ZAJEDNIČKI SEMINAR

Ponedjeljak, 16.svibnja 2016., 14:00 sati (točno)

PMF-Fizički odsjek, Bijenička cesta 32, Predavaonica 201

Damir Kovačić

Laboratorij za istraživanje slušanja i govora,

Medicinski i Prirodoslovno-matematički fakultet Sveučilišta u Splitu

A NEW AUDITORY NEURO-ELECTRONIC INTERFACE: SPIRAL GANGLION NEURONS CULTURED ON ADVANCED MICRO-ELECTRODE ARRAY

One of the strategies to improve the cochlear implant technology is to increase the selectivity of the electrical stimulation of the auditory nerve. We are proposing a novel neuro-electronic interface based on micro-nail-shaped electrode array embedded on silicon-based integrated circuits. Herein we test the in vitro interaction of these substrates with rat spiral ganglion neurons (SGN) [1]. Silicon substrates with micro-nails of different dimensions and spacing were fabricated using standard CMOS-based post-processing [2]. SGN were extracted from P5 rat pups and cultured in vitro on poly-L-ornithine coated silicon substrates in Neurobasal-A with B27 and GDNF. Glass coverslips were used as controls. Cell cultures were fixed and stained with Tuj1 (neurons) and DAPI (cell nuclei). Tuj1+ SGNs grew successfully on micro-electrode arrays, as on control surfaces (139 ± 43 and 181 ± 53 neurons respectively). The micro-nails allowed excellent neurite outgrowth and induced intimate interactions between cell and silicon. After 7 days in vitro, 21% of SGN on micro-electrode arrays showed neurites longer than 100 µm, similarly as SGN on control surfaces (29%). Nail shaped electrodes also promoted axonal guidance, as proved previously with other types of neurons [3] Neurites were oriented preferentially along 30°, 90° or 60°in nail structures with spacing between 1µm and 2.4µm, following the underlying geometry of the silicon surface. Micro-nails support in vitro SGN growth and interaction with neurite outgrowth. Moreover, the neuronal outgrowth followed geometrical features of the surface, indicating these engineered surfaces could be used for directed neuronal growth and differentiation. Altogether, these results indicate micro-electrode arrays are a promising technology for future auditory neuro-electronic interfaces.

References:

[1] Mattotti M, Micholt L, Braeken D, **Kovačić D** (2015) Characterization of spiral ganglion neurons cultured on silicon micro-pillar substrates for new auditory neuro-electronic interfaces. J Neural Eng 12:026001.

[2] Braeken D, Huys R, Loo J, Bartic C, Borghs G, Callewaert G, Eberle W (2010) Localized electrical stimulation of in vitro neurons using an array of sub-cellular sized electrodes. Biosens Bioelectron:5–8.

[3] Micholt L, Gärtner A, Prodanov D, Braeken D, Dotti CG, Bartic C (2013) Substrate Topography Determines Neuronal Polarization and Growth In Vitro. PLoS One 8:1–14.

***

Assistant Professor Damir Kovačić, B.Sc., PhD, is an experienced researcher, former double Marie-Curie Intra-European Fellow at KU Leuven (Belgium) and currently head of the Speech and Hearing Research Lab at University of Split. He obtained diploma of engineer of physics (1999) at University of Zagreb (Croatia) and received PhD in Cognitive Neuroscience (2007) at International School for Advanced Studies (SISSA), Trieste (Italy). He was postdoctoral researcher in the Laboratory for Auditory Neurophysiology at KU Leuven, as well as in the Group for neuro-electronic interfaces at IMEC, Leuven (Belgium). His research interests include neural correlates of auditory perception, both in normal and electrical hearing, as well as development of novel auditory bionic devices.