Biochip Electrical Tweezers for Handling Biological Cells (LY1-12)

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PROJECT OVERVIEW

The study of the human cell is a complicated process which, if made simpler, could lead to exponential advancements in finding medical solutions to the cell’s various abnormalities which lead to life altering physical disorders. We demonstrate here a DEP design for cell manipulation using chip based patch clamping. The design benefits from the microcapillaries present in the devices to act as DEP electrodes removing the needs of surface electrodes.

- Ion channels are cell membrane proteins that play an important role in the human physiology
- Channelopathies may lead to disorders such as cystic fibrosis, epilepsy and myotonia.

CHIP-BASED

- Chip-based approach removes the requirement of high skill level
- Has the potential to increase throughput
- Individual cells are captured at recording sites
- No mechanical suction needed to attract cells leads to reduced cell damage and better recording quality.

OUR APPROACH

- We demonstrate a dielectrophoresis (DEP) design to manipulate cell.
- DEP is a phenomenon in which a force is exerted on a dielectric particle when subjected to a non-uniform electric field.
- In our design, microcapillaries serve dual purpose as patch clamp recording sites and most importantly enhance the coupling of electric field in the main channel for a stronger DEP force.
- This design does not involve surface metal electrodes and also requires less voltage than prior techniques [3].

RESULTS

DEP was combined with other approaches e.g. oxygen plasma treatment to improve seal strength.

Best result was achieved by combining DEP, oxygen plasma and spin coating a layer of PDMS on the glass slide.

The final results were improved by over 400% from where we started.

CONCLUSION

It was successfully demonstrated that DEP can be used to attract biological cells and further automate the patch clamp technology. Also, the microcapillary has a dual purpose as the recording site and coupling electric field. This approach if pursued has promising potential for improvement.