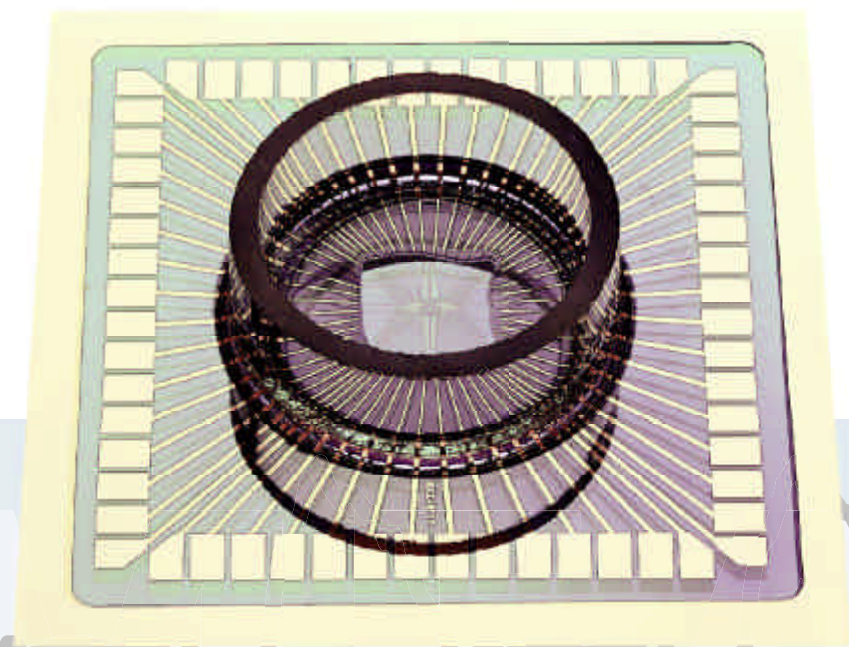


Microelectrode Arrays for all Applications



Advantages

*** Multi-site recording with microelectrode arrays**

- Examine the activities of a complex system in whole cells and tissues
- Study the interaction of several cells in a culture or in their natural tissue environment
- Cultivate cell cultures or slices for several weeks or even months (long-term studies)
- Integrated temperature controls for MEA amplifier and perfusion cannula
- Increase your throughput and achieve a better comparison of activities under similar experimental conditions
- Record single unit activities from several cells in parallel
- Analyze compound action potentials of several cells and tissues (local field potentials)
- Study the spatio-temporal pattern of responses in a neuronal network or slice; use a new class of information in a two-dimensional setup
- Create spatial maps of responses and drug effects that can be related to anatomical properties of the tissue and that will provide you with deeper insights into the specificity of a drug

*** Perfect for various biological preparations and applications**

- Acute preparations and cultures from brain, heart and all other excitable celltypes like:
 - Hippocampus
 - Cerebellum
 - Neocortex
 - Spinal cord
 - Dissociated Cell Cultures (cortex, spinal cord, SCN etc.)
 - Retina
 - Cardiac myocytes
 - Heart tissues
 - Whole-heart preparations
- Paired-pulse facilitation (PPF)
- Long-term potentiation (LTP)
- Long-term depression (LTD)
- Chronobiology
- Neuronal regeneration
- Visual perception
- Ion channel screening
- Drug testing
- Safety pharmacology studies
- Microelectroencephalograms (EEG)
- Microelectroretinograms (ERG)
- and many more

MEA



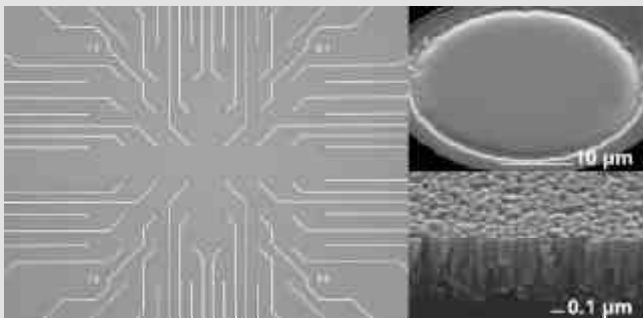
Extracellular recording with microelectrode arrays

A microelectrode array (MEA) is an arrangement of several (typically 60) electrodes in a square recording area of only 700 μm up to 5 mm. An MEA allows the target-ing of several sites for stimulation and extracellular recording of electrically active cells (single cells, neuronal, muscle, or cardiac tissue) simultaneously. Multi Channel Systems MCS GmbH provides not only a complete plug-and-play recording system with high-end technology amplifiers, stimulus generators, data acquisition computer, as well as recording and analysis software, but also microelectrode arrays of outstanding quality. Special geometries for a wide variety of applications available.



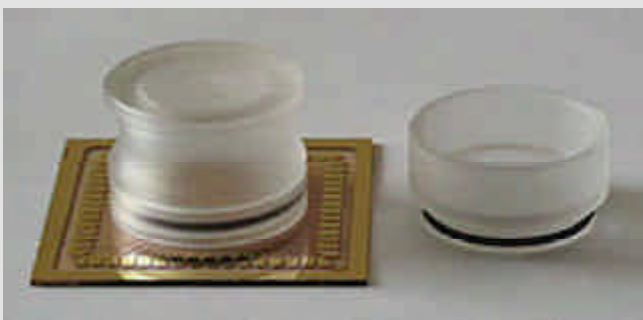
Best expertise in thin-layer and microtechnology

Multi Channel Systems supplies the widest product range and the highest spatial resolution in MEA technology worldwide. The Natural and Medical Sciences Institute (NMI Reutlingen, Germany, www.nmi.de), with which Multi Channel Systems has collaborated in many projects and over many years, manufactures the MEAs and fulfills the highest standards in the production process.



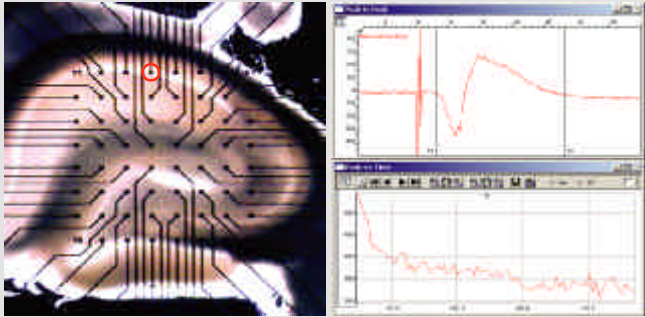
Highest spatial resolution in the market

Electrodes with a diameter of only 10 μm are arranged in a distance of only 30 μm (center to center). This new design demands a high qualification and very good expertise in thin-layer and microtechnology. The challenge of manufacturing very small electrodes and at the same time keeping the impedance and the noise level down has been met by introducing a new electrode material: titanium nitride (TiN). Microfold structures result in a large surface area that allows the formation of electrodes with an excellent signal to noise ratio without compromising on the spatial resolution. The average noise level of 30 μm and 10 μm electrodes is less than 10 μV and 15 μV peak to peak, respectively. TiN is also a very sturdy material that guarantees a long lifetime of the MEA for long-time recordings and multiple reuse.



Widest and best choice for all applications

All MEA electrodes can also be used for stimulation. TiN microelectrodes show a high charge-injection capacity, which describes the limit of an electrode to be charged by an electrical pulse without leading to damaged electrodes or gas production due to electrolysis. The broad range of applications is reflected by the variety of MEAs with different geometries that have been developed as close to the application as possible. The biological sample is cultured directly on the MEA. You can record without needing an incubator, because temperature controls are integrated into the amplifier and the perfusion cannula. You have several options regarding the culture chamber, such as a semi-permeable seal that guarantees stable environmental conditions.

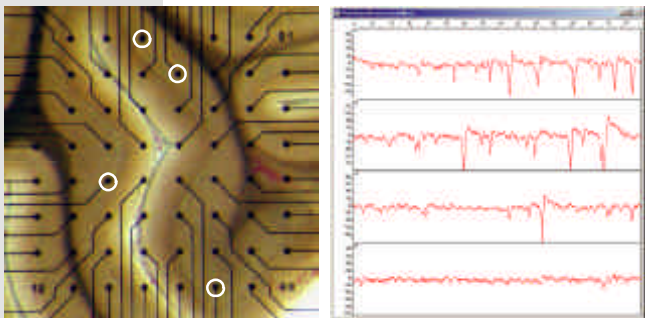


Kindly provided by Dr. M. Fejtl, Multi Channel Systems MCS GmbH

Acute brain slices, for example from the hippocampus

* Place an acute slice, such as from the hippocampus, on the electrode field and immediately start the recording and stimulation; see example of long term potentiation (LTP): The response to the test stimulus shortly after the theta burst stimulation (TBS) in the top picture; the behavior of the peak-to-peak amplitude over time in the bottom picture. You see that the response that was increased after the TBS goes slowly back to the normal level.

* Simultaneously record all subfields (CA1, CA3, DG)

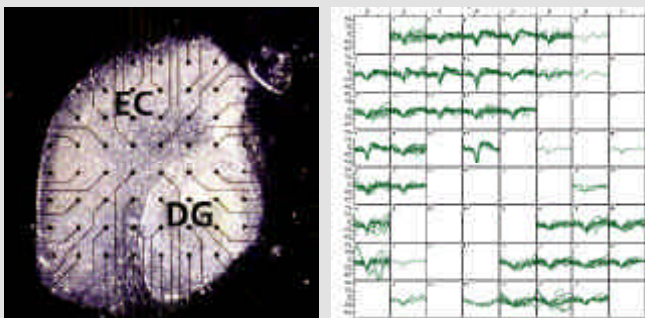


Kindly provided by Dr. U. Egert, University of Freiburg, Germany

Acute slices from the cerebellum

* Similarly, you can study acute slices from the cerebellum, for example for drug screening: The pictures show typical signals from four selected electrodes (marked with a white circle). Any standard MEA, for example with a medium spatial resolution (200/30), can be used for acute slices

* You can also use 3-D MEAs with protruding electrodes developed and manufactured by Ayanda Biosystems SA, Lausanne, Switzerland. The platinum electrodes of a 3-D MEA are about 50 μm high and end in a fine small tip. This is considered to be ideal for penetrating damaged cell layers and contacting healthy cells above.



Kindly provided by Dr. F. Hoffmann, NMI Reutlingen

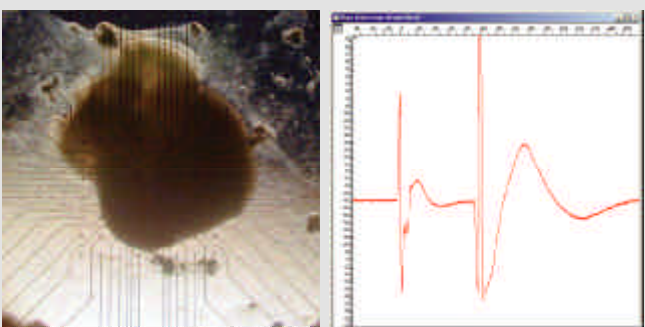
Organotypic cultures and cocultures

* Culture organotypic slices for several weeks or even months directly on the MEA: The example shows a coculture of the rat dentate gyrus (DG) and the entorhinal cortex (EC) and an overlay plot of the spike cutouts of the two regions for studying neuroregeneration

* Study the functional connectivity and interaction of cocultures, neural networks, organization and reorganization of organs in pathophysiological processes

* Standard MEAs with a lower spatial resolution (500/30), which have a larger recording field are well suited for this application

* HighDenseMEAs with a double recording field of 5 x 6 electrodes each provide an ideal geometry for positioning one slice on each electrode field and study the tissue interaction in the coculture. With an extraordinary low electrode spacing of only 30 μm !



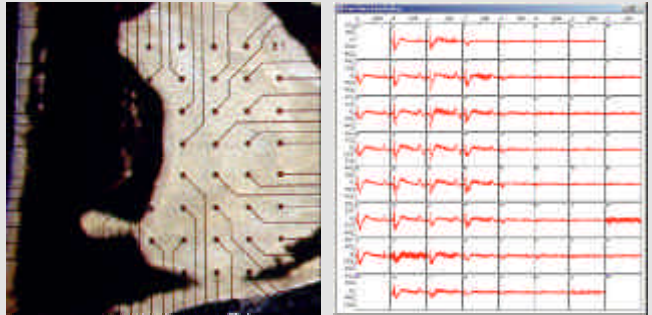
Kindly provided by Dr. Th. Meyer, Multi Channel Systems MCS GmbH

Cardiomyocyte or whole-heart studies

* Study the pacemaker activity and the temporal and spatial propagation of signals with extracellular recording from myocyte cultures, acute heart slices, and whole-heart preparations (for example from chicken, see picture). You can see a representative field potential with atrial and ventricular waveforms.

* Standard MEAs with a medium spatial resolution (200/30) are ideal for this application

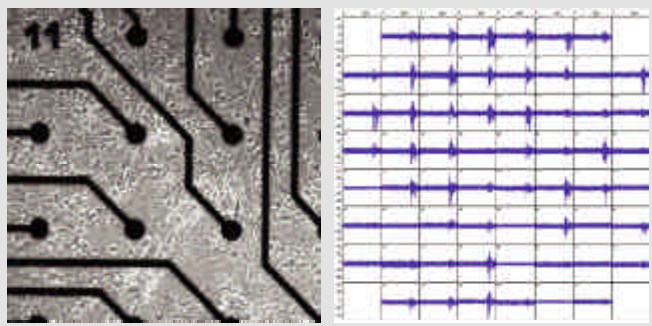
* Increase your throughput of screenings for arrhythmogenic effects of compounds: EcoMEAs provide an excellent signal to noise ratio and minimize costs. Custom electrode grids according to your personal specifications possible at competitive prices.



Kindly provided by Dr. T. Herrmann, NMI Reutlingen, Germany

Drug screening with microelectroretinograms (ERGs)

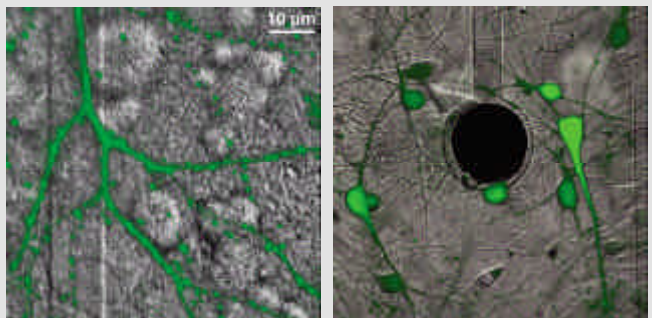
- * The picture shows multifocal microERGs from an explanted chicken retina: You can see typical sum potentials as a response to a full-field light stimulus. The largest amplitudes can be recorded from the pigment epithelium (appears black in the retina slice).
- * Recommended for light-sensitive cells and tissues are all standard MEAs, HighDenseMEAs, ThinMEAs, and HexaMEAs with transparent ITO tracks



Kindly provided by W. Fleischer, University of Düsseldorf, Germany

Single cell studies and circadian rhythm

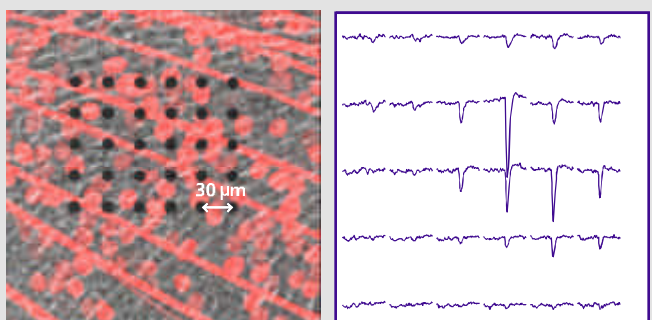
- * The example shows the spontaneous electrical activity of cryopreserved Rat Brain Cortex cells from QBM Cell Science after 35 days in culture
- * Any standard MEA can be used: Choose between various electrode field geometries and spatial resolutions, transparent tracks, internal reference, and other options to meet the requirements of your experiment
- * Study cell interactions and their responses to stimuli
- * Record from multiple cells at once and sort the signals into single cell units
- * Study cellular pacemakers by long-term recordings of supra-chiasmatic nucleus (SCN) neurons in culture



Kindly provided by A. Minerbi and N. Ziv, Technion Faculty of Medicine, Haifa, Israel

High resolution imaging

- * On the left, you see an overlay of a fluorescence image and a Differential Interference Contrast (DIC) image of rat cortical neurons. The expression of GFP-tagged postsynaptic density protein PSD-95 was induced in a small number of neurons.
- * On the right, you see cortical neurons expressing GFP and one of the 60 electrodes.
- * The high resolution of these images was made possible by the thinness (180 μm !) of the ThinMEA glass that allows the use of oil immersion objectives and high numerical aperture.
- * Transparent conductive tracks
- * Mounted on a robust ceramic support

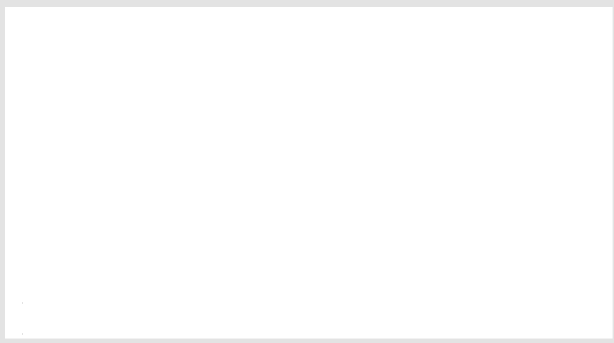


Kindly provided by Dr. R. Segev, Princeton University, New Jersey, USA

Multitrode analysis

- * The retina in the picture was stained by rhodamine dextran. You can see both the axons radiating from the optic nerve and the ganglion cells' soma.
- * The very high electrode density of the two recording fields on a HighDenseMEA is only possible by the special TiN electrode material and production process - unmatched in the market
- * Perfect for multitrode analysis: The activity of a single neuron is picked up by more than one electrode due to the low electrode spacing. As the distances of the electrodes to the electrically active cell are slightly different, the waveforms recorded by separate electrodes are different, too. This information is used in a multitrode analysis for identifying and separating single unit spikes.

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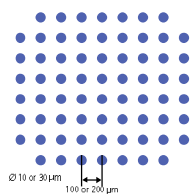
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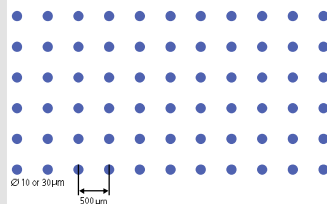
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Product name	Electrode grid	Total # of electrodes	Substrate-integrated reference electrode (i. r.)	Electrode spacing	Electrode diameter \varnothing	ITO tracks option	Culture chamber interface options**			
							without ring	glass ring	plastic ring without thread	plastic ring with thread
Standard MEAs: TiN electrodes, SiN isolator, opaque (Ti) or transparent (ITO) contact pads and tracks										
100/10	8 x 8	60		100	10	○	○	○	○	○
200/10 (i. r.)	8 x 8	60	○	200	10	○	○	○	○	○
200/30 (i. r.)	8 x 8	60	○	200	30	○	○	○	○	○
200/30 (incl. 8 stim. el.*)	8 x 8	60		200	30	○	○	○	○	○
500/10 i. r.	6 x 10	60	●	500	10	○	○	○	○	○
500/30 i. r.	6 x 10	60	●	500	30	○	○	○	○	○
HighResMEAs: Double recording field (500 μm in-between fields) TiN electrodes, SiN isolator, transparent (ITO) contact pads and tracks										
HighResMEA 30/10	2 x (5x6)	60		30	10	●	○	○	○	○
HexaMEAs: TiN electrodes, SiN isolator, opaque (Ti) or transparent (ITO) contact pads and tracks										
Hexa (10, 20, 30)	Hexagonal layout	60		30, 60, 90	10, 20, 30	○	○	○	○	○
ThinMEAs: 180 μm thin recording field, TiN electrodes, SiN isolator, transparent (ITO) contact pads and tracks										
ThinMEA 100/10	8 x 8	60		100	10	●	○	○	○	○
ThinMEA 200/30 i. r.	8 x 8	60	●	200	30	●	○	○	○	○
3-D MEAs: 3-dimensional Pt electrodes (height 50–70 μm) with fine tip, SU-8 isolator, Au contact pads and Pt tracks										
3-D MEA	8 x 8	60		200	40 (base)			●		
EcoMEAs: Gold electrodes, contact pads and tracks										
EcoMEA (i. r.)	8 x 8	60	○	700	100		○	○	○	○
FlexMEAs: Flexible base material (polyimide), TiN electrodes, gold contact pads and tracks										
FlexMEA 36 i. r.	6 x 6	36	●	300	30					

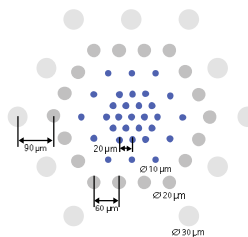
○ = optionally, ● = fixed, * = including 4 pairs of large stimulation electrodes (70 μ m x 250 μ m), ** = Sealed MEA culture dish with semipermeable membrane available for glass rings, MEA culture chamber with removable lid available for plastic rings with thread



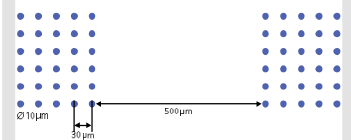
Standard MEA 8x8



Standard MEA 6x10



HexaMEA



HighDenseMEA