**Multiwell MEA Technology**

Why use microelectrode arrays?

- Microelectrode array technology offers a platform for directly connecting key biological variables, such as gene expression or channel currents, to measures of cellular and network function.

- A planar grid of microelectrodes at interfaces with electro-active cultured cells (b); modeling complex, human systems in a dish. The electrodes detect changes in raw voltage (c) caused by the electrical activity of nearby neurons or cardiomyocytes.

Raw Voltage

Extracellular Action Potentials

Network Activity

Raw voltage signals can be processed in real time to obtain extracellular action potentials from across the network, providing valuable electrophysiological phenotypes for applications in drug discovery, toxicology, and safety screening, disease models, and stem cell characterization.

**Lumos: 48-well Optogenetic Stimulation**

Why use optogenetics?

- Optogenetics is the integration of fast, light-activated channels (opsins) that allow targeted, precise manipulation of cellular activity. Upon incident light of the correct wavelength, the opsins produce currents that directly hyperpolarize or depolarize the cell.

- Bi-directional control enables activation and suppression of neural cultures.

- Genetic targeting allows cell-type specificity when stimulating complex networks.

- Control intracellular signaling or gene expression to enhance development of disease-in-vivo models.

- Optical stimulation eliminates artifacts, simplifying the analysis process.

- Establish well-to-well consistency for more reliable results.

- Scalable optical solution introduces optogenetic applications to new levels of throughput.

Lumos

Lumos is the first commercial multiwell light delivery device designed for optogenetics. It integrates seamlessly with the Maestro and AxIS, allowing an array of features:

- Increased throughput – 152 LEDs across 48 wells.

- Maximal intensity – high power LEDs couple with optimized plate materials and custom plate lid optics for unmatched intensity and reliability.

- Use any opsin – wavelength options cover 460-670nm, with 4 wavelengths per well, allowing the use of any opsin and multiple wavelengths per well.

- Fully configurable in AxIS Stimulation Studio, with precise temporal and adjustable intensity for each LED – independently and simultaneously.

- Label-free and non-invasive recording of extracellular voltage from cultured neurons on Axion MEA plates.

- Environment controlled provides a stable benchtop environment for short- and long-term toxicity studies.

- Fast data collection rate (12.5 KHz) accurately quantifies the magnitude of depolarization events.

- Sensitive voltage resolution detects subtle extracellular action potential events.

- Industry-leading array density provides high spatial clarity through the integration of information from multiple locations in the culture.

- Scalable format (12-, 48- and 96-well plates) meets all throughput needs on a single system.

**Applications in Screening**

Getting Started

The following simple steps may be used achieve optically-evolved activity in vitro:

1. Obtain viral vector encoding desired opsin
2. Add viral vector directly to hESC-derived or cryopreserved cardiac cells, or to a vial of freshly harvested cells
3. Wait 7-12 days for expression
4. Evaluate optically-driven functional activity

Control Cardiac Beating

Cardiac repolarization is intrinsically linked to the beating frequency, both of which are sensitive to pharmacological manipulation. Optogenetic stimulation can be used to control the beating frequency and remove its influence on the physiology, resulting in increased reliability and sensitivity of the repolarization measurement.

Quantity Arrhythmic Risk

Arrhythmogenic indicators, like DADs (arrows), are also sensitive in the beating frequency of cardiomyocyte networks. Optogenetic stimulation can be used to control emergent arrhythmic events or more precisely quantify cardiac arrhythmia.

**Conclusions**

- The Maestro multiwell MEA platform connects key biological variables to cellular and network function by extracting information from complex biological systems in vitro.

- Optogenetics enables cells to be controlled by light, offering the opportunity to precisely control or manipulate complex, in vitro cell models.

- Lumos, the first commercial optogenetic stimulation device, enables high throughput optogenetics with unprecedented control over light delivery in a easy-to-use format.

- Together, the Lumos and Maestro improve the reliability and sensitivity of existing assay screens, while simultaneously enabling new directions in high throughput network electrophysiology.

**Figures**

- [Image of multiwell optogenetic stimulation device](https://example.com/image1)
- [Diagram showing electrophysiological activity](https://example.com/image2)
- [Graph showing improved reliability and sensitivity](https://example.com/image3)