24 September 2021

Press release

Ball Wave Inc.
Tohoku University
Toyoda Gosei Co., Ltd.

Ball Wave, Tohoku University, and Toyoda Gosei in joint development of high-speed COVID-19 sensor: Aiming for direct detection of viruses in aerosols

Key points of the announcement

• Ball Wave Inc. (Head office: Sendai City, Miyagi Prefecture; CEO: Dr. Shingo Akao), has been working together with Tohoku University Graduate School of Medicine and Toyoda Gosei Co., Ltd. (Headquarters: Kiyosu City, Aichi Prefecture; President: Toru Koyama) on research to verify the principles of the ball surface acoustic wave (SAW) virus sensor.

• This joint development establishes a new principle of virus concentration measurement within a short period of time—just a few seconds—by capturing airborne viruses present in aerosols using antibodies and aptamers.[1] The goal is to develop the fastest virus sensor ever.

• Proteins specific to the SARS-Cov-2 contained in aerosols generated in experiments were detected within 1 minute.

• Our aim is to develop not only diagnostic equipment that can detect viruses in the exhaled breath of patients, but also equipment for monitoring viruses in the air in restaurants, on public transport, at facilities with large crowds, and in the home. In the future, it may be possible to develop systems in which a virus sensor is mounted on Internet of Things devices, allowing the spread of viruses to be visualized in real time.

Overview

The COVID-19 virus is believed to infect people through aerosols, but methods and equipment capable of detecting the concentration of airborne viruses in real time (a gas phase virus sensor) have yet to be developed. The simplest test method currently in use for rapid detection of newly infected patients is the immunochromatographic antigen test kit, but this test takes more than 15 minutes to complete. This presents a major challenge in the ongoing fight against the spread of COVID-19 infection (Fig. 1).

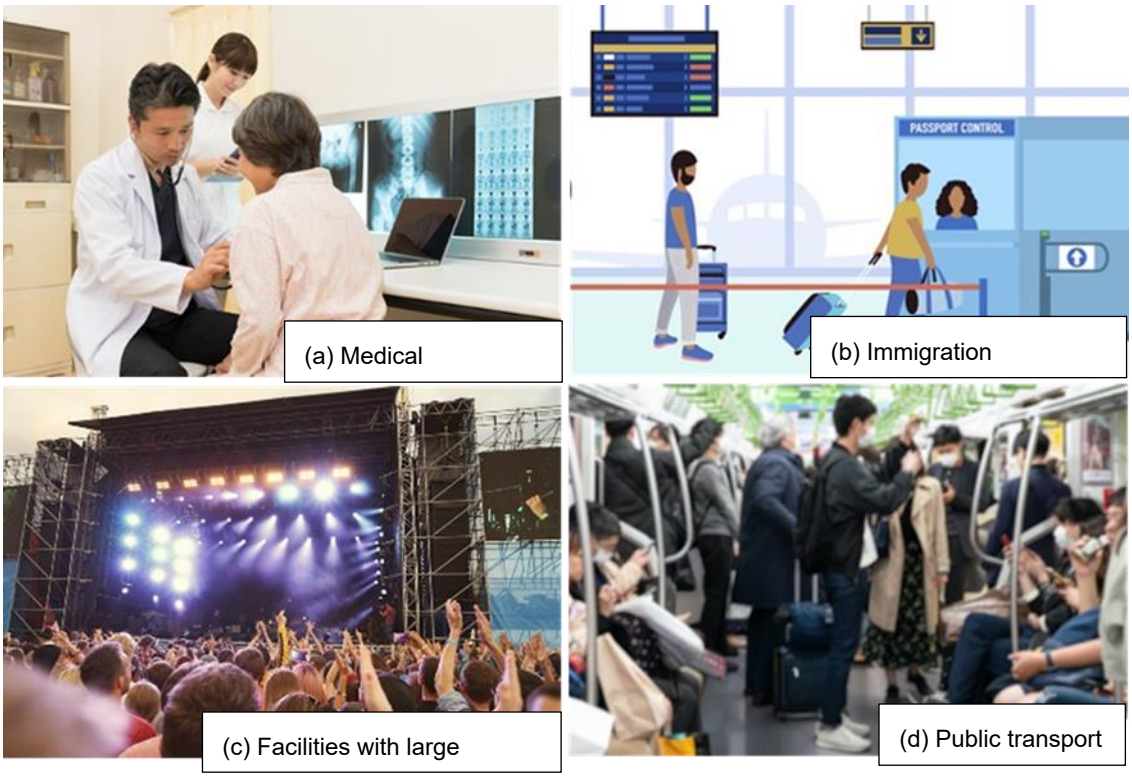

Figure 1. Examples of environments where virus sensors/detection methods are an important part of infectious disease control

Aerosols released into the air when people talk or cough travel rapidly through space with a speed of several tens of centimeters per second. If a sensor is located within a distance of 1 m from an infected person, the aerosol will reach the sensor within 10 s. Viruses in the aerosol remain on the sensor surface, coated in water. Ball Wave devised a sensor using the ball SAW sensor,[2] which is its proprietary technology—antibodies or aptamers are fixed to the surface of the ball SAW sensor, and these react with the spike protein of the captured virus (Fig. 2). The reaction time of the sensor is less than 10 s, and the sensor is expected to be able to detect viruses with high sensitivity as the innovative principle of the ball SAW sensor amplifies even very small responses to minute viruses. The joint development will be carried out by combining the surface treatment technology cultivated by Toyoda Gosei through its development of car interior and exterior parts with Tohoku University's expertise in breathomics,[3] a high-precision diagnostic method that uses mass spectrometry to detect viruses and inflammatory proteins in exhaled air.

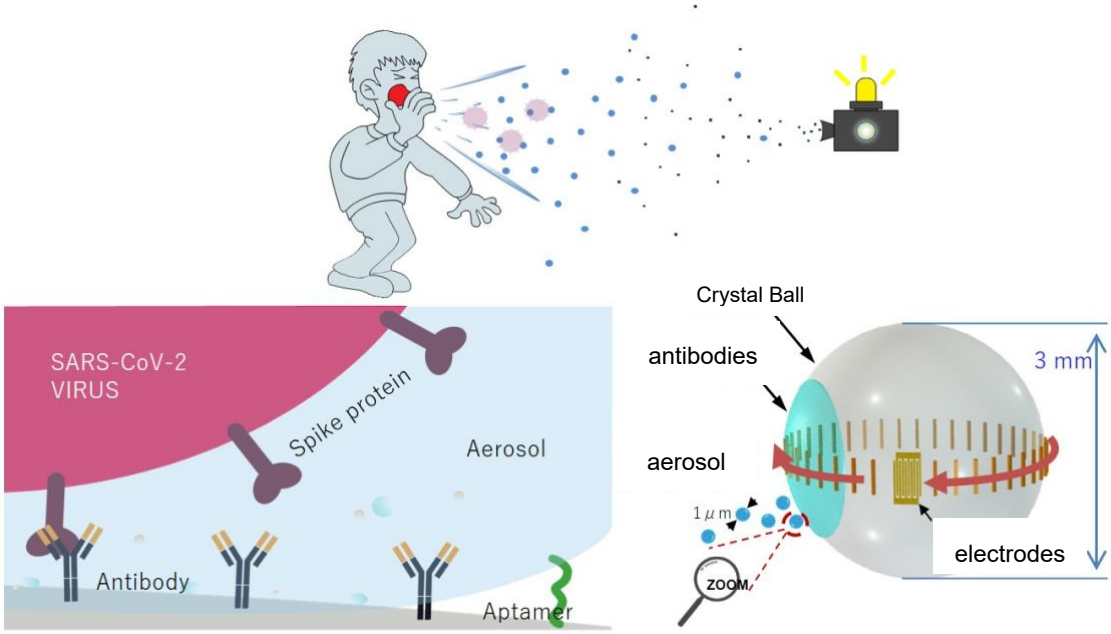

Figure 2. Sensor that captures viruses through the antigen-antibody reaction using water in the aerosol

In addition to the challenges associated with the current COVID-19 pandemic, society may face other pandemics in the future. Our aim is to provide the ball SAW sensor to people all over the world as soon as possible, enabling detection of viruses in environmental air and non-invasive, rapid virus testing.

Explanation of terms

1. Aptamer: A nucleic acid molecule that specifically binds to a specific foreign substance such as a cell or protein and inhibits its function. Aptamers have a similar function to antibodies, but they are thermally and chemically stabler than antibodies, and release antigens when the temperature is raised for reuse.
2. Ball SAW sensor: A sensor that uses surface acoustic waves (SAWs), which are concentrated on the surface of a sphere and repeatedly circle around it without spreading in a lateral direction. The ball SAW sensor was developed by Emeritus Professor Yamanaka and at Tohoku University Graduate School of Engineering and collaborators.
3. Breathomics: A method in which exhaled air is collected from a subject so that viral proteins and genomes, inflammatory mediators, and energy metabolites present in the aerosol can be efficiently and safely collected for automated, high-speed, and ultra-sensitive analysis. It was developed by Professor Akaike and his colleagues at Tohoku University Graduate School of Medicine.

Contact:
Ball Wave Inc.
Administration Department
Tel：022-302-6659
E-mail：mori*ballwave.jp (replace * with @)

Tohoku University School of Medicine Public Relations Office
Tel：022-717-8032
E-mail： press*pr.med.tohoku.ac.jp (replace * with @)

Toyoda Gosei Co., Ltd.
Public Relations Department, General Affairs Division
Tel：052-400-1452