

## Surface Modification by Fluorocarbon Plasma Deposition for Controlled Cell Growth and Neural Circuit Arrangement



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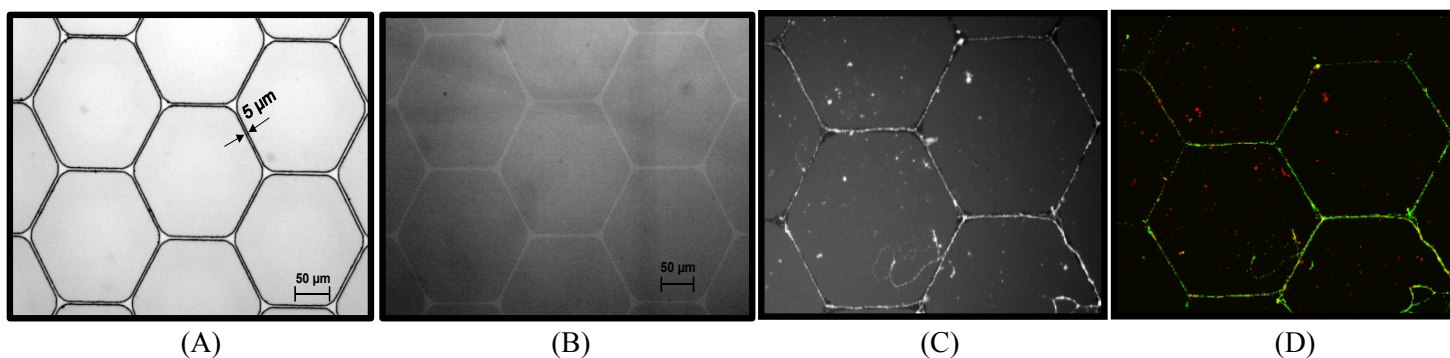
The incorporation of microfabrication methods with cell culture systems is presently of enormous interest in many fields of research, with potential applications in fundamental cell biology, cell-based biosensors, tissue engineering, and the modeling of cellular interactions.

A new method pioneered by our group has allowed one to prepare such pristine surfaces using devices designed by fabricating a patterned glass substrate that features a cytophobic (or cell repelling) surface, fluorocarbon polymers, with regions of cytophilic (cell attracting) channels. By patterning this polymeric surface, the underlying substrate is exposed, creating the channels for controlled cell growth and neural circuit arrangement. The fabrication of these devices is performed entirely in the Nanofabrication Facility at Western University. After preparation of the glass substrate, high resolution patterning is achieved through the use of photolithography. A thin film of positive photoresist is spin coated on the glass substrate, which is then exposed to UV light (Karl Suss MJB3) through a mask featuring hexagonal grids. The exposed photoresist is then developed, to reveal the patterned channels. (Figure A)

The next step is the deposition process of the polymer surface. The fluoropolymer film is the result of a modified process using an Alcatel 601E deep silicon etching machine, in which the etched level is removed, allowing for the deposition of the fluorocarbon passivation layer. After subsequent cleaning of the underlying photoresist channels, the surface is now comprised of the hydrophobic fluoropolymer surface, with channels in which the glass substrate is exposed. (Figure B)

The bioactivity of this method was then assessed through the growth of neurons on the surface. The neurons were shown to grow preferentially through channels, and tended to avoid the fluoropolymer surface, as desired (Figure C). Finally, as an application using these devices, the locations of the synapse communications between neurons were also identified by confocal fluorescence microscopy based on fluorescent labelling, proving that the neurons interact all over the circuitous map. (Figure D)

In conclusion, this approach would be very favourable for the study of neurotransmitters release of communicating neurons during a synapse event. It is noteworthy that all the instruments required for the fabrication of these cell micropatterning devices are available in the Nanofabrication Facility at Western University.



**Figure:** Optical image of: A) photoresist channels; B) channels within the polymer surface; C) neurons growing through channels; D) confocal image of neurons grown through channels.