

The concept of the project is to conduct studies on the extraction of DNA of a toxigenic *Corynebacterium diphtheriae* strain into a solid phase in a microchip using miniaturized pumps and valves, followed by PCR and biosensor detection.

Nowadays, we are experiencing the importance of rapid detection of infectious diseases to avoid a major epidemic such as that caused by SARS-CoV-2. *Corynebacterium diphtheriae* causes a disease called diphtheria, which had unexpected new outbreaks in recent years, even though humanity was close to eradicate it once and for all. Therefore, it is important to have a tool that will quickly allow to detect presence of this pathogen. One of the stages of such detection process is DNA extraction, which will be thoroughly investigated in this project. We plan to conduct research in such a way as to best reproduce the extraction conditions in a possible target miniaturized and portable device. Therefore, each step of the extraction process will be supported using miniaturized and automated pumps and valves. This will allow for a detailed study of the impact of such devices on the process of DNA extraction to the solid phase, which will be packed in a part of the microsystem. The microsystems themselves will be made of inexpensive materials such as PeT and PMMA using techniques such as micro-milling and laser cutting. Thanks to this, it will be possible to make many cheap, disposable microchips. We think that it will give hope that a similar technology will be used for mass production of microchips for simple and quick diagnostics.

At a later stage of the project, research will be carried out to determine the best conditions for the extraction process in the microsystem, such as the type of material used for extraction in a microchamber, the types of solutions used and their optimal flow rates. The extraction efficiency will be determined as well as the minimum time needed to carry out this process. The DNA obtained in this process will be amplified by the polymerase chain reaction. It will be an asymmetric variant of this reaction, i.e. one in which there is an excess of one strand of DNA. Then this amplified DNA will be analyzed with the previously developed DNA biosensor selective for the toxic strain of *Corynebacterium diphtheriae*. Both the DNA amplification and detection process will also be performed in a microchip with the support of micropumps and microvalves. The result of the research will be therefore not only new knowledge about the extraction process into the solid phase in the microsystems, but also a full process leading to the detection of the pathogen, which will be entirely carried out in an integrated microchip.

The team takes up this research topic primarily to explore the solid phase extraction process more broadly than before. However, in addition to the main goal, a complete diagnostic process will also be presented, ending with the detection of the toxic strain of *Corynebacterium diphtheriae*. The use of a microchip will also show the possibility of using an electrochemical biosensor as a detection element in miniaturized portable devices.