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The Influence of Soft Layer Electrokinetics on Electroporation of Gram-positive Bacteria NAGA NEEHAR DINGARI, JEFFREY L. MORAN, PAULO A. GARCIA, CULLEN R. BUIE, Massachusetts Inst of Tech-MIT — Bacterial electroporation involves subjecting cells to intense (˜10 kV/cm) electric pulses, to open pores on the cell membrane for intracellular delivery of exogenous molecules. Its high efficiency in genetic transformation makes it an attractive tool for synthetic biology. While mammalian cell electroporation has received extensive theoretical and experimental investigation, bacterial electroporation has received markedly less attention. In this work, we develop a theoretical model of electroporation for gram-positive bacteria, taking into account the effect of the bacterial cell envelope on the cell's response to an electroporation pulse. We model the influence of the cell wall charge on the electrokinetic transport (and hence the pore properties) around the bacterial cell envelope using the Poisson-Nernst-Planck equations. Further, we account for the influence of the cell wall's mechanical elasticity on the pore radius evolution during electroporation, which is typically neglected in mammalian cell electroporation. This yields valuable information about favorable conditions for pore formation and will enable designing optimal platforms for bacteria electroporation.

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