Video Article

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Abstract

Protocol

The 8th issue of JoVE focuses on cell patterning and microfluidic technologies used in the production of numerous BioMEMS (Biological Microelectromechanical Systems) with applications ranging from high throughput drug screening to basic neuroscience.

Particularly prominent among the enabling technologies used to fabricate BioMEMS is soft lithography, which involves molding these miniature devices from the organic polymer polydimethylsiloxane (PDMS). The Folch lab at the University of Washington, Seattle [demonstrates the fabrication of a parallel mixer](#) – a microfluidic device allowing researchers to rapidly subject cells to varying concentrations of applied solutions using computer controlled microvalves made from a thin sheet of PDMS. The [process of production of Microfabricated Post-Array-Detectors](#) (mPADs) is described by the Chen lab at University of Pennsylvania who further apply this system to studies of mechanical forces at the single cell level measuring cellular contractility under serum stimulation.

Microfluidic devices provide a basis for development of new diagnostic instruments for HIV, cancer and other diseases where precise and cost-effective detection of rare cell types is highly important. The Toner lab at Massachusetts General Hospital demonstrates [the process of production of the microfluidic device](#) for capture and analysis of specific blood cell populations such as granulocytes. Application of this technology to [immunofluorescent analysis of CD4+ cells](#) is also shown by the Demirci lab (Brigham and Women's Hospital).

Cell patterning technologies facilitate development of new approaches to tissue engineering. The Demirci lab describes one such technology based on [cell encapsulation and ejection](#). Another is demonstrated by the Voldman lab (MIT) and allows [micro-manipulation of embryonic stem \(ES\) cell differentiation](#).

Currently the methods used to apply neurotransmitters to brain slices are restricted to globally applying them over an entire slice, which fails to mimic stimulation patterns typically evoked in vivo. The Eddington group of the University of Illinois, Chicago shares their [technique for constructing a prototypical Brain Slice Device](#), which will allow for precise spatiotemporal application of neurotransmitters to brain slices. Perhaps the most useful feature of this device is the fact that it can be integrated with standard perfusion chambers commonly employed in slice-recording methodology, which will allow for rapid implementation in electrophysiology labs. The Jeon Lab (UC Irvine) performs the procedure for [dissociating fetal rat cortex](#) and loading cortical neurons in a microfluidic device designed to fluidically isolate neuron soma and axons. The procedure for doing axotomy (or axon cutting) is also illustrated.

Basic protocols in this issue focus on broadly applicable techniques such as [immunohistochemistry on paraffin sections](#) and [laser capture microdissection](#) as well as fundamental techniques restricted to disciplines such as immunology and the [study of development in chicks](#).