MICROMACHINED CERAMIC PLATFORM FOR LIVING NEURONAL NETWORKS

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ABSTRACT

Unlocking the mechanism of neural growth and communication is needed for understanding and treatment of many degenerative diseases, as well as for neural prosthesis and restoration of damaged neural connections. Living neuronal networks enable a broad array of new methods for neural research. Additionally, the ability of neuronal networks to detect minute environmental perturbations makes them an attractive tool for chemical and biological sensing. However, producing reliable living neuronal networks is challenging, and requires a support substrate that facilitates reproducible control over neuronal growth and formation of synaptic junctions, enables high charge density/high-resolution neuronal contacts, and allows for overall biocompatibility and reproducibility. Substrates for growing and manipulating attached neurons that satisfy all of these requirements are not currently available.

In this talk we will present our recent results on the development of micromachined ceramic chips for guided growth of living neurons and their interfacing into functional networks. Our core method utilizes the synergy of several approaches: nanoscale engineering of the topology of self-organized nanoporous alumina, micromachining alumina ceramic to create patterns for guided neuronal growth, and utilization of arrays of nanoelectrodes to provide electrical contact to cultured neurons.

The described ceramic chips are being evaluated for growing living networks of neurons, tissue culturing, biosensing, bioanalysis and related bioengineering applications.

ACKNOWLEDGMENTS

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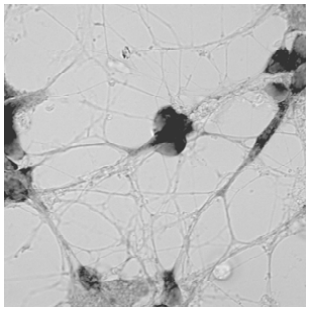

Figure 1. Neurons grown on nanoporous ceramic without polylysine matrix.

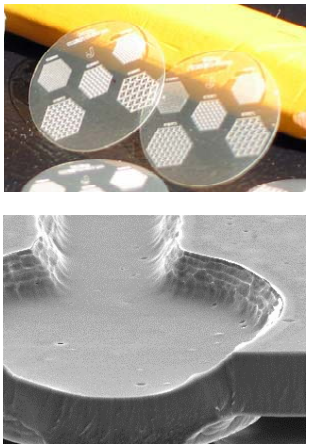

Figure 2. Ceramic chips with micromachined pattern for guiding the outgrowth of neurons.

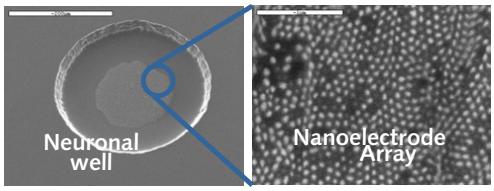

Figure 3. Neuronal well with integrated arrays of nanoelectrodes.