Abstract Submitted
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Frequency Dependent Regulation of Cell Behavior by Electrical Stimuli: a Theoretical-Experimental Approach[1] TOLOO TAGHIAN, University of Cincinnati, ABDUL SHEIKH, Yale University, University of Cincinnati, DARIA NARMONEVA, ANDREI KOGAN, University of Cincinnati — Ionic environment of extracellular matrix (ECM) and cell cytoplasm on both sides of the insulating cell membrane generates a trans-membrane electric field (EF) that has been shown to regulate cell functions. Therefore, application of external EF may provide a tool for alteration of this intrinsic EF to trigger desired cell responses. To achieve this, however, the induced EF distribution in the cell and the mechanisms for EF-cell interaction need to be known. We have developed a combined theoretical-experimental approach to predict and measure the cell responses to the external EF in a wide frequency range. The 3D theoretical model of cell interactions with EF in native configuration is based on numerical solutions of Maxwell's equations (ANSYS_HFSS) and provides high resolution distribution of induced EF in the cell membrane, cytoplasm and the extracellular space. The model predicts that cell response to the EF strongly depends on the EF frequency, which is consistent with our experimental results of endothelial cell activation by high (but not low) frequency EF. Further, the model suggests that the mechanism for such response may involve differential regulation of membrane-dependent and intracellular pathways in low vs. high frequency regimes.

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