

# Polymer-Based Microstructures for Controlled 2D and 3D Cell Networks

Host Professor Pr. S. TAKEUCHI

**Keywords** Polymer structures, 2D/3D cell networks, immobilization, biosensors



Florian LARRAMENDY (IMTEK)



BiMEMS

**Context** The analysis of neuronal cells embedded in networks of controlled geometry has grown rapidly over the past decade and stays important for biological studies and medical research. The positioning of individual cells has become a key technique for cell engineering applications such as cell therapy and brain regeneration.

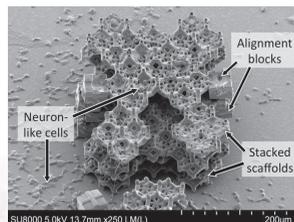


*Fig. 1. Optical micrograph of neuron-like PC-12 cells grown on micropillar arrays with neurites guided by laminin lines to form 'BIOHYBRID'.*

**Objectives & Methods** We developed different kinds of polymer-based microstructures for positioning and fixing cells in specific locations. Cells could develop extensions freely or with guidance, and create a network in two or three dimensions. Several approaches, based on various structures and polymers, have been investigated: mechanical constraint [1], high-topography surface functionalization [2] and stackable structures [3]. The long-term objective is to create a hybrid system (electronic and polymer-based structures) for biological and medical applications.

**Results** We successfully developed an innovative technique for patterning functionalization layers on substrates with high topography [2]. The technique

is based on the peel-off of a parylene layer deposited on a structured sacrificial photoresist. We have successfully demonstrated the guided growth of neuron-like PC12 cells on different patterns of cell-growth promoting proteins on micro-pillars, in microwells, and in-between, as shown in Figure 1. We are currently working on the approach for controlled 3D cell network [3]. The technique is based on stacking direct laser written structures, each structure containing cells. It was successfully demonstrated that neuron-like PC12 cells grow on such structures and establish cell-cell connections and that microstructures can be stacked, thanks alignment block, for creating 3D cell networks, as shown on Figure 2.



*Fig. 2. Scanning electron micrograph of 4 stacked structures containing cells after one day of culture, where cell-cell connections create 3D cell network.*

## References

- [1] F. Larramendy et al., J. Micromech. Microeng., 2015.
- [2] F. Larramendy et al., IEEE MEMS 2015.
- [3] F. Larramendy et al., IEEE Transducers. 2015.