Brain tissue response to nanowires implanted into the rat striatum.

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Nanostructured surfaces can improve electrical properties of electrodes and lower evoked tissue responses in brain-machine interfaces. Nanowires have a great potential for the development of new types of brain electrodes. We have shown [1] that neurons can thrive on nanowire substrates, even when penetrated by the nanowires, which may indicate that the nanowires are biocompatible and which opens up for recording from individual neurons since the cell-electrode distance is very small. Here, we investigate the biocompatibility of nanowires in the brain. Gallium Phosphide (GaP) nanowires (2 μm long and 100 nm in diameter) were epitaxially grown by Metal Organic Vapor Phase Epitaxy (MOVPE). In order to investigate the effect of size and chemistry on the biocompatibility, some nanowires substrates were coated with sputtered SiOx, which is known to be biocompatible. Nanowires were suspended in a physiological solution, which was then implanted into adult rat striatum. The animals were implanted with, either a GaP nanowire solution, a SiOx-coated nanowire solution or a control solution devoid of nanowires. After 1, 6 and 12 weeks survival, the animals were transcardially perfused. The brains were dissected, cryostat sectioned and prepared for immunohistochemical investigations. Antibodies for microglia (ED1 positive cells), astroglial cells (GFAP positive cells) and cell nuclei were used. The ED1 and GFAP positive cells constitute the signature of an inflammatory response in the brain. Detecting ED1-positive microglial cells, as well as GFAP-positive astroglial cells, we were able to locate the implantation scar. Furthermore, it was possible to visualize the nanowires (through the scattered laser light) inside the scar using confocal microscopy. Our results show that the nanowires are distributed homogeneously along the scar one week after the implantation. After 6 weeks, the ED1 positive cells have ”collected” most of the nanowires. After 12 weeks, it is more difficult to find nanowires in the scar and some debris can be seen in the ED1 positive cells.

[1] W. Hällström, T. Mårtensson, C. Prinz, P. Gustavsson, L. Montelius, L. Samuelson, M. Kanje : *Gallium phosphide nanowires as a substrate for cultured neurons*. Nano Letters 7 (10) : 2960-2965 Oct 2007.