The aim of the proposed project is to develop a new cellular model based on human cells of the peripheral nervous system through the use of microfluidic bioanalytical systems. According to statistical data, neurological disorders are the leading cause of disability and the second leading cause of death in the world. The human nervous system is very complex, and despite considerable efforts by scientists, neuroscience still remains one of the most failure-prone areas of research. In response to an important social problem of rare autoimmune demyelinating diseases, also known as peripheral neuropathies (*e.g*. Guillaina-Barré syndrome, chronic inflammatory demyelinating polyneuropathy, multifocal motor neuropathy) we propose research to create a completely new cellular model that will better mimic the growth conditions and cellular processes occurring in the neural network.

Myelin is a multilayer membrane produced by glial cells, mainly by the Schwann cells in the peripheral nervous system and oligodendrocytes in the central nervous system. Glial cells stretch and form myelin sheaths around the axons through the process of myelination. Myelin sheaths play important roles in the functioning of the nervous system: they protect axons from mechanical damage and act as electrical insulators. Myelin sheaths significantly improve the speed of conduction of nerve impulses between neurons. Demyelinating diseases are associated with the loss of myelin, which can be caused by many genetic, chemical or environmental factors. In the case of damage to the myelin sheath, there are difficulties in the conduction of nerve signals, which leads to the deterioration of basic body functions (e.g. movement or sensation).

As part of the project, the *Cell-on-a-chip* microbioanalytical system will be developed for the culture of human cells of the peripheral nervous system, and a procedure will be developed to imitate the processes of myelination and demyelination of neurons in laboratory conditions. A methodology for analyzing the formation of myelin sheaths and their degradation under the influence of selected factors will also be developed. The research will use miniature fluidic systems, called *Cell-on-a-chip* systems, also known as integrated microlabs on a chip. They are a good laboratory tool for developing appropriate research methodology. The use of the *Cell-on-a-chip* systems enables real-time testing of microliter samples and single-cell analysis, making these systems suitable for the culture of nerve cells and the analysis of biological phenomena occurring at the level of a single neuron. A hypothesis was formulated according to which the developed microfluidic system could be used as a tool in the rapid diagnosis of demyelinating diseases of the peripheral nervous system, based on the analysis of the patient's blood sample. The use of the *Cell-on-a-chip* system for nerve cells culture and mimic nerve cells myelination will allow testing the effectiveness of new treatments for patients with rare demyelinating diseases and tracking the course of their diseases.

The scientific research proposed in the project on the borderline of chemistry, biology, immunology, medical diagnostics and microtechnology is interdisciplinary. The results of the research will contribute to expanding knowledge about the development and course of demyelinating diseases of the peripheral nervous system, which in turn may influence the knowledge of alternative methods of their treatment, as well as the method of monitoring the effectiveness of the therapies used. In the future, the developed new model of myelination and demyelination of human neurons may form the basis of laboratory tests that will contribute to the early diagnosis of patients with neurodegenerative disorders only in the analysis of a blood sample.