The design and characteristics of electroactive materials for diagnostics and treatment of neurological disorders

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Abstract

Apart from the unquestionable success of electroactive organic materials in organic electronics, this group of compounds proved to be truly beneficial also in the wide-field biomedical engineering. Electroactive materials are especially relevant in neural tissue engineering, since the main function of neural tissue is the transfer of electrical pulses. What is more, the application of external electrical pulses may have a tremendous effect on the functionality of neural cells. For instance, through the electrical stimulation of degenerated neurons, it is possible to restore their inherent functions. Such kind of therapy relies on the implantation of microelectrodes or microelectrode arrays into the deep parts of human brain, to transfer electrical pulses of specified amplitude, width and frequency to the surrounding neural cells.

The neural microelectrode technology is based on noble metals and their alloys. Although exhibiting beneficial electrical properties, these materials usually lack in biocompatibility, mainly due to their hard and smooth surface, so different from the wet, soft and rough surface preferred for the interface with living tissue. Therefore, it is a common issue that following the implantation, metal microelectrodes induce the inflammatory state and the formation of a glial scar which significantly reduce chronic functionality of neural electrodes. Currently, the experimental approaches to eliminate this foreign body response are focused on developing anti-inflammatory neuroelectrode coatings, which offer potential to enhance the electrode performance while providing a localized delivery of anti-inflammatory or neurotropic drugs. Nevertheless, because of the complexity of the design approach that needs to combine the electrical performance of the coating with its biological response, there is still large room for further improvements in the existing solutions of the neural electrode coatings.

About the presenter

Katarzyna Krukiewicz, Associate Professor at SUT, defended her PhD in 2016, and since then she has been employed at the Department of Physical Chemistry and Technology of Polymers, Faculty of Chemistry, Silesian University of Technology. The main aim of her research is the development of novel, multifunctional electroactive materials combining beneficial electrical properties with high biocompatibility, that can be used in biomedical

engineering, especially for the diagnostics and treatment of neurological disorders, regional chemotherapy as well as impedance tomography.

The scientific contribution of Prof. Krukiewicz includes 72 research papers published in international peer-reviewed scientific journals, and more than 50 conference presentations. She has been the principal investigator of 3 research projects (NCN-SONATA, NCN-OPUS, FNPINTER) and an investigator in other 8 projects funded by NCN, FNP, MNiSW, Science Foundation Ireland, and European Commission. Since 2017, Dr Krukiewicz has been a Marie Curie Fellow at the Centre for Research in Medical Devices (National University of Ireland, Galway).