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News Release

September 7, 2020

Plasmacluster Technology Demonstrates Effectiveness in Reducing Airborne Novel Coronavirus (SARS-CoV-2) *1, a World First*2

In a world first, Sharp Corporation developed a device equipped with Plasmacluster technology, which exposed an airborne novel coronavirus (SARS-CoV-2) to Plasmacluster ions for approximately 30 seconds*3, and demonstrated that the virus infectious titer*4 was reduced more than 90%. This achievement was accomplished in collaboration with Professor Jiro Yasuda of the National Research Center for the Control and Prevention of Infectious Diseases/Institute of Tropical Medicine, Nagasaki University, Professor Asuka Nanbo (a Board member of the Japanese Society for Virology) of the same institution, and Professor Hironori Yoshiyama of the Department of Microbiology, Shimane University Faculty of Medicine (also a Board member of the Japanese Society for Virology), and in cooperation with Nagasaki University, an internationally respected authority on infectious disease research.

In December 2019, an outbreak of “Coronavirus disease 2019 (COVID-19)” caused by a novel coronavirus (SARS-CoV-2) was reported, and by August 2020, more than 25 million people have been infected with SARS-CoV-2 and more than 840,000 individuals died of this infectious disease in a world*5. This outbreak represents an urgent problem facing society, and demands that immediate countermeasures be taken across a wide range of fields.

In 2004, Sharp demonstrated the effectiveness of Plasmacluster technology against feline (cat) coronavirus, a member of the Coronaviridae family*6. In the following year, 2005, Sharp also demonstrated its effectiveness against the original SARS coronavirus*7 (SARS-CoV), which caused the outbreak (2002-2003) and genetically similar to the novel coronavirus (SARS-CoV-2). Now, Sharp has demonstrated its effectiveness against SARS-CoV-2 in airbornedroplets.

Since 2000, Sharp has promoted academic marketing*8 to demonstrate the effectiveness of Plasmacluster technology, working in collaboration with independent third-party research organizations around the world. Thus far, numerous independent research organizations have proven its clinical efficacy in suppressing the activity of harmful substances including new pandemic influenza viruses, drug-resistant bacteria, and mite allergens, as well as in reducing bronchial inflammation levels*9 in children with asthma. At the same time, the safety of Plasmacluster ions has also been confirmed*10. Sharp will continue to contribute to society by conducting a wide range of studies demonstrating the effectiveness of Plasmacluster technology.

For further information, please contact us at:
050-5433-1321

Comments from Dr. Jiro Yasuda, Professor, National Research Center for the Control and Prevention of Infectious Diseases, Nagasaki University

Disinfectants such as alcohol and detergents (surfactants) are well-known to be effective to reduce the risk of the virus on materials, however, for infection via aerosols (microdroplets), there are few effective countermeasures such as a mask.

Here, effective inactivation of SARS-CoV-2 in airborne droplets by Plasmacluster technology was demonstrated.- It would be expected that it is useful to reduce the risk of infection in real spaces including office, home, medical facilities and vehicles.

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*1 Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2): The strain of coronavirus that causes coronavirus disease 2019 (COVID-19).
*2 In ion-emission air purification technologies (as of September 7, 2020; based on Sharp research).
*3 Calculated by dividing the test space volume by the flow recovery rate, assuming that the aerosol containing the virus is passing through the space at a constant speed.
*4 Number of infectious virus
*5 Based on data from Johns Hopkins University (as of August 31, 2020).
*6 Announced on July 27, 2004.
*7 *Severe acute respiratory syndrome-related coronavirus*: The species and its viruses – a statement of the Coronavirus Study Group. bioRxiv doi 10.1101/2020.02.07.937862 (February 11, 2020).
*8 A marketing method to promote commercialization of products based on verification of scientific data on the effectiveness of a technology in collaboration with leading-edge academic research institutions.
*9 Announced on September 18, 2014.
*10 Tests conducted by LSI Medience Corporation (inhalation toxicity, eye/skin irritation/corrosion, and teratogenicity tests, plus a two-generation reproduction toxicity study)

■ Overview of Verification Test

- Testing organization: National Research Center for the Control and Prevention of Infectious Diseases (CCPID)/Institute of Tropical Medicine, Nagasaki University
- Verification test apparatus: Virus testing device equipped with Plasmacluster technology

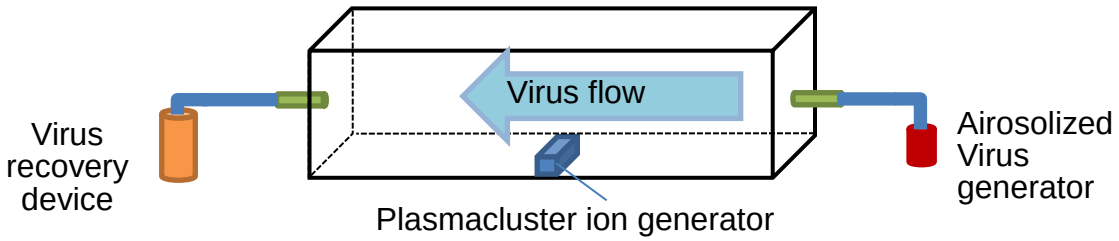

Figure 1 Test device diagram

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- Plasmacluster ion concentration: Approx. 10 million/cm^3 (in the vicinity of the Plasmacluster ion generator)
- Test space volume: Approx. 3 liters
- Control study: Comparison using the device described above without Plasmacluster ion generation
- Validation virus: Novel Coronavirus (SARS-CoV-2)
- Test method
  1) Pass the aerosolized virus through the test devise from the generator.
  2) Recover the aerosolized virus after exposure to Plasmacluster ions.
  3) Calculate the infectious virus titer of the recovered virus solution by a plaque assay*.

  * A standard assay to evaluate the number of infectious virus in the sample.

- Results

Table 1 Effect of Plasmacluster ions on infectious titer of novel coronavirus (SARS-CoV-2) suspended in air

	Without Plasmacluster ions	With Plasmacluster ions	Reduction
Infectious virus titer (number of plaque)	1.76×10^4	1.54×10^3	91.3%

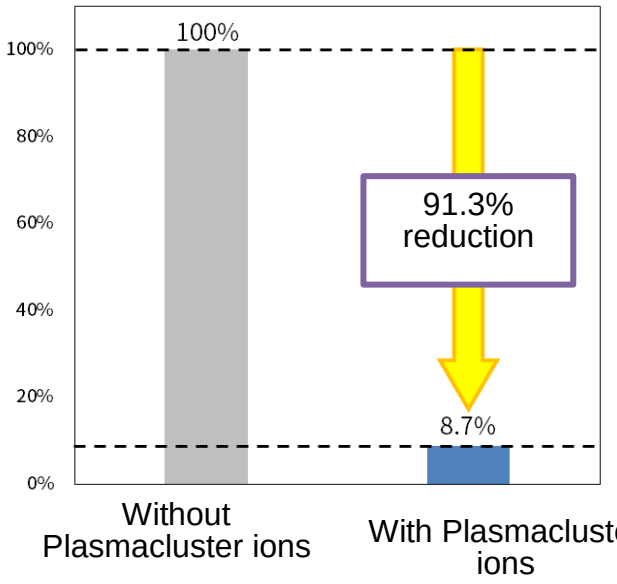


Figure 2 Effect of exposure to Plasmacluster ions on infectious titer of Novel Coronavirus (SARS-CoV-2)

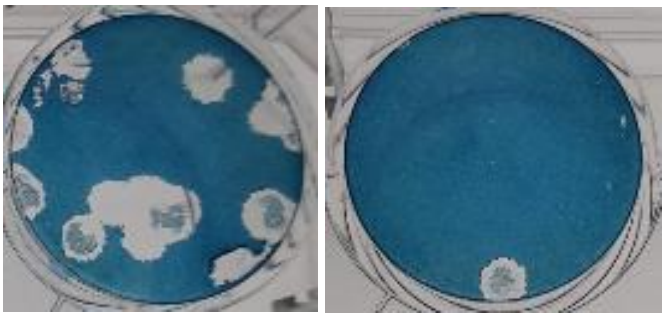
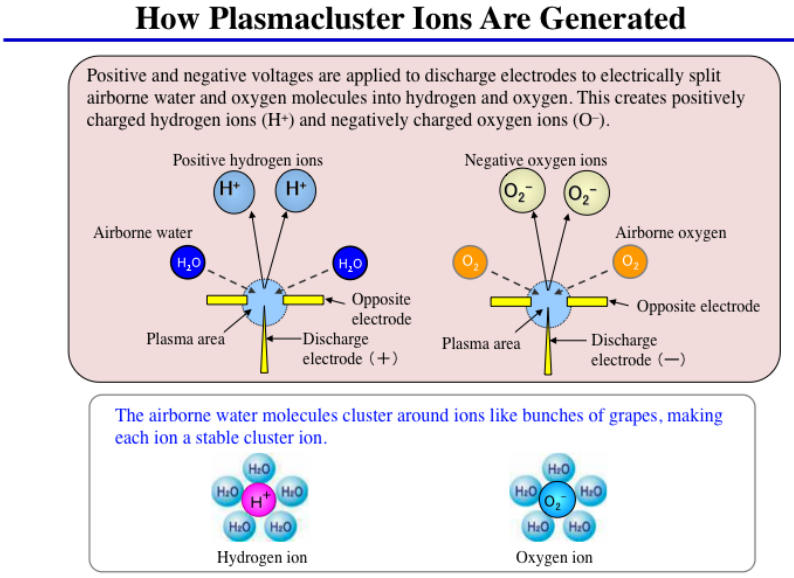


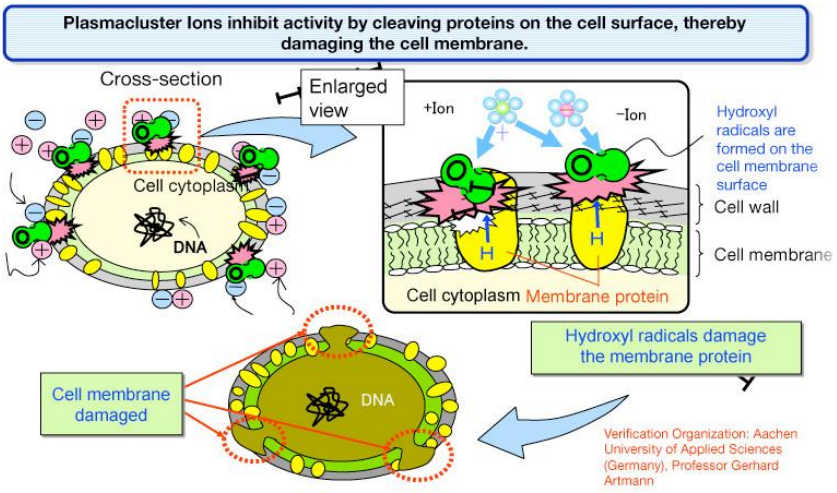
Figure 3 Representative result of plaques assay

- About Plasmacluster Technology

Positively charged ions ($H^+(H_2O)_m$) and negatively charged ions ($O_2^-(H_2O)_n$) are released into the air simultaneously, and the positive and negative ions instantaneously bond on the surface of airborne bacteria, fungi, viruses, allergens, and the like, becoming OH (hydroxyl) radicals which have very high oxidizing power. This is a unique air purification technology that works to suppress the activity of bacteria, etc., by breaking down proteins on their surface by a chemical reaction.



Mechanism for Inhibiting the Activity of Airborne Bacteria



Comparison of Oxidizing Power

The OH^- (hydroxyl) radical has the strongest oxidizing power among active oxygen species

Active Oxygen Species	Chemical Formula	Standard Oxidation Potential [V]
OH^- (hydroxyl) radical	·OH	2.81
Oxygen atom	·O	2.42
Ozone	O_3	2.07
Hydrogen peroxide	H_2O_2	1.78
Hydroperoxyl radical	·OOH	1.70
Oxygen molecule	O_2	1.23

■ Research Institutes That Provided Data for Sharp's Academic Marketing

Target	Testing and Verification Organization
Efficacy proven in clinical trials	Graduate School of Medicine, University of Tokyo / Public Health Research Foundation
	Faculty of Science and Engineering, Chuo University / Clinical Research Support Center, University Hospital, University of Tokyo
	Animal Clinical Research Foundation
	Soiken Inc.
	School of Bioscience and Biotechnology, Tokyo University of Technology
	National Trust Co., Ltd. / HARG Treatment Center
	National Center of Tuberculosis and Lung Diseases, Georgia
	Dentsu ScienceJam Inc.
	Littlesoftware Inc.
	National Institute of Fitness and Sports in Kanoya
Viruses	Kitasato Research Center of Environmental Sciences
	Seoul National University
	Shanghai Municipal Center for Disease Control and Prevention, China
	Kitasato Institute Medical Center Hospital
	Retroscreen Virology, Ltd., UK
	Shokukanken Inc.
	University of Indonesia
	Hanoi College of Technology, Vietnam National University, Vietnam
	Institut Pasteur, Ho Chi Minh City, Vietnam
	National Research Center for the Control and Prevention of Infectious Diseases/Institute of Tropical Medicine, Nagasaki University
Allergens	Graduate School of Advanced Sciences of Matter, Hiroshima University
	Department of Biochemistry and Molecular Pathology, Graduate School of Medicine, Osaka City University
Fungi	Ishikawa Health Service Association
	University of Lübeck, Germany
	Professor Gerhard Artmann, Aachen University of Applied Sciences, Germany
	Japan Food Research Laboratories
	Shokukanken Inc.
	Shanghai Municipal Center for Disease Control and Prevention, China
	Biostir Inc.
	Medical Mycology Research Center, Chiba University
Bacteria	Ishikawa Health Service Association
	Shanghai Municipal Center for Disease Control and Prevention, China
	Kitasato Research Center of Environmental Sciences
	Kitasato Institute Medical Center Hospital
	Dr. Melvin W. First, Professor Emeritus, Harvard School of Public Health, US
	Animal Clinical Research Foundation
	University of Lübeck, Germany

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	Professor Gerhard Artmann, Aachen University of Applied Sciences, Germany
	Japan Food Research Laboratories
	Shokukanken Inc.
	Chest Disease Institute, Thailand
	Biostir Inc.
Odors, pet smells	Boken Quality Evaluation Institute
Skin beautifying effects	School of Bioscience and Biotechnology, Tokyo University of Technology
Hair beautifying effects	Saticine Medical Co., Ltd.
	C.T.C Japan Ltd.
Plant	Facility of Agriculture, Shizuoka University
Hazardous chemical substances	Sumika Chemical Analysis Service Ltd.
	Indian Institutes of Technology
Working mechanism of inhibitory effects on viruses, fungi, and bacteria	Professor Gerhard Artmann, Aachen University of Applied Sciences, Germany
Working mechanism of inhibitory effects on allergens	Graduate School of Advanced Sciences of Matter, Hiroshima University
Working mechanism of skin moisturizing (water molecule coating) effect	Research Institute of Electrical Communication, Tohoku University