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DC microelectrode array for cell investigation

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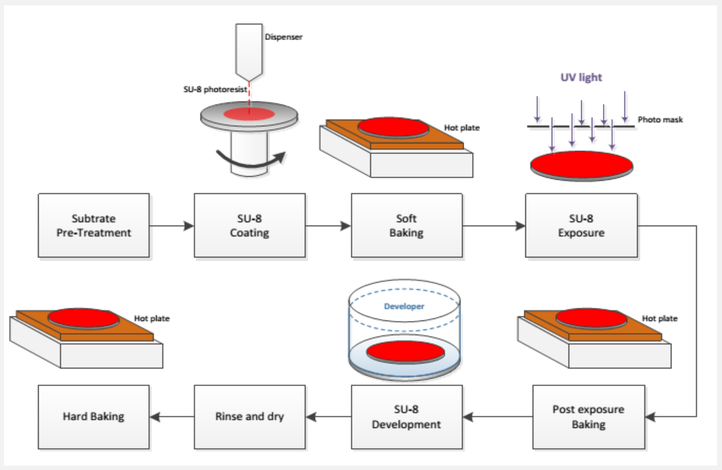
Abstract

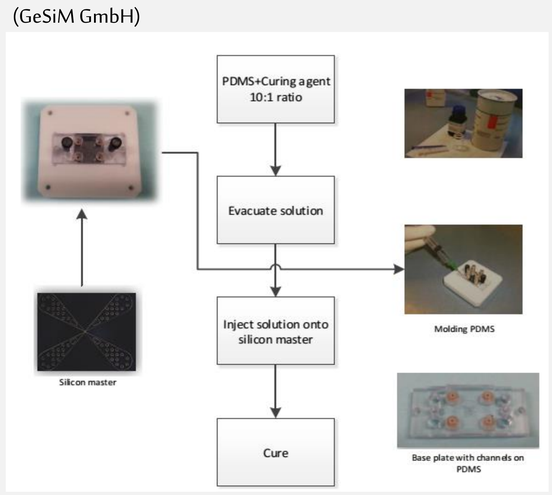
- Endogenous DC electric fields are known play a role in many cell biological phenomena, ranging from cell adhesion and migration, embryonic and tissue development to wound healing;
- Recent studies suggest that electrically sensitive cells lines are the rule and not the exception. However, the lack of understanding of these phenomena conditions mimicking and optimization;
- In this work, a microelectrode array enabling the use of DC current was designed. The first results shown the device is biocompatible;
- Future work will systematically investigate the effect of DC electric fields on 2D cultures of 661w murine photoreceptor-derived cells.

Microelectrode array fabrication

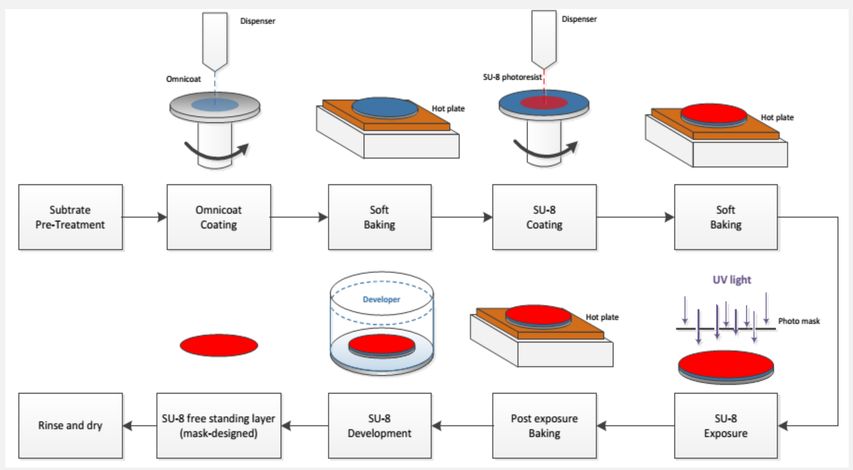
Step 1: Photolithographically patterned SU-8 master



Step 2: PDMS replica by soft lithography using the MicCell platform (GeSiM GmbH)

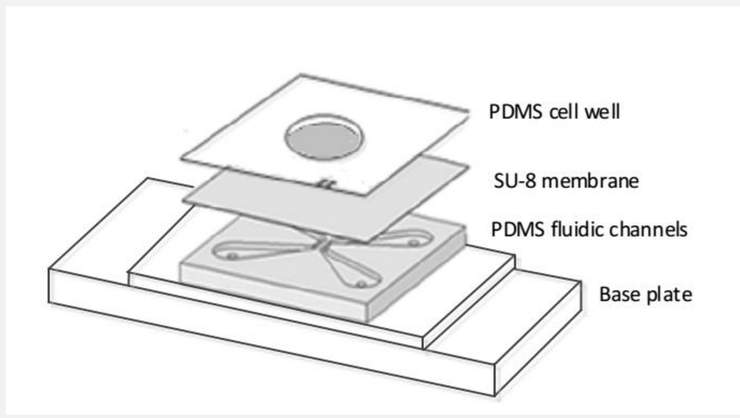


Step 3: Photolithographically patterned SU-8 free-standing layer



Step 4: Surface modification

Step 5: Multilayer integration



Results

The device's biocompatibility was first tested by accessing cell growth and adherence of the 661w cells on the (3-Aminopropyl)triethoxysilane (APTES) treated SU-8 membranes.

Retinal cell culture of murine 661W photoreceptor-derived cell were seeded with 8×10^4 concentration and allowed to grow for 48 hours. In order to access cell number and proliferation in the different as-treated and protein coated membranes, the DNA-intercalating fluorochromes, Hoechst 33342 and Hoechst 33258 were used. Cells were subsequently washed with PBS, dried, mounted with DABKO solution and immediatly imaged.

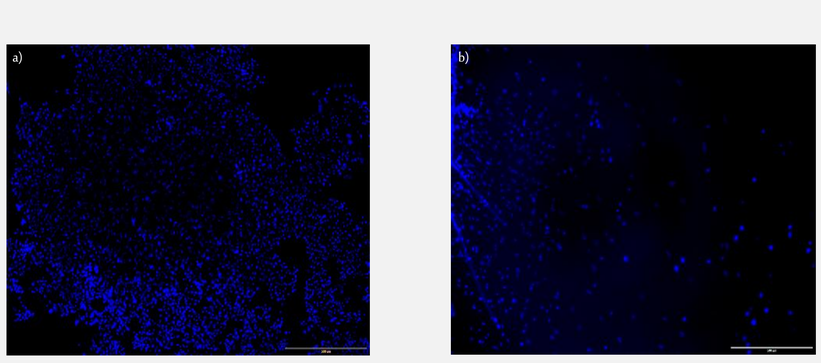


Figure 1: 661w stained with Hoechst growing on a) APTES-treated SU-8 membrane; b) APTES-treated SU-8 membrane + Fibronectin

The cultures of 661w cell showed to adhere and grow on the APTES-treated SU-8 membranes independently of the addition of the glycoprotein fibronectin.

Conclusions and Future Work

- In order to mimic the endogenous electric fields in vivo the presented DC MEA uses microfluidic channels to separate the electrodes from the cell surface
- The DC MEA uses multilayer integration to construct a platform that enables application of DC electric fields for cell investigation under an inverted microscope
- 661w cells showed good adhesion and growth on the APTES-treated SU-8 membranes
- The use of fibronectin to improve cell adhesion was showed unnecessary for APTES-treated SU-8 membranes
- DC electric field stimulation and recording under different conditions including addition of growth factores will be the next step

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