Introducing XonaChips®

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INNOVATIVE SYSTEMS FOR EXPERIMENTAL NEUROSCIENCE℠

XonaChips®

Abstract

Xona Microfluidics, Inc. has developed a new easy-to-use microfluidic chip to compartmentalize neurons and establish microenvironments, called the XonaChip®. XonaChips® are made out of an optically transparent plastic, cyclic olefin copolymer, which provide fully assembled chips that require few preparation steps, and result in excellent neuronal growth. Importantly, XonaChips® are compatible with high-resolution fluorescence imaging.

Introduction

Traditional neuron culture approaches result in random outgrowth of axons and dendrites, which prevent the study of neurons in their unique polarized morphology. Microfabricated multicompartment devices, pioneered by Xona scientists, have become well-established and well-used research tools for neuroscientists in the last 10-15 years (selected high profile publications are referenced [1-17]). These devices compartmentalize neurons and provide a method to physically and chemically manipulate subcellular regions of neurons, including somata, dendrites, axons, and synapses [19-20]. They also provide multiple experimental paradigms that are not possible using random cultures, including studies of axonal transport, axonal protein synthesis, axon injury/regeneration, and axon-to-soma signaling.

To provide an easy-to-use and fully assembled device, Xona has now developed plastic XonaChips® **(Fig. 1)**[18]. The interior of the XonaChips® is made permanently hydrophilic, simplifying device wetting. Further, these chips are fabricated in an optically transparent plastic, cyclic olefin copolymer, ideally suited for high resolution imaging.

Methods

XonaChips® were prepared according to our protocol published online https:/xonamicrofluidics.com/protocols. XC Pre-Coat™ was first used to ensure even wetting of the chip. XC Pre-Coat™ is included with each XonaChip® order. The chip was then coated with XonaPDL™, which includes the optimal concentration of poly-D-lysine for Xona's devices. The chip was washed multiple times with PBS and then filled with neuronal culture media.

E18 Hippocampal Rat Neurons were dissociated and prepared for loading into the XonaChip® as described in the protocol. Approximately 120,000 neurons were seeded into the right compartment of the XonaChip®.

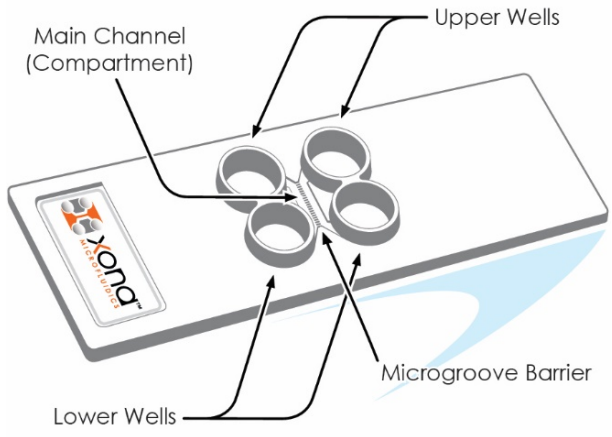

Fig. 1. Schematic representation of the XonaChip® showing the locations of the upper and lower wells, main channels (or compartments), and the microgroove barrier separating the two compartments.

Images were acquired with a laser scanning confocal microscope using a 30x/1.05 N.A. silicone oil (ne = 1.406) objective lens.

Results & Discussion

To evaluate the performance of the XonaChip®, researchers at the University of Carolina at Chapel Hill grew rat hippocampal neurons within the chip for 21 days. As illustrated, axons are healthy and isolated within the axonal compartment **(Fig. 2).**

To demonstrate the ability to create isolated microenvironments, researchers added a low molecular weight fluorescent dye (Alexa Fluor 488 hydrazide) to the axonal compartment. The dye stayed isolated to the axonal compartment consistent with Xona's silicone devices[17].

Researchers at UNC-Chapel Hill also evaluated high-resolution live imaging within the XonaChip®. The XonaChip® consists of a molded COC top bonded to a thin optically transparent 150 µm thick COC film. All excitation wavelengths tested (405, 488, 568, 647 nm) resulted in comparable results to images acquired in SND series devices attached to glass coverslips (data not shown). Because of the high quality of COC production, there is no autofluorescence of the material.

Fig. 2 demonstrates the high image quality. A variety of objectives have been tested from 10x to 60x silicone oil. In all cases, results were comparable to glass coverslips.

Conclusion

In summary, the XonaChip® is a fully assembled multicompartment device that is easy to use and results in healthy, long-lasting cultures. These chips allow microenvironments to be established as with our SND series devices and are equally compatible with high-resolution fluorescence microscopy.

About Xona Microfluidics, Inc.

Xona Microfluidics, Inc. is a North Carolina corporation located in Research Triangle Park, North Carolina. More information can be found at xonamicrofluidics.com.

If you are interested in testing a XonaChip® contact us at info@xona.us

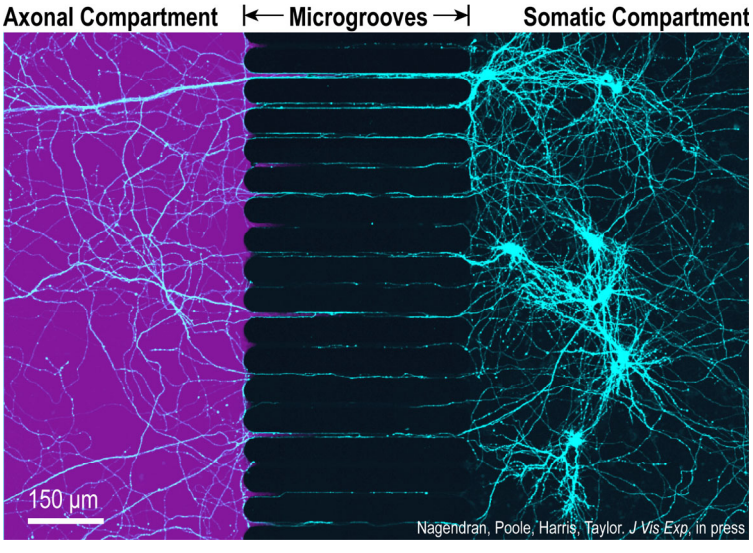

Fig. 2. Fluorescently labeled neurons extend axons into a fluidically isolated axonal compartment within the XonaChip®. A merged fluorescence micrograph showing live retrograde labeled neurons infected with a modified mCherry rabies virus (pseudocolored cyan). Neurons were imaged 3 days post-infection at 21 days in culture. Fluidic isolation of the axonal compartment is demonstrated by application of a low molecular weight dye, Alexa Fluor 488 hydrazide (pseudocolored magenta).[18]

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