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iCovid, impedimetric platform based on boron-doped diamond nanostructures for quantitative analysis of virus-receptor interactions

Our cells are relatively well protected from different types of intruders. Therefore, in order to get inside, the viruses need to hijack proteins, called receptors that are located at the surface of cells. Viruses bind to these proteins very tightly and use them as gateways to enter our cells. This mechanism is used by the variant of the SARS virus responsible for the current COVID-19 pandemic. More specifically, the SARS virus binds receptors called ACE2 that play an important role in regulating blood pressure. This binding process represents an important early stage at which the disease could be prevented using appropriately tailored new drugs. Unfortunately, at the moment we have quite limited methods allowing for studying the infection process of the SARS virus in the laboratory, relying mainly on experiments using small laboratory animals or culturing special types of cells in a dish. If only we had methods enabling us to reliably analyze the early stages of the invasion process, we could characterize this process better and search for new medicines that have a potential for preventing COVID-19 before the disease even starts.

To this end, scientists from the Gdańsk University of Technology in cooperation with researchers from the Institute of Biotechnology and Molecular Medicine (Gdańsk) and supported by simulations carried out in California Institute of Technology (Caltech, USA) will develop an innovative device, called *iCovid,* to study how the SARS virus invades human cells. They will employ special electrodes built of extremely small pieces of diamonds to which they will bind the very ACE2 receptor that is used by the SARS virus to invade. The properties of such a device, including its ability to transmit electricity, change when the ACE2 receptor binds whole viruses or even their fragments. In this way, it will be possible to very precisely investigate how the virus is using different proteins to attach and hijack normal cell receptors. This seemingly simple task will require a lot of innovative approaches and prototyping to achieve the required sensitivity and selectivity.

Apart from creating a tool for studying potential new drugs against COVID-19 for humans, researchers will also use the new device to check which methods efficiently inactivate the SARS virus in saliva and nose swabs. This is particularly important, as the virus in samples sent for laboratory testing is currently collected and transported alive, which can cause staff in diagnostic laboratories contract the disease. In the future, the iCOVID platform may be further developed into a high-throughput tool for screening large libraries of drug candidates with speed, ease, and significantly lower biohazard risks compared to the traditional research methods.

As far as research projects go, this one is planned for a relatively short period (18 months), which means that its first goals should be available for employment by the doctors and pharmacologists in a timescale relevant to the current pandemic. The results of the project will be broadly published both in Poland and worldwide.