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(G*) Development of a Non-Contact Experimental Platform for Quantitative Migration and Electrotaxis Analysis of Biological Cells

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Cell migration is a fundamental process in various physiological scenarios such as cancer metastasis, wound healing, immune responses,and embryonic development. Among the environmental cues, physical factors especially the electric field (EF) have been widely demonstrated to guide the migration of various cell types. EF guided cell migration, termed 'electrotaxis', has been traditionally studied in vitro, using contact based direct current (DC) or alternating current (AC) EF by placing electrodes directly in the media. More recently non-contact AC EF guided electrotaxis has also been explored. Since DC EF is closer to physiological conditions, the availability of non-contact wireless DC EF guided electrotaxis will be highly valuable. In this study, we developed a customizable parallel plate capacitor based experimental platform that could facilitate the use of non-contact DC EF to guide cell migration.COMSOL Multiphysics modeling shows that our platform can generate a relatively uniform EF in the center region of the cell chamber. This uniformity is important as it allows for more consistency and reproducibility of the experimental results. The design of the parallel plate capacitor apparatus allows for complete customization during use, including the flexibility to adjust the distance between electrode plates, removable petri-dish holders, and seamless integration with an optical microscope for live cell imaging. The developed platform was validated with several cell types including human metastatic breast cancer cells and human peripheral blood immune cells. With the developed platform, interesting cell migratory behaviors were observed through various quantitative analyses of time-lapse cell migration image data.We have started to further explore the mechanism behind non-contact DC EF guided electrotaxis.

Keyword-1

Cell Migration

Keyword-2

Non-contact Electrotaxis

Keyword-3

Immunotrafficking

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