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A Study of Carteria sp. Cell Electrical Lysis in Straight and Tapered Microfluidic Systems

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Electrical cell lysis is one of the most efficient techniques in cell analysis in extracting intracellular components for further use or examination. Cells are exposed to high electric field strength that can rupture cell membrane due to nano-size pores creation. Thanks to microfabrication technology, electrodes can be materialized in close proximity to each other leading to high electric field strength with low applied voltage. In this study, two microfluidic systems were designed: straight and tapered systems. The straight channel was chosen due to the ease of fabrication, while the tapered channel was picked since it intensifies electric field strength in the tapered area. Finite element method was used to simulate electric field distribution inside the microfluidic systems and transmembrane potential (TMP) across membrane. In the experiment, green algae *Carteria* sp. which contains large amount of lipid was used in performing microfluidic electrical cell lysis. For 30 nm thick gold planar electrodes with 110 μm spacing fabrication, the simulated TMPs produced in both microfluidic systems exceed 0.2 V which is a threshold potential cell membrane destruction when applying 34 V_{p-p}, 1000 Hz AC voltage. However, *Carteria* sp. cells were only successfully lysed in straight microfluidic system. Although electric field in tapered region is higher than that of the straight microfluidic system, the cells were rushed out of the tapered region due to electrohydrodynamic effects.

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