JOHANNES KEPLER UNIVERSITÄT LINZ

P H Y S I K K O L L O Q U I U M

Fachbereich für Physik

Im Rahmen des Physikkolloquiums spricht

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über

Neuroelectronics - interfacing neuronal cells with electronic devices

Abstract:

A challenging issue in Neuroscience is tightly monitoring and controlling of the functionality of neural networks. Direct interfacing of devices based on inorganic and organic semiconductor and (non conventional) electrode material with nerve cells and brain tissue open novel perspective for multifunctional electrophysiological tools in vitro and in vivo with high spatiotemporal resolution and improved sensitivity.

We aim for the fabrication of chip-based sensors that enable an efficient neuro-electronic interface towards precise recording of cellular signals. Within this framework, we have developed a variety of microelectrode array (MEA) designs that enable non-invasive, parallel, multi-site recording of action potentials from primary neurons and cardiomyocyte-like HL-1 cell line. We have modified standard planar 64 electrode MEA design with different geometries ranging from nanometer-sized cavities that allow for cellular protrusion into the sensor to mushroom-shaped 3D electrodes. Furthermore, we investigate various field-effect transistor (FET) designs ranging from silicon nanowires to graphene.

A systematic characterization of cell–electrode interaction and an understanding of the interaction of cells with the electronic sensors is of utmost importance as the recorded signals are generally only in the 100 µV range. To allow a very detailed investigation of the neuro-electronic interface we developed an ultra-thin resin embedding method of individual neurons. In addition we employed surface plasmon microscope (SPM) to monitor in real-time the cell–metal interface and to measure in situ the gap distance of the cleft with the spatial resolution reaching to the optical diffraction limit

Ultimately, the combination of new technological approaches yields novel devices for the study of network development and communication and may improve our understanding of neuroscience in the future.

Datum: Do, 23.11.2017 **Zeit: 17:15 Uhr** **Ort: HS 8**