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Fine-tuning of implant material-cell interactions by laser microstructuring

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A optimal electrical stimulation of neuronal cells requires a closed position of the electrodes to the neuronal structure and a low impedance of the electrode contacts. In case of the cochlear implant the interaction to the connective tissue is important. In contract by the neuronal auditory implants the close contact to the neuronal cells are important.
The electrodes contain platinum contacts in a silicone carrier. The silicone carrier is manufactured (Cochlear Ltd, Sydney) from two types of silicone. For our studies we use silicone sheets (LSR 30) with rough and smooth surface, moulded silicone LSR 30 and rough silicone HCRP 50. As a model for the platinum contact material we used a micro-structured and platinum sputtered glass wafer. With femtosecond laser geometric microstructures produced on the surface of cochlear implant materials (width 1-10 µm). GFP-marked cells allow to observe cell morphology and cell growth in correlation with the structure geometry also on the non-transparent materials.

The cell growth rate on all kinds of silicone is significantly lower than on platinum. Polished silicone surface decreases cell growth on silicone. The laser structure further reduced the growth of fibroblasts. The number of cells on the microstructured platinum was significantly reduced. On all types of the silicones the effect of the microstructuring was also visible. On LSR 30 with smooth surface the reduction during the microstructure tends to be larger than on the rough surface and also larger then on the moulded silicone.

GFP-marked fibroblasts are a model for connective tissue cells. The micro structure affected fibroblast growth and guide neuronal cell growth. In further experiments structures of different size are to be tested on several electrode materials. The aim is to optimize the electrode interface, to reduce the connective tissue growth antd increase the electric contact to the neuronal target cells.

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