Towards better neural prostheses: improvement of adhesion of host cells cultured on 'neurochips'

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The application of conventional neuroelectronic interfaces in impaired nervous sytems is limited by low efficiency. By creating an appreciable amount of contacts between guided sprouts from nerve fibers and neuron-precultured (before implantation) electrode arrays a more efficient interface can be created. The precultured neurons serve as 'attracting hosts' for the sprouts. The efficiency of this new type of neuroelectronic interface depends on the quality of the contact between electrode and the group of neurons cultured on top of each eelctrode. Especially, each electrode should maintain its own flat 'island' of neurons, as long as possible. However, in the flat culturing substrate environment of the electrode probe, neurons try to restructure into a three dimensional habitat which results in cell mobility and the forming of aggregates. Therefore, improved control over the topography of a cultured neuronal ‘island’ would be of great interest. An important tool for the regulation of cell cultures lies in the control of cell-cell adhesion. Adhesion between individual neurons is regulated by cell adhesion molecules. We investigate the effect of blocking cell adhesion molecules on neuron mobility and aggregation. Three important adhesion molecules: N-CAM, N-cadherin and integrin will be blocked by homophilic binding to other cell adhesion molecules or by binding to antibodies.
For monitoring the blocking effect *in vivo* we apply 'electric cell-substrate impedance sensing' (ECIS). When growing densily packed neuronal cells over a gold electrode, electrode impedance will increase. A change in the dimensions of extracellular space by molecular intervention on cell-cell adhesion changes the impedance. Carrying out impedance measurements over a broad range of frequencies points out the contribution of trans- and paracellular impedances, giving information about cell-substrate and cell-cell adhesion.

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