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Tokai University
Toyohashi University of Technology
Chubu University
DENSO Corporation

Universities and DENSO Develop Biosensor to Detect SARS-CoV-2 and Accelerate Development for practical application

— Collaboration results in simple, highly sensitive biotechnology and semiconductor technology that detects virus —

Tokai University, Toyohashi University of Technology, Chubu University, and DENSO Corporation have been developing testing equipment to detect SARS-CoV-2 with support from the Japan Agency for Medical Research and Development (AMED)[*1]. Universities and DENSO announced today that the group has succeeded in developing a biosensor based on a new mechanism and detecting SARS-CoV-2. The group will accelerate the development toward practical application to contribute to early diagnosis of infectious diseases, which is a key factor in limiting virus' spread.

To prevent the medical system from being overwhelmed due to viral infectious diseases, it is essential to prevent the spread of viruses by early diagnosis and isolation. At present, PCR tests[*2] and antigen tests[*3] are used for the diagnosis of SARS-CoV-2. However, these tests cannot evaluate "virus infectivity," which indicates the power of the detected virus to infect. PCR tests are characterized by its high virus detection sensitivity, but effort of sample pretreatment process imposes a high workload on medical professionals. Meanwhile, antigen tests are simple, but the detection accuracy varies. There has been growing demand for a high-sensitivity and simple detection method to evaluate viral infectiousness.

The universities and DENSO have been developing a biosensor for clinical testing equipment to enable high sensitive and quick quantitative detection of viral infectivity. Unlike PCR tests and antigen tests, the biosensor detects the spike protein[*4] on the virus surface, which triggers infection, by using a semiconductor sensor and aptamer.[*5] The group has succeeded in developing highly sensitive detection of SARS-CoV-2 with high sensitivity by using this technique for the first time in the world.[*6]

The semiconductor sensor can quantitatively measure the viral load by using electrical signals. Thus, it is expected to be used to determine the status of infection and confirm the

efficacy of treatment with high accuracy. An aptamer is small in size and binds selectively to various types of protein. It is also easy to design and can be mass-produced quickly, and so the aptamers can be used to detect unknown viruses.

The goal of the development of the biosensor by the universities and DENSO is to determine the infectivity of SARS-CoV-2 and offer novel tests which have virus detection sensitivity equivalent to that of PCR tests and which is as simple as antigen tests. The group will enhance the basic technology and accelerate the development toward practical application.

The universities and DENSO remain committed to preventing the spread of SARS-CoV-2 infection by harnessing the technologies that have been refined through the project.

Glossary

*1 AMED
Universities and DENSO develop biosensor with the support of AMED, with the project called “Advanced semiconductor sensor-based biomolecule detection system towards diagnosis of infectious SARS-CoV-2”
*2 PCR test
A test for detecting genes in a virus.
*3 Antigen test
In a typical antigen test, the nucleocapsid protein in a virus is detected using an antibody.
*4 Spike protein
Protein on the virus surface. It has the function of binding to human cell receptors and triggers infection.
*5 Aptamer
An artificially synthesized nucleic acid molecule. It bonds with specific substances.
*6 For the first time in the world
World’s first technology to detect the spike protein by using a semiconductor sensor and aptamer.

Respective roles and comments

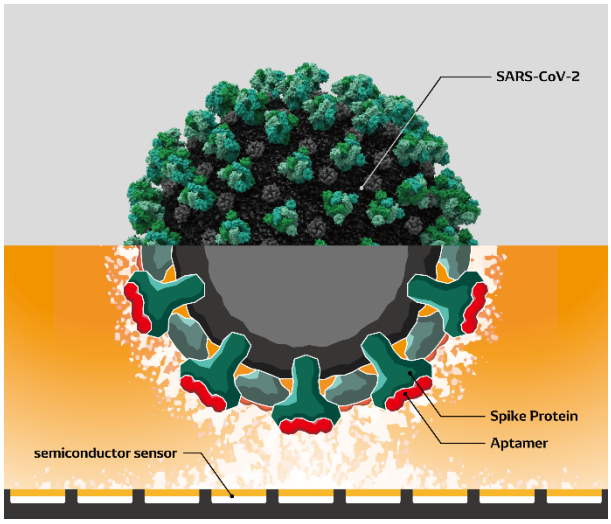
■ Tokai University
From the viewpoint of infection control and laboratory physicians, we are eager to develop a system characterized by superb sensitivity and specificity and capable of quick diagnosis to determine infectiousness with simple operation. We offer advice on practical application and ensure accuracy management by using products, which are developed with world-leading engineering capabilities.

■ Toyohashi University of Technology
We fabricated a semiconductor sensor capable of converting the viral load into electrical signals and supplied it to this project. The use of semiconductor technology makes it possible to distinguish viruses which cause very similar symptoms in a single test by using a sensor as small as a grain of rice.

■ Chubu University
We prepared and supplied various types of viruses to evaluate the specificity of the semiconductor sensor. This biosensor is capable of quick detection of “infectious viruses” which cannot be determined by conventional methods such as PCR tests. Determination of the status of viral proliferation (that is, whether the viruses that have entered the body

keep their infectivity or not) will clarify the timing when viral detection and/or isolation could be finished, and help infected individuals return to normal life.

■ DENSO Corporation
We supplied biotechnology to detect viruses using a semiconductor sensor with higher sensitivity by taking full advantage of our expertise derived from R&D on detecting various viruses and biomarkers, which was conducted as part of advanced research to create a comfortable cabin space. We will accelerate the development toward practical application by leveraging biotechnology and semiconductor technology that have been refined through many years of operations.



The image of detecting SARS-CoV-2

The semiconductor sensor

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