Poster

BIOCOMPATIBILITY STUDIES OF POLYPYRROLE DERIVATIVES FOR MODIFICATION OF NEURAL ELECTRODES

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Rehabilitation of sensory and/or motor functions in patients with neurological diseases is more and more dealing with artificial electrical stimulation and recording from populations of neurons using biocompatible chronic implants. For example deep brain stimulators have been implanted successfully in patients for pain management and for control of motor disorders such as Parkinson's disease; cochlear implants are being used for restoring auditory function and micro-array type devices have been implanted in rudimentary artificial vision systems. Moreover there is preliminary data showing that by using electrophysiological methods it is possible to extract information about intentional brain processes and then translate these signals into models that are able to control external devices. As more and more patients have benefited from this approach, the interest in neural interfaces has grown significantly. However an important problem reported with all available microelectrodes to date, is long- term viability and biocompatibility.

A method to improve long-term biocompatibility and the interaction of these devices with surrounding tissues is the modification of microelectrode surfaces to create more biocompatible and bioactive surfaces. In this context, the biocompatibility of electrochemical conducting polymers such us polypyrrole (PPy) has been demonstrated *in vivo.*[1] Furthermore, in the last years the possible usefulness of these materials is being tested in neural engineered applications, including neural probes[2], nerve conduits and scaffolds for tissue and nerve regeneration.[3]

In this communication, we investigate several electrochemically synthesized PPy derivatives to improve biocompatibility and modulate the response of neurons and glial cells (Fig. 1). The biocompatibility of polypyrrole is compared to the more hydrophilic carboxylic acid-functionalized polypyrrole. Some extra examples have been synthesized including some biomolecules. For example chondroiting sulfate (CS) has been introduced in the polymeric matrix as a dopant. In other cases some laminin peptide fragments have been also introduced in the matrixes.

The biocompatibility studies have been carried out using three different cell lines: neurons (PC12 cells), glial cells (42 MG-BA cells), fibroblast (3T3 cells) and endhotelial HEK cells (293T cells). The above mentioned commercial cell lines were culture on pure materials and on the functionalized surfaces following standard procedures. Cytotoxicity was analyzed based on the colorimetric (3-(4,5 dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide) MTT assay.

We have developed a cell culture model to investigate the growth and adhesion of neurons, glial cells and other cells present in the central nervous system on substrates coated with different surfaces and biological molecules. We did not observe evidence of toxicity in any of these cell cultures. Although there were some minor variations depending of the sample, our results revealed a faster recuperation in the presence of PPy coating samples in comparison to the controls. Among the biological macromolecules that were immobilized and tested, the most promising results were achieved with chondroiting sulfate (CS).

References:

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[2] X. Cui, J. Wiler, M. Dzaman, R. A. Altschuler, D. C. Martin, Biomaterials, **24** (2003), 777.
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Figures:

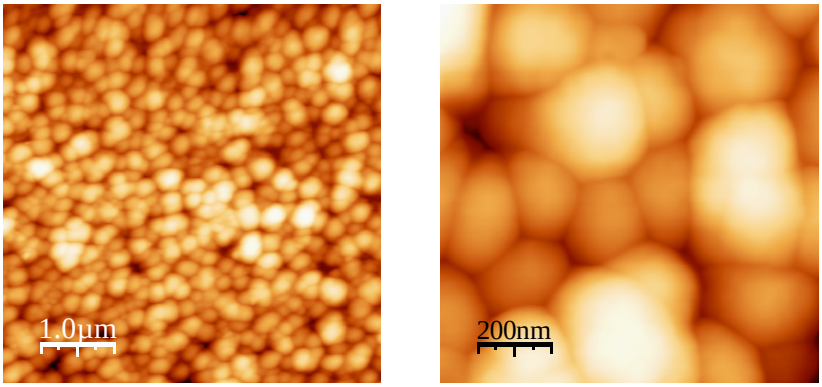

Figure 1: AFM image of PPy-PPyCOOH film.