

# Contacting Biological Cells with Electronic Circuits

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## Abstract

Information processing in real biological neuronal networks differs in many aspects from information processing in electronic circuits. Though information is represented in both systems by electrical signals, charge carriers on the biological side are ions while electrons transmit electrical current in the silicon-based microelectronic world. In order to bridge this fundamental gap, several methods have been used during the last decades that provide electrical access to neuronal tissue. This talk will first discuss the properties of the most prominent methods such as long-term stability, temporal and spatial resolution as well as the number of contacts. Technical limitations of these techniques still prevent deeper insight into biological neuronal networks. It will be explained how typical properties of CMOS fabrication like surface planarity or large scale integration can improve common contact techniques. Presenting the most recent chip development in this field, it will be demonstrated how CMOS chips can be used as a substrate for neuronal cell cultures while sensing the electrical activity in a non-invasive mode. CMOS processing allows electronic circuits to be integrated under the sensor surface. These active sensor pixels are the basis for dense, large sensor arrays which allow electrical imaging of complex neural networks with sub-cellular resolution. The emerging applications of these sensor devices will deliver insight into biological information processing thus providing a basis for future man-machine interfaces like implants or prostheses.