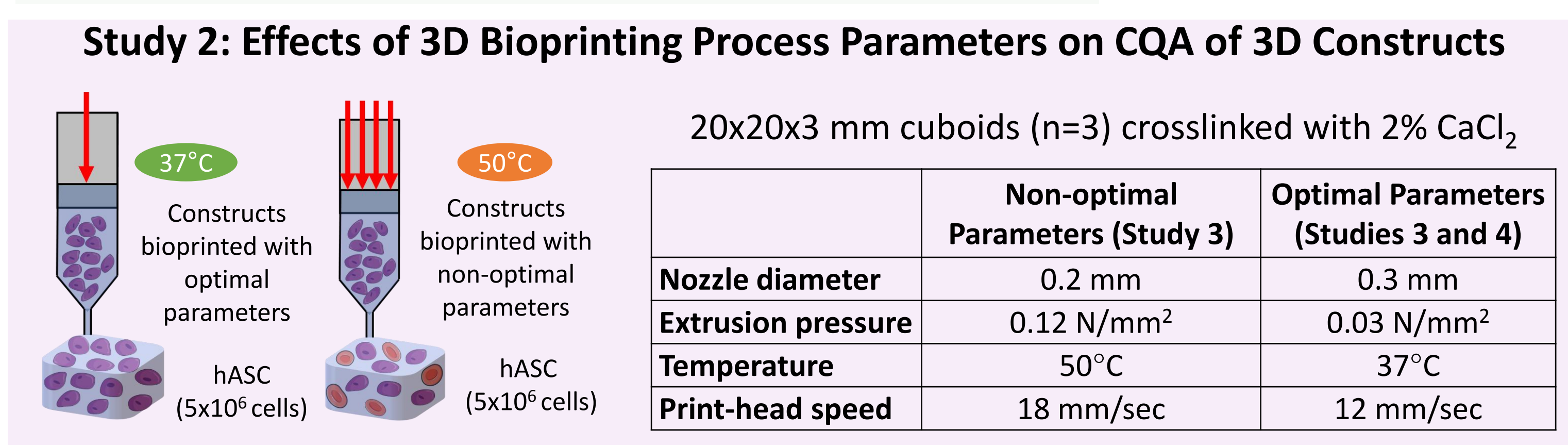
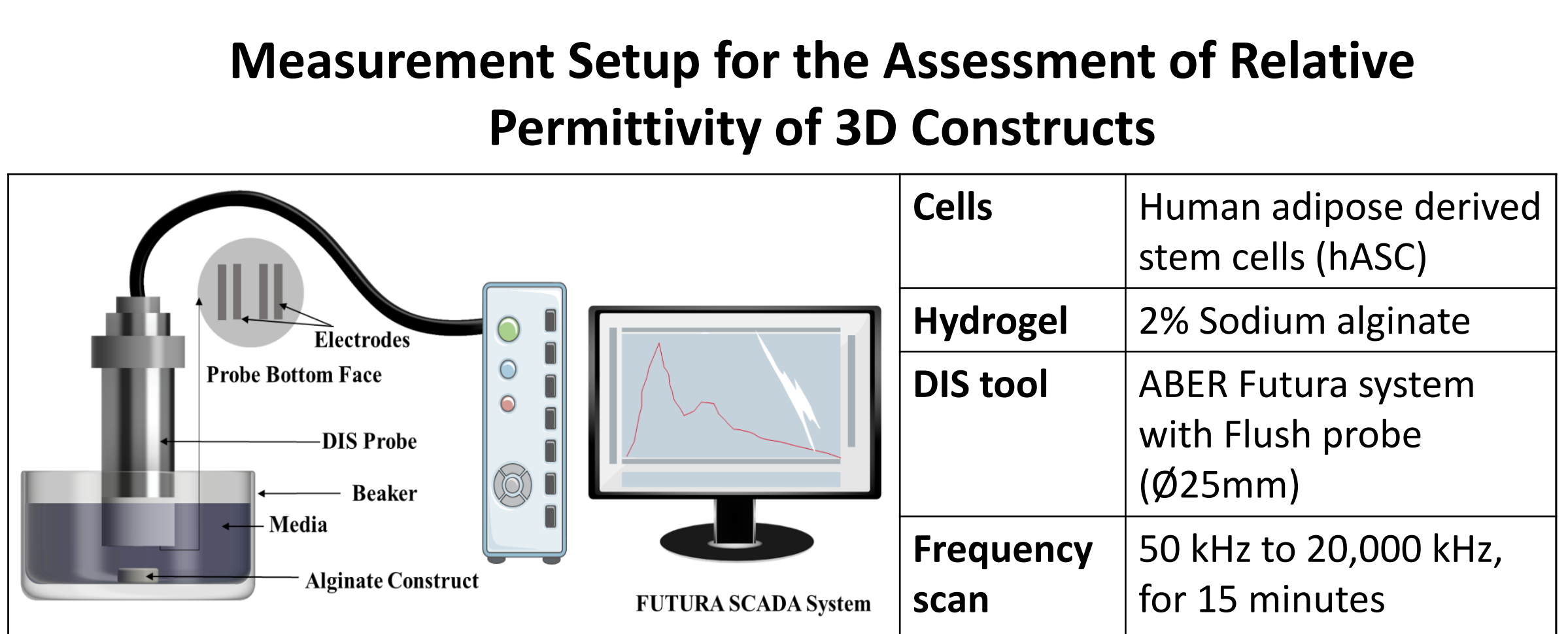
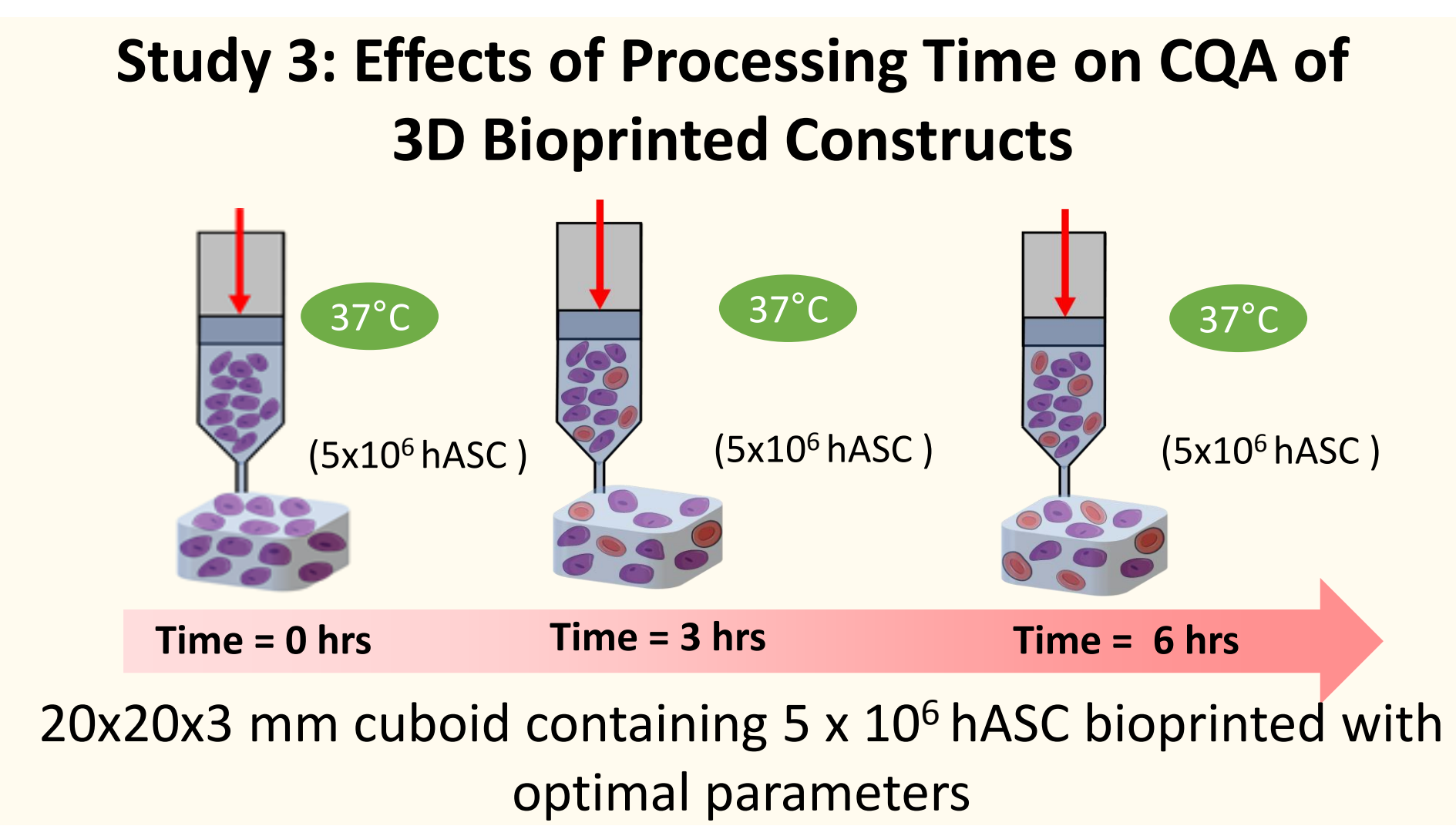
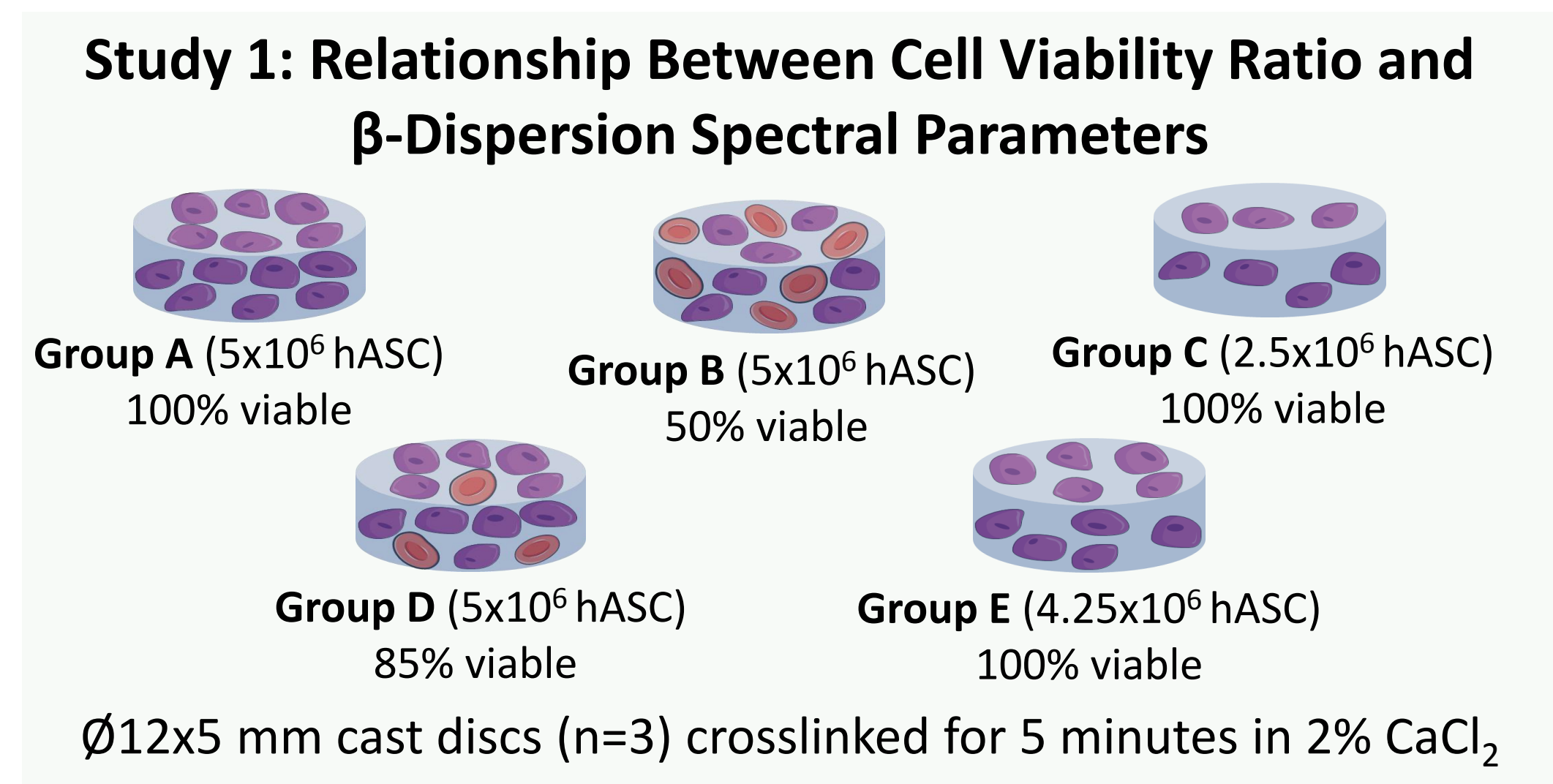


Cells with intact cell membranes will polarize. Cells with damaged cell membrane will not polarize.

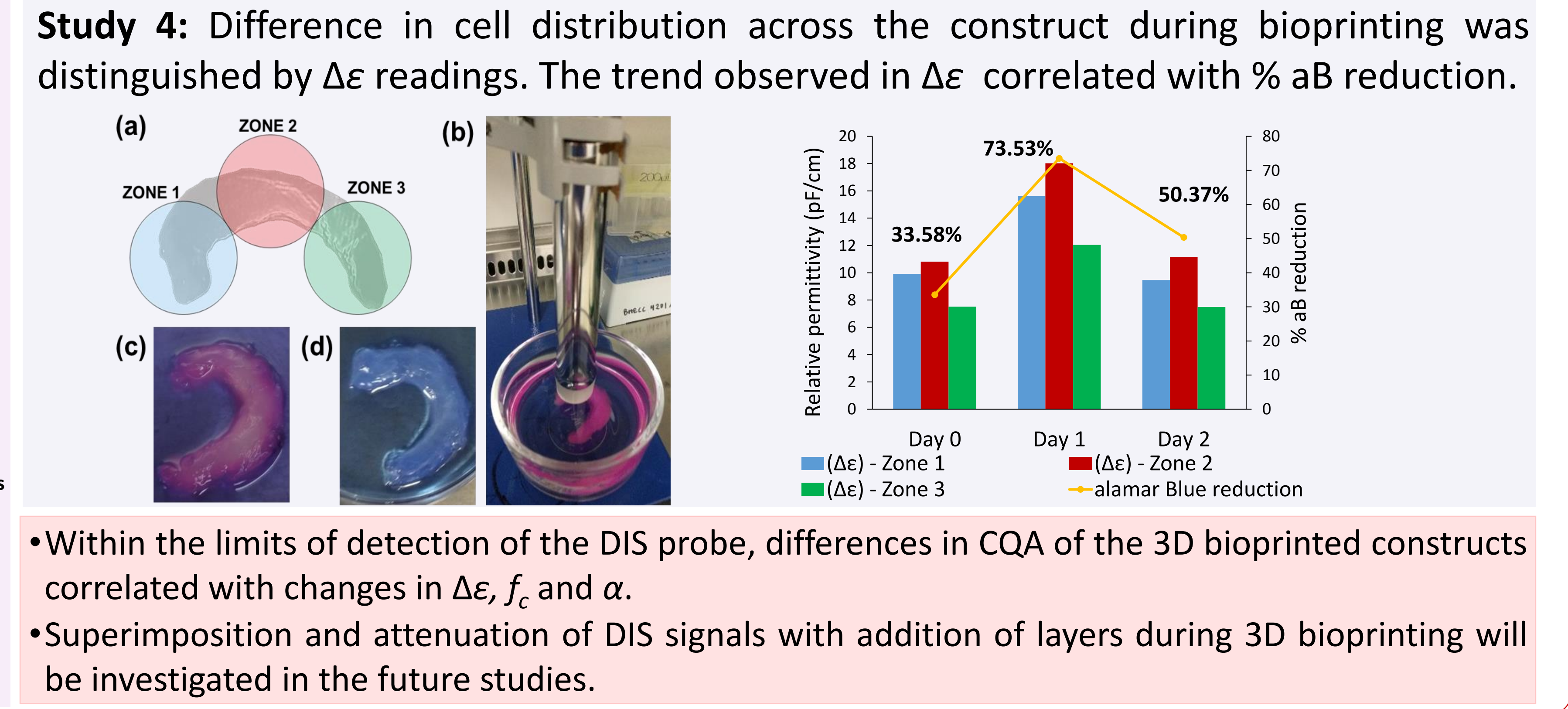
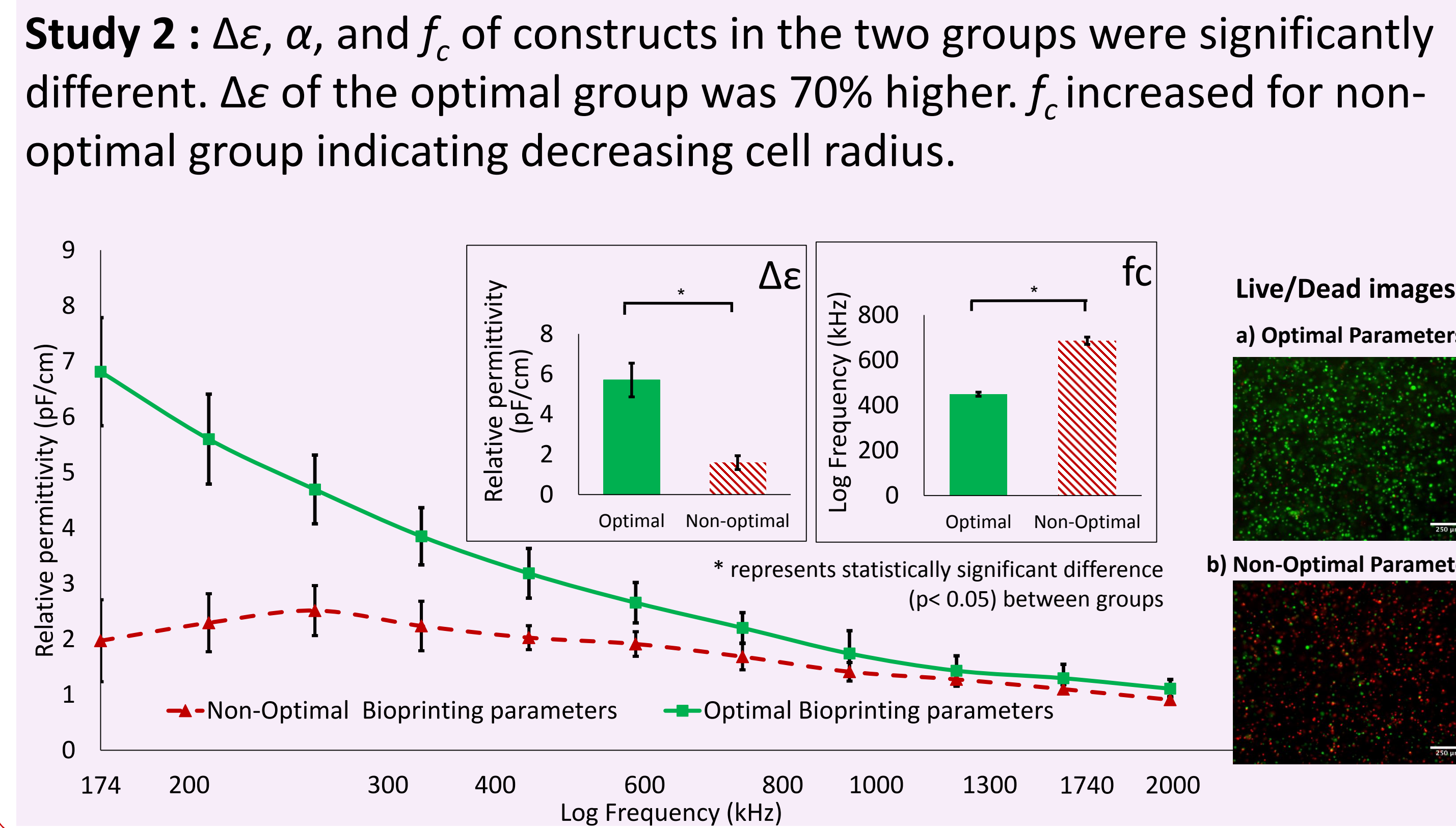
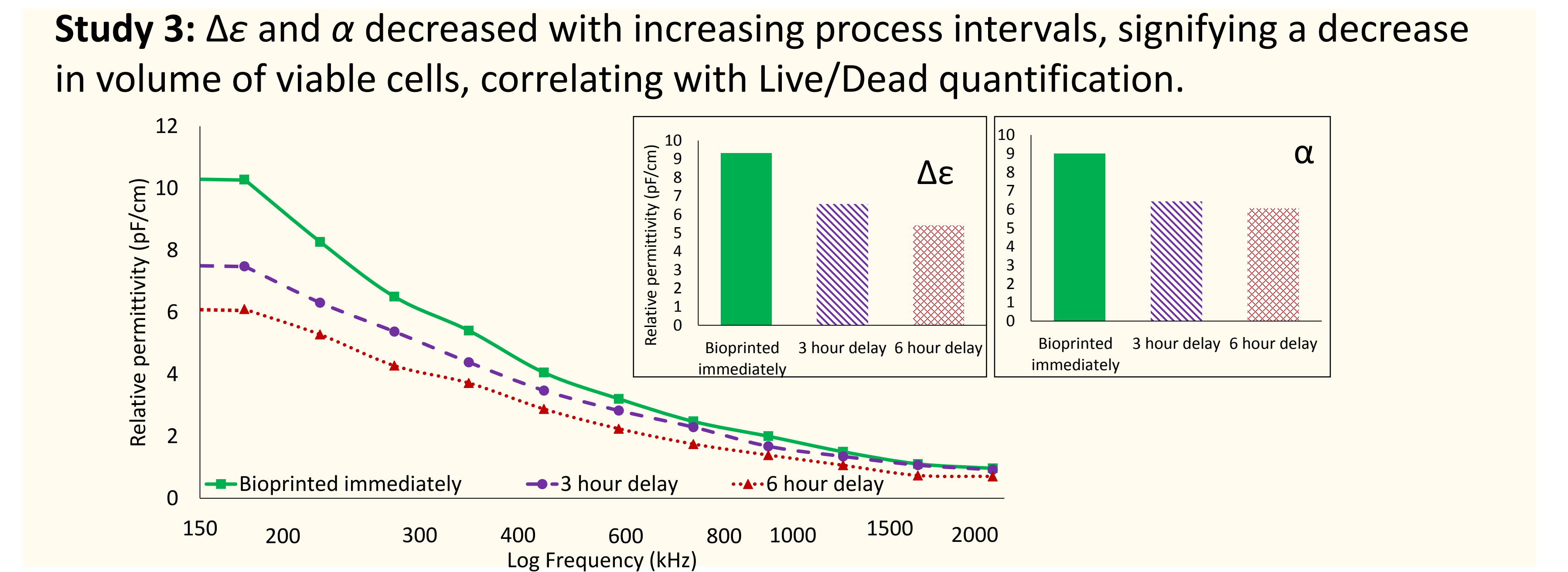
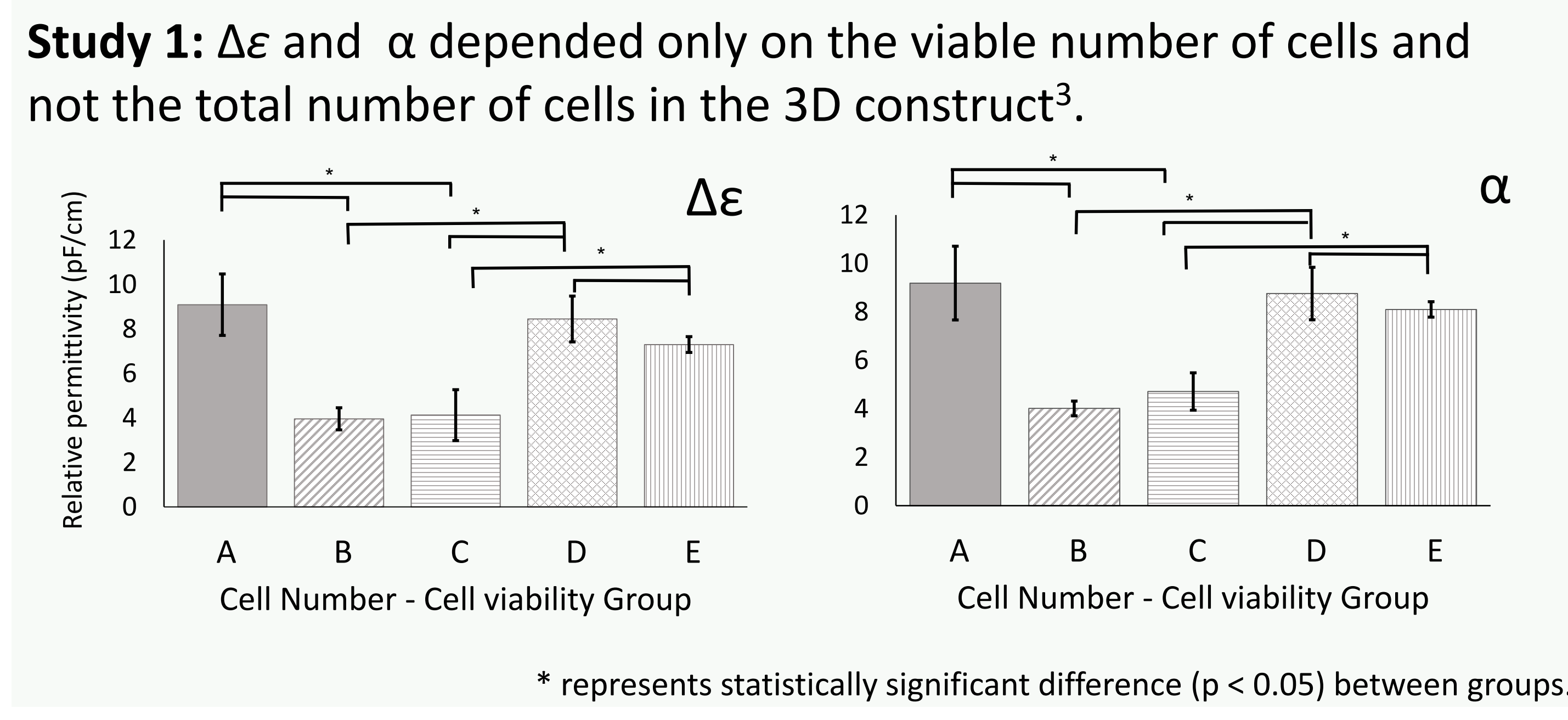


- Delta permittivity ($\Delta\epsilon$):** Difference between low-frequency high-plateau and high-frequency low-plateau and is the measure of volume of viable cell number.
- Critical frequency (f_c):** Mid-point of the curve and is a characteristic of the measured cell type.
- Cole-Cole-alpha (α):** Slope of the curve that is approximately related to the cell size distribution.

MATERIALS AND METHODS



RESULTS AND DISCUSSION



REFERENCES

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² K.H, J.D and M.T (2013): *Biosensors and Bioelectronics* 49 348-359.
³ L.K.N, T.L.T, A.B, B.S and R.A.S. (2017) *Proc. ASME-MSEC* 2017-2725

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