New-generation MEA technology: improving the interface to physiological function

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Since its introduction 30 years ago, the MEA (microelectrode array) technology and the related culture methods for electrophysiological cell and tissue assays have been permanently improved and have found its way into many academic and industrial laboratories. Currently, increased interest is brought to it by the industrial need to screen thousands of compounds against ion channel targets in their native environment at organic, cellular and sub-cellular level. The talk will give an overview on available MEA solutions for specific applications and the road-map for the future development.

For specific needs novel solutions are now available or will rolled out shortly:

- MEAs with thin glass substrate allows for combining electrophysiological and optical recording techniques for high-content measurements at cellular and sub-cellular level
- Flexible and perforated MEAs allows for sandwich-like configurations for the combination of multi-site stimulation and multi-channel recording in tissue slices and the adaptation of the curvature of the substrate to anatomical structures in vivo
- Special electrode designs and materials enables single-cell recordings with high signal/noise ratio
- Improved fabrication methods will provide low-cost MEAs

For future applications the development of sophisticated solutions have been brought onto the road:

- smart single-cell contacts: improved electrode designs and materials as well as cellular engineering will enable stable single-cell contacts that allow the recording of slow voltage- and ligand-gated ion currents through specific ion channels
- smart arrays: arrays with a high number and a high density of microelectrodes will allow 1) the parallel recording from many dissociated cells without the need for controlling the settling-down of cells on the electrodes by means of surface patterning and 2) the mapping and analysis of neuronal activity in brain slices with high spatial and temporal resolution
- smart stimulation and recording hardware: improved electronic circuits will provide artifact-reduced simultaneous stimulation and dc-recording at many electrodes in parallel.

Due to the emerging demand for novel electrophysiological methods that allows for parallel and automated recording from cells and tissue it is expected that the MEA technology now is crossing the threshold to become a widely accepted and used standard tool in the field of drug discovery and basic research.

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