Research Institutes That Provided Data for Sharp's Academic Marketing

Target	Testing and Verification Organization	Country
Viruses	Kitasato Research Center of Environmental Sciences	Japan
	Seoul National University	Korea
	Shanghai Municipal Center for Disease Control and Prevention	China
	Kitasato Institute Medical Center Hospital	Japan
	Retroscreen Virology, Ltd.	UK
	Shokukanken Inc.	Japan
	University of Indonesia	Indonesia
	Hanoi College of Technology, Vietnam National University	Vietnam
	Institut Pasteur, Ho Chi Minh City	Vietnam
Allergens	Graduate School of Advanced Sciences of Matter, Hiroshima University	Japan
	Department of Biochemistry and Molecular Pathology, Graduate School of Medicine, Osaka City University	Japan
Fungi	Ishikawa Health Service Association	Japan
	University of Lübeck	Germany
	Professor Gerhard Artmann, Aachen University of Applied Sciences	Germany
	Japan Food Research Laboratories	Japan
	Shokukanken Inc.	Japan
	Shanghai Municipal Center for Disease Control and Prevention	China
Bacteria	Ishikawa Health Service Association	Japan
	Shanghai Municipal Center for Disease Control and Prevention	China
	Kitasato Research Center of Environmental Sciences	Japan
	Kitasato Institute Medical Center Hospital	Japan
	Dr. Melvin W. First, Professor Emeritus, Harvard School of Public Health	US
	Animal Clinical Research Foundation	Japan
	University of Lübeck	Germany
	Professor Gerhard Artmann, Aachen University of Applied Sciences	Germany
	Japan Food Research Laboratories	Japan
	Shokukanken Inc.	Japan
	Chest Disease Institute	Thailand
Odors, pet smells	Boken Quality Evaluation Institute	Japan
Skin beautifying effects	School of Bioscience and Biotechnology, Tokyo University of Technology	Japan
Hair beautifying effects	Saticine Medical Co., Ltd.	Japan
	C.T.C Japan Ltd.	Japan
Efficacy proven in clinical trials	Graduate School of Medicine, University of Tokyo / Public Health Research Foundation	Japan
	Faculty of Science and Engineering, Chuo University / Clinical Research Support Center, University Hospital, University of Tokyo	Japan
	Animal Clinical Research Foundation	Japan
	Japan Soiken Inc.	Japan
	School of Bioscience and Biotechnology, Tokyo University of Technology	Japan
	National Trust Co., Ltd. / HARG Treatment Center	Japan
	National Center of Tuberculosis and Lung Diseases	Georgia
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	Japan
Working mechanism of skin moisturizing (water molecule coating) effect	Research Institute of Electrical Communication, Tohoku University	Japan

Efficacy of Plasmacluster Ions in Inhibiting Activity of Various Pathogens Confirmed Through Collaborative Research

Target Substance	Species	Testing & Verification Organization	Date of Announcement
Bacteria	*Serratia* bacteria	Harvard School of Public Health (Dr. Melvin W. First, Professor Emeritus), United States	March 2007
	Coliform bacteria (*E. coli*)	Ishikawa Health Service Association, Japan	September 2000
	E. coli, *Staphylococcus* (*aureus*), Candida	Shanghai Municipal Center for Disease Control and Prevention, China	October 2001
	Bacillus subtilis	Kitasato Research Center of Environmental Sciences, Japan	September 2002
		CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences), Germany	November 2004
	MRSA (methicillin-resistant *Staphylococcus aureus*)	Kitasato Research Center of Environmental Sciences, Japan	September 2002
		Kitasato Institute Medical Center Hospital, Japan	February 2004
	Pseudomonas, Enterococcus, Staphylococcus	University of Lübeck, Germany	February 2002
	Enterococcus, Staphylococcus, Sarcina, Micrococcus	CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences), Germany	November 2004
Allergens	Mite allergens, pollen	Graduate School of Advanced Sciences of Matter, Hiroshima University, Japan	September 2003
	Mite allergens	Osaka City University Medical School's Department of Biochemistry & Molecular Pathology	July 2009
Fungi	Cladosporium	Ishikawa Health Service Association, Japan	September 2000
		University of Lübeck, Germany (growth-suppressing effect)	February 2002
		CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences), Germany	November 2004
	Penicillium, Aspergillus	University of Lübeck, Germany (growth-suppressing effect)	February 2002
	Aspergillus, Penicillium (two species), Stachybotrys, Alternaria, Mucorales	CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences), Germany	November 2004

Viruses	H1N1 human influenza virus	Kitasato Research Center of Environmental Sciences, Japan	September 2002
		Seoul University, Korea	September 2003
		Shanghai Municipal Center for Disease Control and Prevention, China	December 2003
		Kitasato Institute Medical Center Hospital, Japan	February 2004
	H5N1 avian influenza virus	Retroscreen Virology, Ltd., London, UK	May 2005 August 2008
	SARS virus	Retroscreen Virology, Ltd., London, UK	October 2005
	Coxsackie virus	Kitasato Research Center of Environmental Sciences, Japan	September 2002
	Polio virus	Kitasato Research Center of Environmental Sciences, Japan	September 2002
	Corona virus	Kitasato Institute Medical Center Hospital, Japan	July 2004
	New-type H1N1 influenza virus	Retroscreen Virology, Ltd., London, UK	November 2009

Note: Efficacy in inhibiting activity of the airborne target substances noted above was verified by exposing the substances to an ion concentration of at least 3,000 ions/cm^3.

SEAL OF APPROVAL CERTIFICATE

This is to certify that

Sharp Electronics UK Ltd

Has been awarded the British Allergy Foundation Seal of Approval for reduction in exposure to House Dust Mite and Pollen for their product

Plasmacluster Air Purifier

Model No's without Humidifying Function	Countries
KC930EK	UK
FUW53E, FUW43E, FUW28E, FPF30EU, FUY30EU	EU & Russia
FPP30U, FPA80U, FPA60U, FPA40U, FPA40C, FPA28U, FPA28C, FPF60U, FPF50U	North America
FUA80SA, FUA80EA, FUY30EU, FUZ31E, FUY30SA	Middle East & Africa
FUW53J, FUW28J, FUA80J, FPF30J, FPG50J FUY30J	Australia & New Zealand
FUZ35TA, FUY50K, FUA80E, FUA80A, FUA80TA, FUA80T, FUA80Y, FUW50A FUW40A, FUW25A, FUW53E, FUW53TA, FUW43E, FUW43TA, FUW43T, FUD40T FPD40T, FUD40A, FPD40A, FUD50A, FPD50TA, FPD50E, FPD50Y, FUD80T, FUD50T FUE30A, FPE50E, FPE50TA, FPE50Y, FU551KB, FU551KY, FU551KE, FU551KT, FPF30L FPF30E, FPF30TA, FPF30Y, FPF30SA, FPF30A, FPF40L, FPF40E, FPF40TA, FPF40Y, FPF40A FP-FM40L, FPFM40E, FPFM40B, FPFM40Y, FPGM30E, FPGM30L, FPGM30Y, FPGM30B FPG50L, FPG50E, FPG50TA, FPG50Y, FPGM50L, FPGM50E, FPGM50B, FPGM50Y DWE16FA, FPAG9, FPJ30E, FPJ30L, FPJ30TA, FPJ30Y, FPJ30M, FU-GM50T, FU-G30T FP-FM40A, FUHM30T, FUH30T, FUG50T, FPHM30A, FPH50A, FUJH70T, FPH80L FPH80E, FPH80TA FUY30E, FUY30A, FUY30K, FUY30TA, FUY30T, FUY30EV, FUZ31E FUZ31Y, FUZ31T, FUY28E, FUY28TA, FUY28Y, FUY28EP, FUA28E, FUA28TA, FUA28Y FUA28EV, FUD30T< FPJ30K, FP-H30A-B, FP-J40K, FU-H80T, FP-H90L	Asia
FUA420S, FUAW240SR, FUAW240SW, FUCD30, FUWD30, FUBD30, FUCD20, FUWD20 FUBD20, FUWE10, FUBE10, FUCE10, FUBE80, FXCF100, FXCF90, FUBF30, FUGFM50 DWCE15F, DWE10FT, FXCG908, FUBF30W1, FPBG500W, FUBG31, FPCH70, FUY180SW FUGB10, FP-WH70, FU-WGM51	China
FUA80, FUA51, FUB51, FU-D80, FU-D51, CV-DF100, FUE80, FUE51, CV-EF120, FUF51 FUGK50, FP140EX, FPFX2, FUG51, FUH50, FPAT3, FUA30, FU30P1, FUB30, FU-D30, FUE30, FUF30, FUF28, FUG30, FUH30, FU-JK50	Japan

(Appropriate Room Sizes and the following wording must be Clearly Marked on External Packaging and Instruction Manual)

Signed: Carla Jones

Carla Jones, Chief Executive
Licence No: 323
Valid until: 8th August 2019

BRITISH ALLERGY FOUNDATION • ALLERGY UK SEAL OF APPROVAL •

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Registered in Scotland – Charity No: SC039257

September 18, 2014

In an investigator initiated[*1] clinical trial, Plasmacluster Ion technology[*2] reduced airway inflammation in pediatric patients with mild[*3] to moderate[*4] atopic asthma

In investigator initiated clinical research[*5] commissioned by Sharp, results were obtained in exploratory analysis[*6] indicating that Plasmacluster Ion technology reduced the level of airway inflammation in pediatric patients with mild to moderate atopic asthma (FeNO[*7] value less than 90).

Sharp commissioned The University of Tokyo Hospital, Clinical Research Support Center, to conduct this research, and provided special Plasmacluster Ion generators for use in the clinical study. Mr. Yasuo Ohashi, Emeritus Professor of The University of Tokyo, and also a Professor on the Faculty of Science and Engineering at Chuo University, assumed responsibility for data analysis and design of the clinical research. In addition, Mr. Toshio Katsunuma, Associate Professor, Department of Pediatrics, The Jikei University Daisan Hospital, served as coordinator of trial sites and was in charge of recruiting subjects as well as testing and measurement.

This clinical study targeted 130 pediatric patients with mild to moderate atopic asthma, In this clinical research study, special Plasmacluster Ion generators producing an ion concentration of 100,000 ions/cm^3 were set up in the home in two rooms where the subjects spent long periods of time selected from among the bedroom, living room, and children's room (nursery). Observations were made for eight weeks before and eight weeks after activation of the Plasmacluster Ion generators using the individual randomized crossover double-blind comparison protocol[*8].

This clinical study found that the level of airway inflammation in children with atopic asthma was reduced, and that Plasmacluster Ion technology[*2] will contribute to human health in an actual living environment.

Dust mite allergens are one of the major antigens causing asthma. Thus far, Sharp has proven that Plasmacluster Ions have an inhibitory effect against airborne dust mite allergens[*9], which are in dust mite fecal pellets and body fragments, and also went on to elucidate the mechanism underlying the inhibition of these allergens[*10].

In the future, Sharp will push ahead with further development of Plasmacluster Ion technology[*2] and continue to prove its efficacy with the aim of creating a healthy environment.

It should also be noted that the details of this clinical study are scheduled to be presented by the research group (Professors Yasuo Ohashi and Toshio Katsunuma) at the 51st Annual Meeting of the Japanese Society of Pediatric Allergy and Clinical Immunology to be held beginning November 8, 2014.

Comments by Mr. Yasuo Ohashi, Emeritus Professor of The University of Tokyo, and Professor, Faculty of Science and Engineering, Chuo University

This double-blind randomized clinical study of a home appliance technology for pediatric asthma patients is unique, and I can say that there is a strong trailblazing spirit in this current study. The findings indicate that there is a potential for Plasmacluster Ion technology to reduce the level of airway inflammation in pediatric patients with mild or moderate atopic asthma. This study will contribute to the development and deployment of the methodology, and I think it suggests that Plasmacluster Ion technology will make a difference in the world.

Comments of Mr. Toshio Katsunuma, Associate Professor, Department of Pediatrics, The Jikei University Daisan Hospital

Plasmacluster Ion technology is not a drug nor even medical equipment. This technology shows the potential to suppress respiratory tract inflammation in children with mild to moderate asthma and to improve their respiratory function, and I think this is highly significant with respect to undertaking long-term care of asthmatic children.
It is my hope that this data will bring good news to children with asthma and to their families.

*1 The University of Tokyo Hospital, Clinical Research Support Center was commissioned to conduct this research and provide research support.

*2 Plasmacluster is a registered trademark of Sharp Corporation.

*3 Mild asthma is defined as having coughing or wheezing symptoms more than once a month but not more than once a week. At times, it may be accompanied by difficulty in breathing. Duration is short, and interference in daily life is minimal (based on the Japanese Pediatric Guideline for the Treatment and. Management of Asthma 2012).

*4 Moderate asthma is defined as having coughing or wheezing symptoms at least once week, but not continuing on a daily basis. On occasion, it may manifest as a moderate to severe attack, and disrupts sleep and/or normal daily activities (based on the Pediatric Guideline for the Treatment and. Management of Asthma 2012).

*5 The University of Tokyo Hospital, Clinical Research Support Center, the organization contracted to conduct this research, is independent of Sharp Corporation and was commissioned to provide support in the form of planning of clinical research to implementation and reporting.

*6 Prior to the start of the study, it was determined that the analysis would cover all subjects. However, under this criteria, it was not possible to verify the effects of Plasmacluster Ion technology, most likely because subjects suffering from high levels of inflammation were included. By limiting the range of subjects, an improvement in respiratory function was found, for which expectations were initially low.

*7 Fractional exhaled nitric oxide, a measure of the concentration of NO in exhaled breath. An indicator of the level of airway inflammation.

*8 A protocol for clinical trials designed to objectively examine the efficacy of investigational new drugs.

*9 Announced on September 3, 2003.

*10 Announced on July 21, 2006.

Overview of Clinical Research

Participants

130 asthma patients between the ages of 6 and 15 years, with mild*3 or moderate*4 cases of atopy

Research design

Subjects were randomly split into two groups, and ion generators made specifically for clinical research were placed in their homes.
The individually randomized double-blind crossover comparison protocol*8 was used.

Period

August 9, 2013 to May 30, 2014

Assessment items

Change in FeNO value*7, change in asthma symptoms, change in respiratory function value, QOL (quality of life)*11

Ion density of ion generating device made specifically for clinical research

Maximum ion density of approximately 100,000 ions/cm^3

Test results

• For subjects who had an initial FeNO value*[7] of 90 or less, compared to the placebo device*[12], use of the ion generating device made specifically for clinical research resulted in a decrease (an improvement) in the FeNO value*[7], which is one of the indicators of inflammation.

• For subjects who had an initial FeNO value*[7] of 90 or less, compared to the placebo device*[12], use of the ion generating device made specifically for clinical research resulted in an increase (an improvement) in V_{25}*[13],which is one of the indicators showing constriction of peripheral airways of lungs.

• Compared to pre-test values, by the end of the test there was a decrease (an improvement) in the QOL score.

*11 QOL: Like the name suggests, Quality of Life is an assessment of the quality of a person's day-to-day living conditions.

*12 Placebo device: A device that disperses air without Plasmacluster Ions.

*13 An indicator of the state of the airways (in particular the peripheral airways of lungs), one of the factors of respiratory functions.

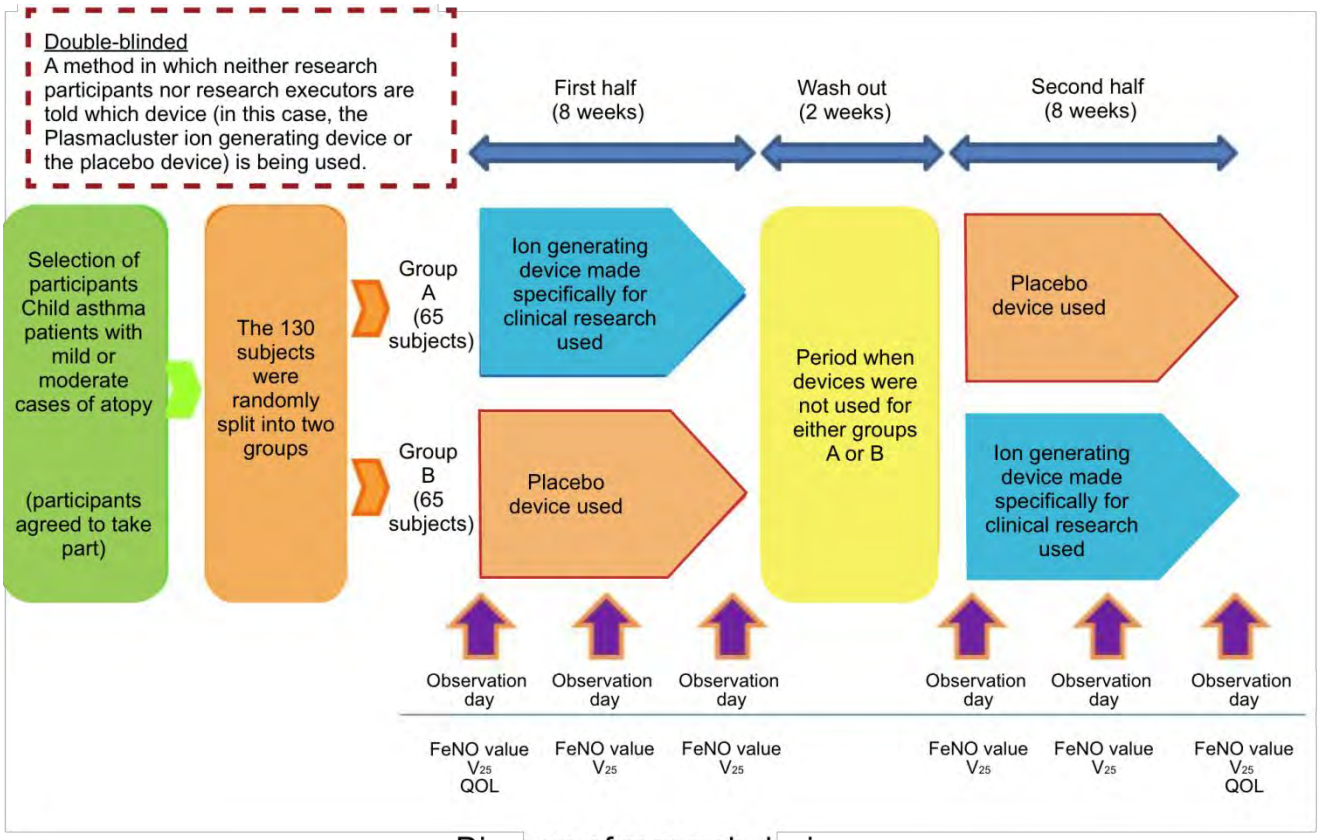

Diagram of research design

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The International Journal of Tuberculosis and Lung Disease

The Official Journal of the International Union Against Tuberculosis and Lung Disease

ABSTRACT BOOK

41st World Conference on Lung Health of the International Union Against Tuberculosis and Lung Disease (The Union)

BERLIN · GERMANY
11–15 NOVEMBER 2010

PS-101205-13 Monitoring anti-tuberculosis drug induced chemical changes in *M. tuberculosis* by SERS

Y Chen,[1,2] C Y Chuang,[1] W C Cheng,[1] H H Wang,[1,3] R W Jou,[4] J K Wang,[1,5] C H Lin,[2] Y L Wang.[1,3] [1]Institute of Atomic and Molecular Sciences, Academia Sinica, Taipei, Taiwan, [2]Institute of Microbiology and Immunology, School of Life Science, National Yang-Ming University, Taipei, Taiwan, [3]Department of Physics, National Taiwan University, Taipei, Taiwan, [4]Centers for Diseases Control, Taipei, Taiwan, [5]Center for Condensed Matter Sciences, National Taiwan University, Taipei, Taiwan, China.
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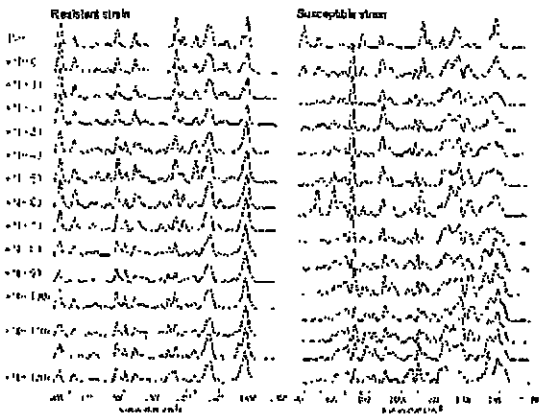
Aim: To monitor antibiotic-induced chemical changes of *Mycobacterium tuberculosis* by surface-enhanced Raman spectroscopy (SERS) and to demonstrate the feasibility of using such a high-speed nondestructive optical technique for detecting the differences between drug-susceptible and drug-resistant strains.
Methods: Substrates with extremely large and uniform enhancing power are exploited for measuring the vibrational spectra of molecules on the cell-wall of *M. tuberculosis* by SERS. Thanks to the sensitivity of the method, the spectrum of single or few bacteria can be recorded in a few seconds, allowing real time monitoring of chemical changes on bacteria after being exposed to antibiotics. Based on the characteristic differences in the changes, drug susceptibility of *M. tuberculosis* can be identified. Pan-susceptible and monodrug (isoniazid, rifampicin, ethambutol, or pyrazinamide) resistant *M. tuberculosis* were analyzed.
Results: The SERS spectra of a pan-susceptible *M. tuberculosis* strain exhibits dramatic changes in a few tens of minute after treating with isoniazid (INH), as shown in the following example (Figure). In contrast, the SERS spectra of an INH-resistant strain show relatively minor and stable changes. Two robust peaks (400 cm-1 and 525 cm-1) for INH resistant, while one (725 cm-1) for INH susceptible *M. tuberculosis* were identified.



Conclusion: The SERS-based detection platform with single bacterium sensitivity opens unprecedented opportunities for drug susceptibility testing of *M. tuberculosis* and assessing the efficacy of new drugs for tuberculosis.

PS-101291-13 SELDI-TOF-MS for detecting serum protein biomarkers of smoking in North Chinese Han males

D Xiao, S I Chu, C Wang. Beijing Institute of Respiratory Medicine, WHO Collaborating Center for Tobacco or Health, Beijing, China. e-mail: xiaodan7299@hotmail.com

Objectives: To discover the potential biomarkers and establish a diagnostic pattern for smoking by using proteomic technology.
Methods: Serum proteomic spectra were generated by surface-enhanced laser desorption ionization time of flight mass spectrometry (SELDI-TOF-MS). A set of spectra, derived from analyzing serum from 40 smokers and 40 age- and sex-matched healthy non-smokers, was used to develop a decision tree model with a machine learning algorithm called decision boosting. A blinded testing set, including 10 smokers and 10 healthy non-smokers, was used to determine the accuracy of the model.
Results: The diagnostic pattern with a panel of three potential protein biomarkers of mass-to-charge (m/z) 3159.13, 7561.03, 9407.32 could accurately recognize 38 of 40 smokers and 39 of 40 non-smokers. Validation on the blinded testing set indicated that the decision tree could differentiate 8 of 10 smokers and 10 of 10 non-smokers.
Conclusions: The preliminary data suggested a potential application of SELDI-TOF-MS as an effective technology to profile serum proteome of smoking, and with pattern analysis, a diagnostic model comprising three potential biomarkers was indicated to differentiate smokers and non-smokers rapidly and precisely.

PS-101364-13 Efficiency of Plasmacluster ion in killing of *Mycobacterium tuberculosis* on culture media ***

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e-mail: charojnj@hotmail.com

Setting: Prevention of tuberculosis transmission in environment is control ventilation, ultraviolet germicidal irradiation and filtration air with high efficiency particulate air filter. New innovation of Plasmacluster ion generation for air cleaning has been proved to be effective in killing pathogenic viruses, clinically important bacteria and fungus. There was no any study done for *Mycobacterium tuberculosis*.
Objective: To study the efficiency and exposure time of Plasmacluster ions in killing standard strain of

M. tuberculosis (H37Rv) and 50 isolated *M. tuberculosis* strains from tuberculosis patients on culture media in laboratory.
Method: Prepare suspension of bacteria with McFarland No.1 and diluted to 1:10000. Inoculate 0.1 ml. suspension on Middlebook 7H10 media for 5 media. Incubate media in incubator at 37°C for 48 hours to check contamination. Expose 4 media at a distance of 1 foot from Plasmaclustrer Ions Generator in a closed chamber. After 15, 30, 45 and 60 minutes brought out one media each time. The uuexposed media was used as a control. Incubate all media in incubator and read result after 3 weeks. Standard strain was repeated test for 3 times.
Result: For standard straius of *M. tuberculosis* there was no growth after exposure time of 30 minutes. For clinical isolate strains, there was no growth after exposure time of 15, 30, 45 and 60 minutes in 4 (8%), 4 (8%), 9 (18%) and 19 (38%) strains respectively. In 14 (28%) strains which has growth on media after 60 minutes of exposure, the number of colony on media was declined according to the longer exposure time.
Conclusion: Plasmacluster ions can kill *M. tuberculosis.*

PS-101427-13 Financing of TB in a low-income country: the case of DRC

F Kalunga,[1] S Kavuke,[1] G Kabuya,[1] M Kaswa,[1] G Bakaswa,[2] S Bisuta,[1] J P Oklata.[1] [1]National Program Tuberculosis, Kinshasa, [2]Damian Action, Kinshasa, Democratic Republic of the Congo. e-mail: kmutala@yahoo.fr

Introduction: The TB Program has a Development Plan 2006-2015, which cost $545 861 560. Since 1996, the NTP applies the DOTS. The detection rate remains low (61%), but the success rate in treatment of new cases TPM + is 85% in 2005. The NTP is supported by the Government, the Global Fund (in Rounds 2, 5 and 6), Action Damien TLMI, USAID, The Union, WHO, ALM, UBS, CE detection rate is increasing with increased funding.
Objective: To show how PNTLT DRC could achieve efficient outcomes (indicators WHO) with a diversity of donors and the mode of financing.
Methodology: Full analysis of how and financing strategies of the Strategic Plan NTP DRC from 2006 to 2009.
Results: Four years after the implementation of its Strategic Plan, the NTP has mobilized $79 079 743 (14.49%). The Gap cover is $466 781 820 (85.51%) until 2015.
Conclusion: End 2009, the Strategic Plan has been funded at 14.49% and the number of diagnosed patients has increased from 98 139 to 111 851 for the same period.

PS-101444-13 Recruiting adolescents for an epidemiology study in Uganda in preparation for TB vaccine trials

J Waako,[1] A Wajja,[2] P Nabongo,[1] H Mayanja-Kizza.[2,3] [1]TB Study, Iganga/Mayuge Demographic Surveillance Site, Iganga, [2]Infectious Diseases Institute, Makerere College of Health Sciences, Kampala, [3]Department of Medicine, Makerere College of Health Sciences, Kampala, Uganda. e-mail: awajja@idi.co.ug

Background: A number of novel TB vaccines currently in early phases of development will need to be tested in large phase III trials in developing countries. Adolescents, a potential target population are not a usual target for vaccines and require both proxy consent and assent to participate. As a prerequisite, it is important to determine the incidence of TB and feasibility of forming, tracking and retaining a cohort in this population. As part of site preparation, we are conducting an epidemiological study to estimate the incidence and prevalence of Tuberculosis disease among adolescents in the Iganga/Mayuge Demographic Surveillance Site in Uganda.
Methods: A cohort of 7000 adolescents aged 12–18 years is being recruited and followed for two years. Adolescents identified from the DSS database are visited at home to obtain parental consent while assent is obtained at school. At enrolment, key demographic parameters, vital signs and relevant medical history are collected. All participants have TST administered to determine annual risk of TB infection. Participants identified as TB suspects as defined by the protocol undergo TB diagnostic work up which includes sputum coaching and collection of 2 sputum samples.
Results: Difficulty in obtaining parental consent and adjusting to the school calendar and schedule are the main challenges in recruitment. Out of 1269 participants enrolled, 1179 (93%) are school going. A total 499 met the criteria for TB diagnostic work up; 224 were TST positive (≥10 mm), 69 had cough of ≥14 days and 106 had positive household contacts. So far, there are 6 smear positive participants of whom 4 are culture confirmed *M. tuberculosis* but none have HIV.
Conclusion: Early results indicate there is TB in this population and recruitment is feasible however sites need to devise ways of addressing the challenges.

PS-100778-13 The nutritional status IFN-γ response of household and non-household tuberculosis contacts

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Background: Malnutrition has long been associated with the development of tuberculosis and may be re-

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News Release

September 8, 2016

Plasmacluster Technology[1] Proven to Decrease Risk of Tuberculosis Infection in Tuberculosis Hospital for the First Time[2]

Sharp, in cooperation with WHO Global Health Workforce Alliance[3] National Center of Tuberculosis and Lung Disease in Tbilisi, Georgia, has effectively proven the decreased risk of Tuberculosis transmission among hospital healthcare workers and prevention of acquired drug resistance (ADR)[4] among patients using Plasmacluster technology (100,000 ions/cm^3) for the first time in history.

Tuberculosis is an infection caused by bacteria *Mycobacterium Tuberculosis*. Over 9.6 million people worldwide were infected with Tuberculosis[5] in 2015 and 1.5 million of those died from the disease[5]. This makes it one of the most fatal stand-alone infection in the world.

By releasing Plasmacluster positive ions (H^+ $(H_2O)_m$) and negative ions (O_2^- $(H_2O)_n$) in the air at the same time, Plasmacluster ions form highly oxidized OH radicals that break down the surface protein of airborne microbes leading to their complete eradication. In cooperation with Chest Disease Institute Dr. Charoen of Thailand, Plasmacluster technology was used to effectively suppress attached Tuberculosis bacteria. Those findings were released in September 2009[6]. This time, Plasmacluster ion test devices emitting an average ion concentration of 100,000 ions/cm^3 were set up at Tuberculosis hospital. Through this test, the decreased risk of Tuberculosis infection for healthcare workers, and positive impact in preventing the development of acquired drug resistance for Tuberculosis patients were confirmed.

Sharp has been involved with academic marketing[7] to verify the effectiveness of Plasmacluster technology in cooperation with global testing organizations since 2000. The effectiveness of controlling hazardous substances such as new types of the influenza virus, drug-resistant bacteria, mite allergens, and also reducing the risk of tracheal inflammation in childhood asthma patients[8] has been proven in our 28 tests that took place so far[9]. The safety of Plasmacluster technology has also been confirmed[10] through these trials. Sharp aims to continue such types of studies to explore even more benefits that the Plasmacluster technology can support the society with.

It should also be noted that the details of this clinical study are scheduled to be presented by the research group at the 21st Congress of Asian Pacific Society of Respirology to be held on November 12-15, 2016.

Comment from the National Center of Tuberculosis and Lung Disease in Tbilisi, Georgia

Until now, there have been limited data globally from high TB burden settings on how Infection Control means such as ventilation, UV, etc. contribute to the prevention of Tuberculosis transmission within hospitals. With the current research on Plasmacluster technology, we have been able to accomplish this task and developed capacity that can be used to pioneer future scientific experiments in the field. We believe Plasmacluster technology has a good chance to play an important role as one of the measures to prevent the spread of Tuberculosis bacteria in specialized Tuberculosis hospitals.

1 Plasmacluster is a trademark of Sharp Corporation.
2 Test applicable to healthcare providers and tuberculosis patients using engineering control in tuberculosis hospitals. Sep 8, 2016, Sharp research.
3 WHO HP: http://www.who.int/workforcealliance/members_partners/member_list/tbgeo/en/
4 Acquired drug resistance (ADR) is defined as patients that develop resistance to antituberculosis drugs.
5 World Health Organization. Tuberculosis fact sheet number 104. Reviewed March 2016.
6 Released on Sep 22, 2009
7 A marketing method that advances commercialization by researching the effectiveness of technology by analyzing scientific data with leading academic institutions.
8 Released on Sep 18, 2014
9 As of Sep 8, 2016
10 Based on tests conducted at LSI Medience Corp. (inhalation toxicity test, skin/eye irritation and corrosion test, teratogenic test, 2D reproductive toxicity test)

■ Plasmacluster ion devices Installation Conditions at Tuberculosis Hospital

All experiments using 140 Plasmacluster ion devices were conducted on a designated floor inside the Tuberculosis Hospital where the ion concentration was kept at an average of 100,000/cm^3.

Photo: Plasmacluster ion device experimental installation in the hospital room

Photo: Plasmacluster ion device experimental installation in the hospital corridor

■ Results of Reduced Risk of Tuberculosis Infection for Healthcare Workers

88 healthcare workers were tested for Tuberculosis bacteria using QuantiFERON®-TB Gold In-Tube (QFT)[11]. 32 of the healthcare workers who did not carry the bacteria were tested again after 6-8 months using QFT test.

Healthcare workers in the 100,000/cm^3 Plasmacluster ion device setting decreased their risk of getting latent Tuberculosis infection by 75% compared with those who were not in the Plasmacluster ion device setting.

Healthcare Provider QFT Results

Use of Plasmacluster Ions	QFT Negative (number of people)	QFT Positive (number of people)	Total (number of people)	Odds
Yes	10	1	11	0.10
No	15	6	21	0.40
Total (number of people)	25	7	32	

■ Prevention of Acquired Drug Resistance in Tuberculosis Hospital Patients

155 Tuberculosis culture positive patients in the Drug Sensitive department received the Drug Susceptibility Testing (DST)[12]. After a 3-month period, 49 patients who remained culture positive received DST again.

Those who were in the 100,000/cm^3 Plasmacluster ion device setting showed 78% of prevention in acquired drug resistance compared to those who were not in the Plasmacluster ion device setting.

Acquired drug resistance among Tuberculosis Patient based on DST result

Use of Plasmacluster Ions	ADR NO (number of people)	ADR YES (number of people)	Total (number of people)	Risk
Yes	25	1	26	0.038
No	19	4	23	0.174
Total (number of people)	44	5	49	

11 QuantiFERON®-TB Gold In-Tube is a test for detection Latent Tuberculosis Infection (LTBI) using a blood sample. It came into use in 2007.

12 Drug Susceptibility Testing is a test used to determine which medicine to administer to patients who carry the tuberculosis bacteria.

■Cooperating Researchers

Zaza Avaliani, MD, PhD
Professor
Director of the National Center for Tuberculosis and Lung Diseases

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Director of Clinical Research at the National Center for Tuberculosis and Lung Diseases
WHO TA on Infection Control and Biosafety

Nino Lomtadze, M.D., MSc, PhD Candidate
Head of TB Surveillance and Strategic Planning Department at the National Center for Tuberculosis and Lung Diseases

■ Introduction of National Center of Tuberculosis and Lung Diseases

National Center of Tuberculosis and Lung Diseases (NCTLD) is a non-profit organization that was founded in 2001. It is a head facility for TB control in Georgia, which creates implements and administers the National Tuberculosis Program. The program aim is to decrease spreading of Tuberculosis in Georgia. The main functions of the Center are:

1. Administration of National Tuberculosis Program, partnership with local and foreign (international) Governmental and Non-Governmental organizations;

2. Provision of high quality TB diagnosis;

3. Treatment of TB patients; and

4. Prevention of Tuberculosis.

The Center was created after reorganization, based on the Institute of Tuberculosis and Lung diseases, the city TB Hospital, and the Georgian Railway TB-Stationary. Today, the center is presented by administrative, diagnostic and treatment branches.

Logo Mark of NCTLD

(Reference *WHO HP*
http://www.who.int/workforcealliance/members_partners/member_list/tbgeo/en/)

Photo; The appearance of the hospital

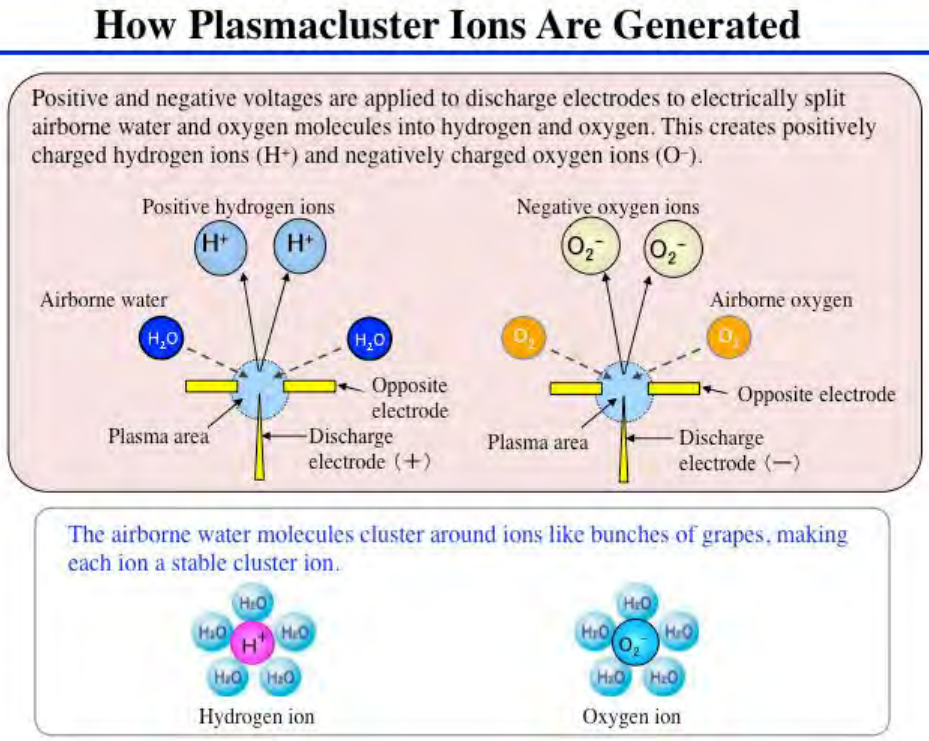
■ **Key Facts on Tuberculosis**

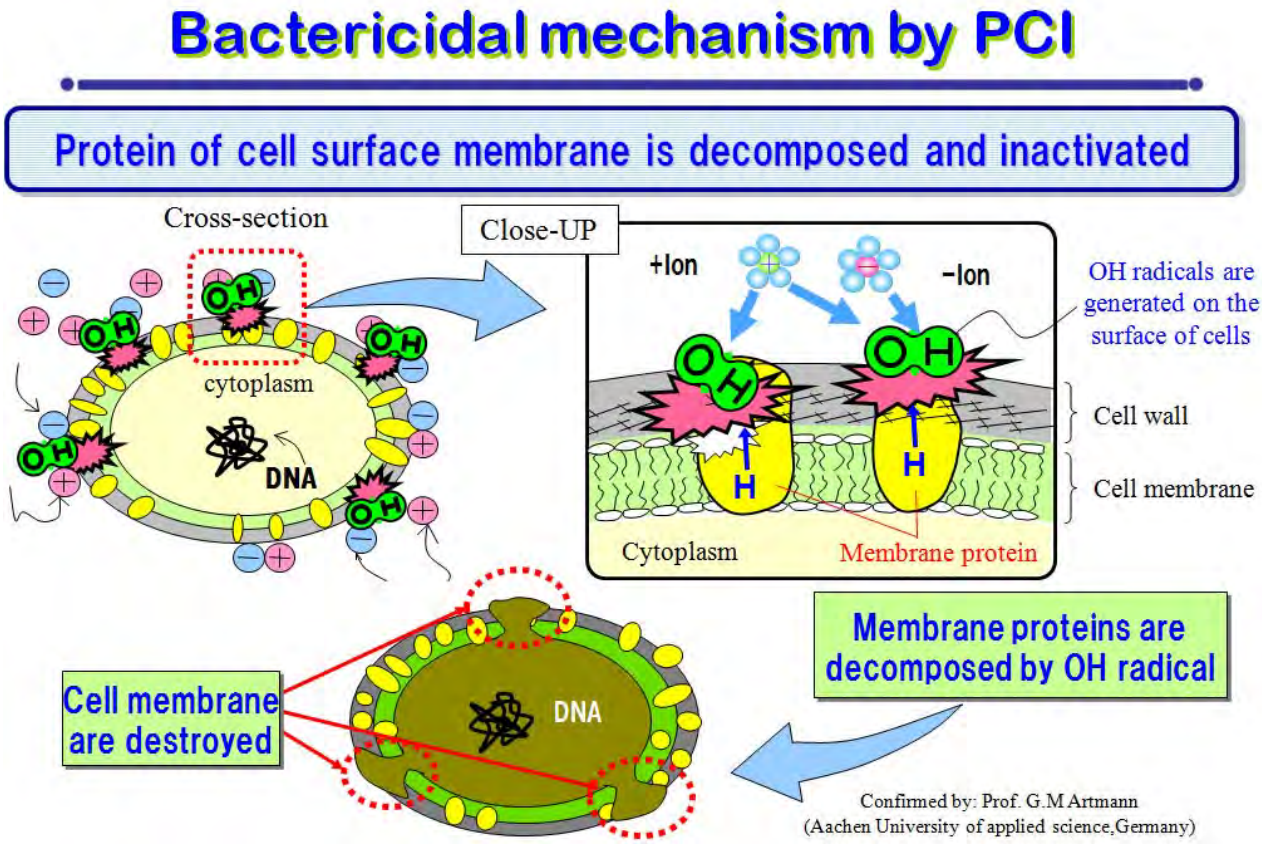
- Tuberculosis (TB) is one of the most fatal stand-alone infection in the world.
- In 2014, 9.6 million people were infected with Tuberculosis and 1.5 million died from the disease.
- Over 95% of Tuberculosis deaths occur in low- and middle-income countries, and it is among the top 5 causes of death for women aged 15 to 44.
- In 2014, an estimated 1 million children were infected with Tuberculosis and 140,000 children died of Tuberculosis.
- Tuberculosis is a leading killer of HIV-positive people: in 2015, 1 in 3HIV deaths was due to Tuberculosis.
- Globally in 2014, an estimated 480,000 people developed multidrug-resistant Tuberculosis (MDR-TB).
- The Millennium Development Goal target of halting and reversing the Tuberculosis epidemic by 2015 has been met globally. Tuberculosis incidence has fallen by an average of 1.5% per year since 2000 and is now 18% lower than the level of 2000.
- The Tuberculosis death rate dropped 47% between 1990 and 2015.
- An estimated 43 million lives were saved through Tuberculosis diagnosis and treatment between 2000 and 2014.
- Ending the Tuberculosis epidemic by 2030 is among the health targets of the newly adopted Sustainable Development Goals.

（Reference　*WHO. Fact sheet N°104. Media Centre. Reviewed March 2016 Tuberculosis*
http://www.who.int/mediacentre/factsheets/fs104/en/index.html ）

About Plasmacluster Technology

In Sharp's proprietary air purification technology, positively charged hydrogen ions ($H^+ (H_2O)_n$) and negatively charged oxygen ions ($O_2^- (H_2O)_m$) are discharged simultaneously. These positive and negative ions instantaneously bond on the surface of airborne substances such as bacteria, fungi, viruses, and allergens, becoming highly reactive OH radicals (hydroxyl radicals) that break down the proteins on the surface of these bacteria and other substances. By chemical reaction, the OH radicals work to suppress the activity of those substances.





Comparison of Oxidation

Positive and negative ions bond on the surface of airborne viruses and bacteria and react chemically to form OH radicals, which have high oxidation power (standard oxidation potential 2.81 V). These reduce the contagiousness of airborne viruses and the activity of bacteria.

Active Substances	Chemical Formula	Standard Oxidation Potential (V)
Hydroxyl radicals	OH	2.81
Oxygen atom	O	2.42
Ozone	O_3	2.07
Hydrogen peroxide	H_2O_2	1.78
Hydroperoxyl radical	OOH	1.7
Oxygen molecule	O_2	1.23

Source: *Fundamentals and Applications of Ozone*

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

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

	Chest Disease Institute	Thailand
Odors, pet smells	Boken Quality Evaluation Institute	Japan
Skin beautifying effects	School of Bioscience and Biotechnology, Tokyo University of Technology	Japan
Hair beautifying effects	Saticine Medical Co., Ltd.	Japan
	C.T.C Japan Ltd.	Japan
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	Japan
Working mechanism of skin moisturizing (water molecule coating) effect	Research Institute of Electrical Communication, Tohoku University	Japan

Contract Research Report.

受託研究成果報告書

Title: Effects of deactivation for mite allergen with plasma Claster Ion (P.C.I.)

研究課題名: プラズマクラスターイオンによるダニアレルゲン失活効果

－アレルゲンとPCIの濃度依存性の検証－

— Verification of concentration dependence between Allergen and P.C.I.

Period:

実施期間: 1st, Feb, 2009 30th, Apr. 2009.

平成21年2月1日 ～ 平成21年4月30日

Osaka City Univ. Medical Department, Biochemistry Course.

大阪市立大学医学部生化学講座・

大学院医学研究科生化学分子病態学講座

教授 井上正康

Prof. Mn. Inoue Masayasu.

Indoor Suspended Allergen Inactivation Technology Using Cluster Ions Generated by Discharge Plasma

Kazuo Nishikawa* Hideo Nojima*

Abstract

Mite allergen deactivation technology has been developed using cluster ions generatedby discharge plasma at atmospheric pressure. The effect of ions on airborne mite allergenshas been evaluated by ELISA and ELISA inhibition methods. The allergy reactivity of miteallergens has been reduced with exposure to ions generated by the present device, andit has been confirmed that these ions can deactivate airborne mite allergens. Furthermore,efficacy tests of these ions on airborne mite dust allergens floating indoors have beenperformed, and significant deactivation of these allergens due to the effect of ions hasbeen confirmed.

Preface

Mite allergies, hay fever, food allergies and atopic rashes receive widespread coverage in the media today.[1,2] The prevalence of these allergies is increasing every year in the developed world, and a survey by Japan's Ministry of Health, Labour and Welfare found that 1 in 3 Japanese have allergies. Caused by factors such as living environments, changing dietary habits and increasing stress, allergies are some of the diseases of civilization' that afflict the modern world.

Previous Sharp research work has shown that positively and negatively charged cluster ions generated by discharge plasma at atmospheric pressure can be used to inactivate suspended airborne bacteria, fungi, and viruses, and to remove toxic substances from tobacco smoke.[3,4,5]

The research described in this paper examined mite allergens (the major indoor allergens) and cluster ions generated by a discharge plasma created by ion generators at atmospheric pressure. We conducted tests to verify the effectiveness of these ions in inactivating these allergens, and found that the interaction of positive and negative cluster ions can significantly inactivate airborne mite allergens and inhibit their allergic reactivity. We also verified their effectiveness of cluster ions in inactivating suspended mite dust in indoor environments. The effects we verified have been successfully applied to develop new-concept air purification technology. This paper reports on the effectiveness of positively and negatively charged cluster ions generated by ion generators in inactivating airborne mite allergens.

1. Experimental apparatus and methodology

1.1 Ion generators[4]

Figure 1 is a photo showing the type of ion generator used in the tests. Electrodes are formed

*A1241 Project Team member

Fig. 1 Photograph of the ion generation device.

on the surface of a flat-plate dielectric, applying a high-voltage AC current to create a plasma discharge state on the surface. The discharge plasma ionizes and dissociates the molecules in the air to generate positively and negatively charged ions. For the tests described in this paper, the generated ions were diffused throughout the space by an air blower. The generated ion species were positively charged cluster ions of $H_3O^+(H_2O)_m$ (where m is an integer) and negatively charged cluster ions of $O_2^-(H_2O)_n$ (where n is an integer).

1.2 Specimen preparation method

We placed 1 g of adult European house mites (Dermatophagoides pteronyssinus; Der p) on 5 g of a food source (powdered Ebios beer yeast mixed in a 1:1 weight ratio with Lab. Animal Diet MF' used for mice, rats and hamsters), and allowed them to propagate for 2 months in an environment of 25°C and 75% RH. We then heated the specimen in a microwave oven for 2 minutes at 500 W, allowed it to air-dry overnight, then finely pulverized it to a uniform consistency in a mortar to create mite dust. The crude mite antigen we used (Dfb) was refined from this mite dust.

1.3 Crude mite antigen inactivation test method

Figure 2 shows the test apparatus. We used an acrylic cylindrical container of 50 cm in height and 14 cm in diameter fitted with 4 ion generators inside it, and a top-mounted nebulizer for spraying allergens. During the experiment, we filled the apparatus with positive and negative ions in an average concentration of 100,000 ions/cm^3, and sprayed a mist of crude mite antigen (with a protein concentration of 200 ng/ml) from the nebulizer (Omron model NE-C10) on top of the apparatus. After the crude antigen had been suspended in the ion space for about 90 seconds, we collected it with the collection container at the bottom of the apparatus.

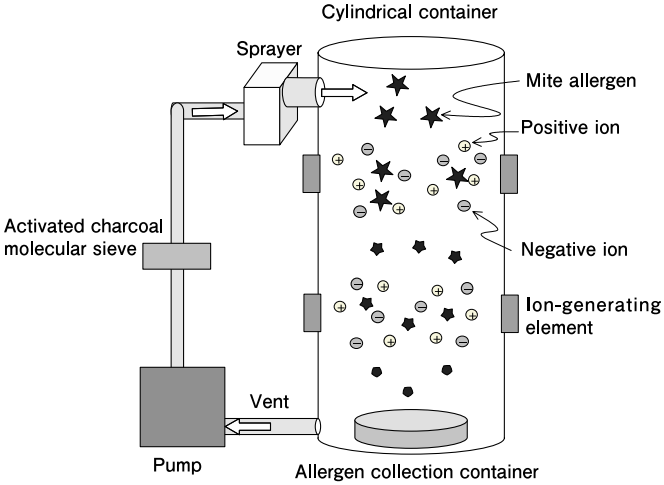


Fig. 2 A mite allergen atomization and collection system.

We then carried out an ELISA (enzyme-linked immunosorbent assay) to assess the change in the allergic reactivity of the collected crude mite antigen (Dfb) to anti-Der f 1 and anti-Der f 2 mouse antibodies (manufactured by Seikagaku Corporation), and to serum IgE antibodies from mite allergy sufferers. To quantitatively assess the allergic reactivity of crude mite antigens exposed to ions, we used the ELISA inhibition method to measure the allergen inactivation rate of the crude mite antigen.

1.4 Mite dust inactivation test method

Figure 3 shows the test apparatus. We installed ion generators and an air blower for ion agitation in a cubic acrylic chamber of 1 m^3 in volume (1×1×1 m). We suspended 0.5 g of mite dust in the chamber, exposed it to ions for 15 minutes, then used a suction pump to evacuate the air from the chamber and pass it through a membrane filter to collect the mite dust. We extracted the proteins from the mite dust exposed to ions (the test group) and the mite dust not exposed to ions (the control group), and measured the protein quantity of each group by the Folin-Lowry method to quantitatively assess the difference between each group's allergic

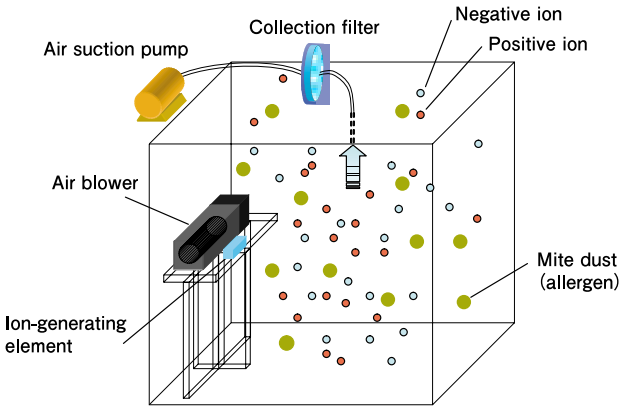


Fig. 3 Schematic diagram of the test apparatus.

reactivity to serum IgE antibodies from mite allergy sufferers. After making the protein concentrations of each group uniform, we used the ELISA inhibition method to measure the allergen inactivation rate of the mite dust of each group. We then allowed sensitized mouse mast cells to react with allergens extracted from the mite dust exposed to ions, and observed the mast cell response.

2. Experimental results and observations

2.1 Change in allergic reactivity of Der f 1 and Der f 2 (major component antigens of the crude mite antigen)

We carried out an ELISA to assess the change that ion exposure created in the allergic reactivity of Der f 1 and Der f 2 (the major component antigens of the crude mite antigen) to their monoclonal antibodies. Figure 4 shows the results. We exposed the crude mite antigen to an average ion concentration of 100,000 ions/cm^3 for 90 seconds.

We measured the allergic reactivity of the crude mite antigen to the anti-Der f 1 and anti-Der f 2 monoclonal antibodies when the crude mite antigen was exposed to ions (test group) and not exposed (control group). We carried out the test 3 times and used significance testing to obtain a 95% confidence interval by statistical analysis. Our results verify that the allergic reactivity of both Der f 1 and Der f 2 (the major component antigens of the crude mite antigen) to their monoclonal antibodies was significantly reduced by ion exposure.

2.2 Change in crude mite antigen allergic reactivity

We carried out an ELISA to assess the allergic reactivity of the crude mite antigen to serum IgE antibodies from mite allergy sufferers, when the crude mite antigen was exposed to ions (test group) and not exposed (control group). Figure 5 shows the results. We tested the significance of the

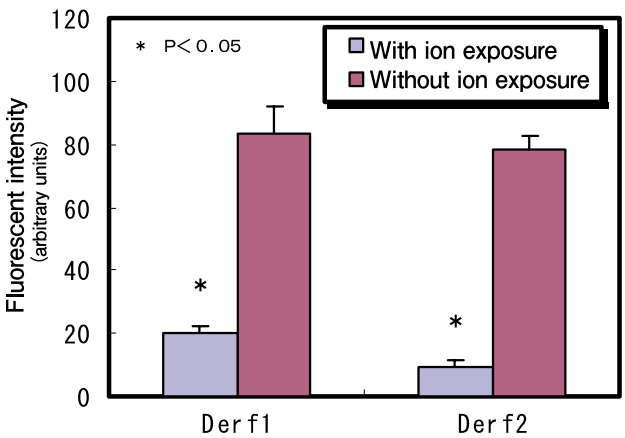


Fig. 4 Allergy reaction of principal mite allergens Der f 1, Der f 2 with exposure to ions.

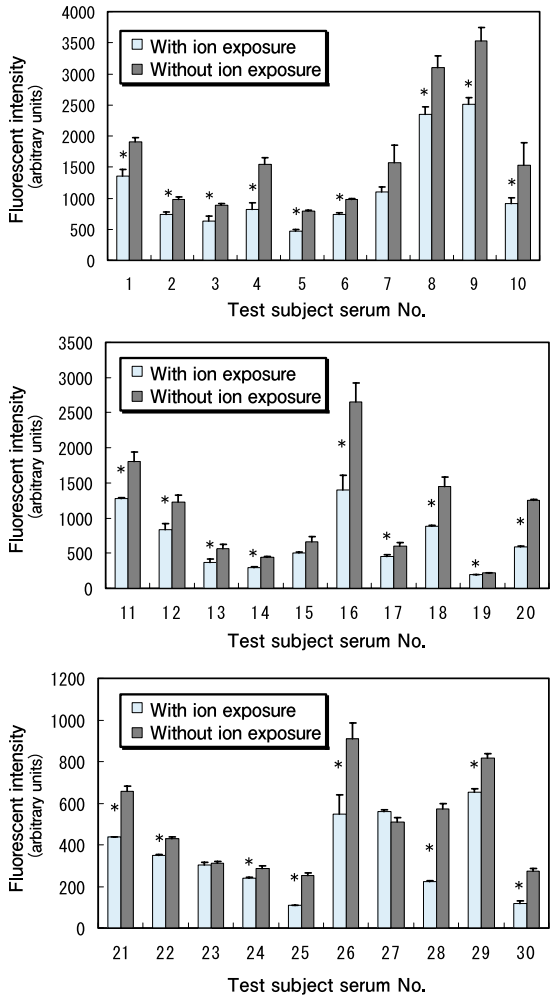


Fig. 5 Allergy reaction of refined mite allergens with exposure to ions.

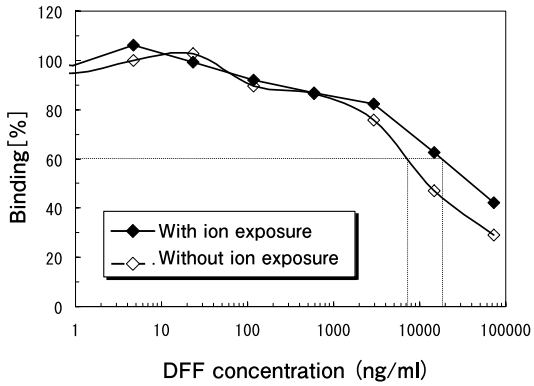


Fig. 6 Deactivation effect of refined mite allergens with exposure to 100,000 counts/cm^3 ions for 90sec.

change 3 times and used significance testing to obtain a 95% confidence interval by statistical analysis.

We measured allergic reactivity to the serum IgE antibodies of 30 mite allergy sufferers, and verified that ion exposure significantly reduced the allergic reactivity of 26 of the 30 sufferers. This finding indicates that allergic reactions were significantly

reduced for 87% of mite allergy sufferers. Reactivity to IgE antibodies fell by 80% or more for 4 test subjects, by 70 to 80% for 2 subjects, by 60 to 70% for 5 subjects, by 50 to 60% for 6 subjects, by 40 to 50% for 3 subjects, and by 30 to 40% for 4 subjects.

We used the ELISA inhibition method to measure the allergen inactivation rate by quantitative measurement of the reactivity of crude mite antigen to serum IgE antibodies from mite allergy sufferers, when the crude mite antigen was exposed to ions (test group) and not exposed (control group). The allergen inactivation rate of the crude mite antigen was 68% when exposed to

2.3 Change in mite dust allergic reactivity

We used the ELISA inhibition method to assess allergen inactivation rates by quantitative measurement of the reactivity of mite dust to serum IgE antibodies from mite allergy sufferers, when the mite dust was exposed to ions (test group) and not exposed (control group). In the test group, mite dust exposed to ions inhibited mite dust not exposed to ions from bonding with serum IgE antibodies from mite allergy sufferers. In the control group, suspended mite dust not exposed to ions inhibited bonding.

In the test group, we suspended mite dust for 15 minutes in a space with an average ion concentration of 10,000 ions/cm^3, then collected it. In the control group, we suspended mite dust in a space not exposed to ions for 15 minutes, then collected it. We compared the antigenic properties of the two groups of mite dust at an inhibition rate of 60%. While 4,000 ng of the mite dust exposed to ions (test group) was required for a 60% inhibition rate, only 360 ng of mite dust not exposed (control group) was required for this rate. In other words, the test group mite dust exhibited the same inhibition rate at about 11.1 times the quantity of the control group, so the allergen inactivation rate of test group mite dust was 91% (Figure 7).

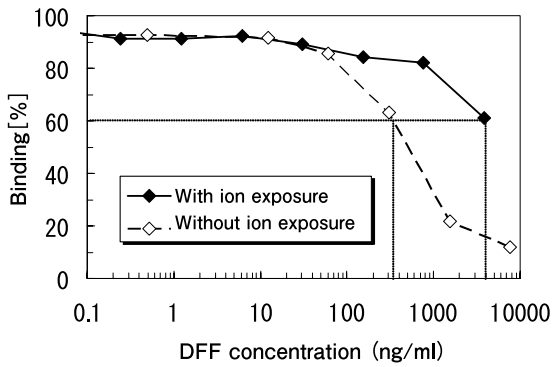


Fig. 7 Deactivation effect of the mite dust allergens with exposure to 10,000 counts/cm^3 ions for 15 min.

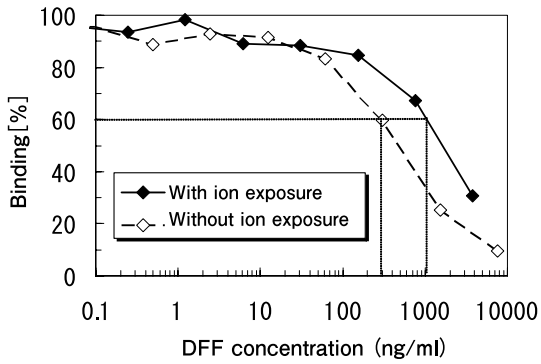


Fig. 8 Deactivation effect of the mite dust allergens with exposure to 3,000 counts/cm^3 ions for 15 min.

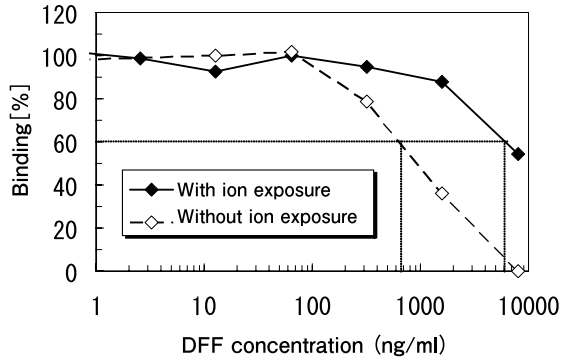


Fig. 9 Deactivation effect of the mite dust allergens with exposure to 2,000 counts/cm^3 ions for 60 min.

Using the same methodology, we tested the mite allergen inactivation effectiveness when mite dust was suspended for 15 minutes in spaces with average ion concentrations of 3,000 ions/cm^3 and 2,000 ions/cm^3. The allergen inactivation rates in these cases were 74% (Figure 8) and 23% respectively. When mite dust was suspended in a space with an average ion concentration of 2,000 ions/cm^3 for 60 minutes, the mite allergen inactivation rate was 89% (Figure 9). These findings indicate that the allergen inactivation rate increases in proportion to ion concentration and length of ion exposure time.

Figure 10 illustrates the mechanism by which allergens cause allergic reactions. The human body contains cells of 10 to 30 μm in diameter called mast cells, located on the epithelium of mucus membranes and in tissues. Mast cells control the body1s immune functions, and produce irritants such as histamines that cause allergies. In allergy sufferers, IgE antibodies stick to the surface of mast cells, causing a discharge of histamines and other irritants from them when allergens bond with the IgE antibodies. These irritants irritate the mucous membranes in the throat and nose causing allergic reactions such as coughing, sneezing and postnasal drip.

Figure 11 shows photos of mast cells in which IgE antibody bonding had previously occurred. Photo

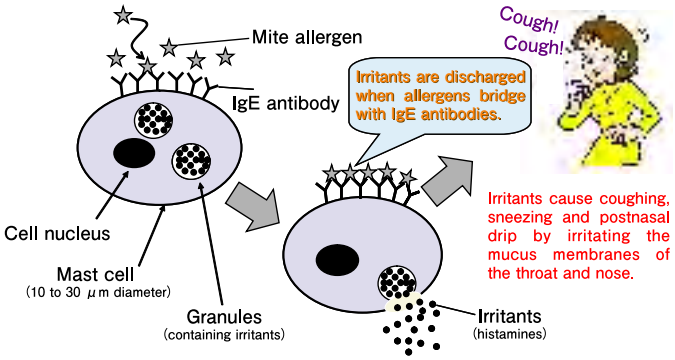


Fig. 10 Mechanism of allergy disease attack by allergens.

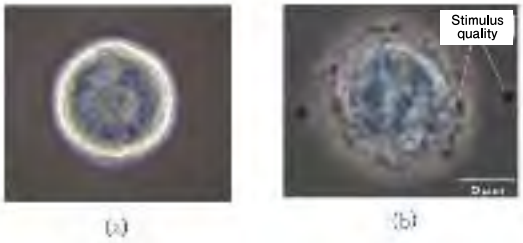


Fig. 11 Photograph of the mast cell reacted with mite allergens (a) with ions, (b) without ions.

(a) shows the mast cell reaction to mite allergens exposed to Plasmacluster Ions. Photo (b) shows the reaction to mite allergens not exposed to Plasmacluster Ions.

Since the mite allergens exposed to Plasmacluster Ions became inactivated, they were unable to bond with the IgE antibodies on mast cell surfaces, and no irritant discharge was observed. In contrast, mite allergens not exposed to Plasmacluster Ions bonded with the IgE antibodies on mast cell surfaces, and irritant discharge from mast cells was observed. These observations of actual cells provided further verification of the effectiveness of Plasmacluster Ions in allergen inactivation.

2.4 Model for allergen inactivation by cluster ions

As described, we verified the effectiveness of positively and negatively charged cluster ions generated by ion generators, in inactivating mite allergens. Figure 12 illustrates the model by which positive and negative cluster ions inactivate suspended allergens. Cluster ions collide with, and surround airborne allergens. Positively charged $H_3O^+(H_2O)_m$ cluster ions (where m is an integer) and negatively charged $O_2^-(H_2O)_n$ cluster ions (where n is an integer) react on the surface of the allergen to generate highly reactive species of active radicals. These active radicals may react with the allergen's proteins, causing them to degenerate. In mite allergens, cluster ions may cause degeneration of

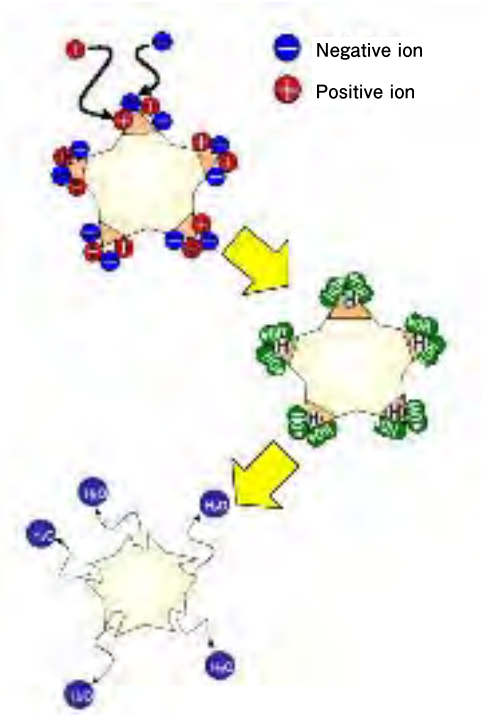


Fig. 12 Model for deactivation of aller gens.

sites for bonding with IgE antibodies, eliminating the allergen's ability to bond with the antibodies. IgE antibody bonding is therefore disabled, inactivating the allergens.

Conclusion

We examined the mite allergen inactivation properties of positive and negative ions generated by ion generators, and found the following results:

(1) We verified that cluster ions significantly reduce the reactivity of both Der f 1 and Der f 2 (major component antigens of the crude mite antigen) to antibodies.

(2) We verified that cluster ions significantly reduce the allergic reactivity of crude mite antigen to serum IgE antibodies from mite allergy sufferers. We verified that ion exposure significantly reduced the allergic reactivity to serum IgE antibodies of 26 out of 30 sufferers, with a 95% confidence interval.

(3) We verified that cluster ions can inactivate the allergens of mite dust suspended in an indoor environment, and actually observed allergic inhibition in mast cells

This research verified the effectiveness of positive and negative cluster ions in inactivating mite allergens (the main cause of indoor allergies), and the allergens in mite dust suspended in indoor environments. These results indicate that Plasmacluster Ions may be highly effective in inhibiting and reducing mite

allergies. This technology has been successfully applied to products such as air conditioners and air purifiers, and can be expected in a wider range of applications in future..

Acknowledgements

For their help with our analysis and assessments of the allergic reactivity of allergens, we would like to thank Professor Kazuhisa Ono, Assistant Professor Seiko Shigeta, and Norihiko Fukuoka, of the Department of Molecular Biotechnology of Hiroshima University's Graduate School of Advanced Sciences of Matter.

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(Received: June 16, 2004)

Asthma Society of India
(Under KKV Trust)

To whomsoever it may concern

Asthma Society of India - Kisaan Kisani Vikas Trust a registered non-profit based charitable organization Registration No 621. Our Aim is to eradicate asthma disorders from general masses.

As a part of the continuous search to find medication and prevention for such disorders, we have observed that Sharp Plasmacluster Ion Air Purifiers, sold in India, are effective in removal of asthma and allergy triggers like House Dust Mites, Pollen, Influenza Virus, Pet hairs, foul odor.

Virendrakumar Jain
President

165, R.N.T. Marg, Indore -452001, India Phone : 0731-3069109, Fax : 0731-2515007
email : asthma@asthmasocietyofindia.org

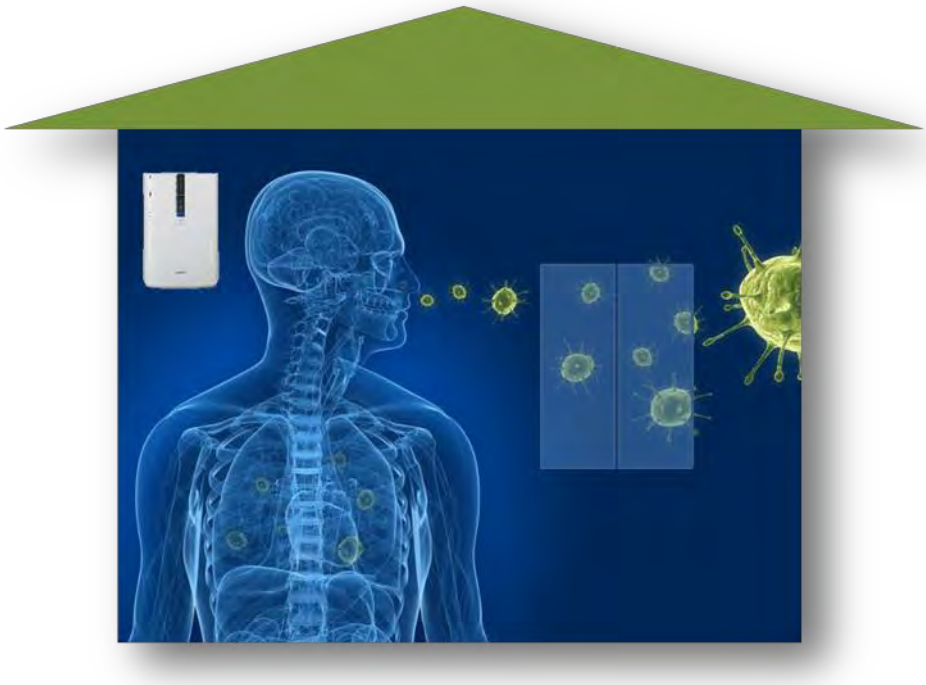
Final Report

Project Code 2016BG04

Studies on Air Purifier Investigation for improvement of IAQ

Prepared for

Sharp Business Systems (India) Pvt. Ltd.



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Studies on Air Purifier Investigation for improvement of IAQ

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Studies on Air Purifier Investigation on Improvement of IAQ

1. Background

Indoor air quality is an area of increasing concern not only in rural households burning biomass fuel but also in urban buildings as it impacts the health, comfort, wellbeing, and productivity of building occupants. While most people are aware of the threat posed by outdoor air pollution, few realize that inside homes, schools and offices one can be exposed to two to five times as many pollutants as outdoors (U.S Environmental Protection Agency). These levels of indoor air pollutants may be of particular concern because most people spend about 90% of their time in indoors and many spend most of their working hours in an office environment.

Pollutants in our indoor environment can increase the risk of illness. Indoor air pollution has been ranked as one of the top five environmental risks to public health by the EPA and its Science Advisory Board. While most buildings do not have severe indoor air quality problems, even well-run buildings can sometimes experience episodes of poor indoor air quality. Windows that could not be opened became a common part of building design. In recent years, the increasing concern regarding IAQ has come primarily from the widespread use of mechanical ventilation and air-conditioning in modern buildings, with limited direct ventilation through open windows.

Because of inadequate ventilation to the outside, the air pollutants inside the buildings are neither diluted nor removed. The results can range from nose, eye and throat irritation and aggravation of asthma to an increased risk of lung cancer. With this growing concern on indoor air pollution, SHARP, a Japanese based electronics company developed plasma cluster health technology generating positive and negative ions similar to which occur in nature, in order to improve indoor air quality and health of occupants. The Positive & Negative Ions when released from the Sharp Air Purifier travels to each and every corners of the room and while they come in contact with the allergens and pathogens, combine together on the surface of the pathogens to create Hydroxyl (OH) momentarily which has a very high oxidizing abilities breaks the DNA of the pathogen thus pulling out the Hydrogen protein. This Hydrogen then combines with the Hydroxyl (OH) instantly and converts into Water Vapour (H2O).This technology suppresses the effects of Virus, mold and fungus in an Indoor environment. This methodology replicates Nature and has been proven through various laboratories across the world. It was tested also using global lab practices standards and has proven safe for skin and eye

Sharp Business Systems India Private Limited approached TERI to assess the performance of their Air Purifiers with Plasmacluster Ion Technology in three different types of locations located in two major tropical cities in India, namely Bangalore & Delhi. The Energy and Resources Institute (TERI) partnered to submit the proposal for undertaking this study for Sharp to see the impact of Air Purifiers in improving indoor air quality with special focus on Particulate Matter (PM) and Gaseous substances.

2. Objectives

The specific objective of the proposed study is to assess the efficacy of SHARP air purifiers with respect to their capacity to capture particulate matter of different size ranges (PM_{10}, $PM_{2.5}$ and PM_1), Carbon monoxide (CO), Carbon dioxide (CO_2), Ammonia (NH_3), Nitrogen dioxide (NO_2) and Formaldehyde (HCHO).

3. Materials and methods

Study area

Two major tropical cities in India namely Delhi and Bangalore having different climate characteristics were selected for the study. In each city, three different types of buildings were selected for impact assessments which are:

1. Centralized air conditioned office building
2. Naturally ventilated office building with individual AC's for conditioning of air
3. Air conditioned Residential building

In each building, locations were selected based on the size and representativeness of the rooms as suggested by SHARP. Monitoring was carried out during the period Feb-Mar 2017 and the indoor air quality assessments were carried out simultaneously in both Delhi and Bangalore. Measurements in all the locations were carried out in real world conditions and not in a controlled environment, with opening and closing of the doors of the rooms, as and when required. This means that no extra care has been given to maintain the air leakage in the rooms in order to achieve the maximum performance of air purifiers as specified by SHARP. However, we have taken good care on not to open the door unless and until it is that much required. Also the doors and windows in all the rooms, except that of the residential building, are made of glass.

Indoor air quality monitoring and assessment

Indoor air quality monitoring was carried out for the following parameters at all the selected locations with and without air purifier in both the cities

- Respirable suspended particulate matter less than 10µm (RSPM/PM_{10})
- Fine particulate matter less than 2.5 µm ($PM_{2.5}$)
- Fine particulate less than 1 µm (PM_1)
- CO (Carbon monoxide)
- CO_2 (Carbon dioxide)
- Ammonia (NH_3)
- Nitrogen dioxide (NO_2)
- Formaldehyde (HCHO)

GRIMM Aerosol Spectrometer was used for the measurement of PM_{10}, $PM_{2.5}$ andPM_1 in indoors.CO, CO_2, Temperature and Relative Humidity (RH) were measured simultaneously using a portable Q-track monitor (TSI make, USA). For gaseous pollutants like NH_3, NO_2 and HCHO, air is allowed to bubble through a suitable absorbing solution using a handy

sampler which was further analysed by wet chemical methods. The summary of the sampling and monitoring techniques is given in Table 1.

Table 1: Summary of sampling and monitoring technique

Pollutant	Sampling and measurement Techniques
PM_{10},$PM_{2.5}$ and PM_1	GRIMM Aerosol Spectrometer
CO, CO_2, temperature and RH	Q-track, TSI instrument
HCHO, NO_2 and NH_3	Absorption and analysis by wet chemical methods

The methods followed were strictly in accordance with the guidelines laid down by Central Pollution Control Board (CPCB) and Bureau of Indian Standards (BIS) wherever applicable. Sharp Air Purifier model FP-F40E was used in this study for impact evaluation. The Plasmacluster Ion technology works by generating Positive and Negative Ions by breaking water vapour in the atmosphere which through the fan mechanism is pushed out of the Purifier and spreads into the room. The role of Sharp thus ends here and Nature takes over. These Ions then react with the pathogens to create Water vapour which combines with the indoor atmosphere. Indoor Air quality monitoring was carried for continuous 8 hours at each of the locations and after the installation of air purifiers, monitoring was carried out for five time periods namely, 15 minutes, 30 minutes, 45 minutes, 60 minutes and 90 minutes to assess the impact of air purifiers on indoor air quality over the period of time. Three samples each were collected from each of the selected locations in both the cities before and after the installation of air purifiers. This enabled us to average out the value of the monitored data. Throughout the study period, air purifier was operated at high speed fan mode as suggested by SHARP.

4. Results and discussions

a. Particulate Matter:

The data collected from both the cities were compiled and analysed. The data from same building type of both the locations were averaged out and plotted. The variation in PM10, PM2.5 and PM1 with air purifier monitored for different time periods namely, 15 minutes, 30 minutes, 45 minutes, 60 minutes and 90 minutes are plotted in figure 1, 2 and 3 respectively.

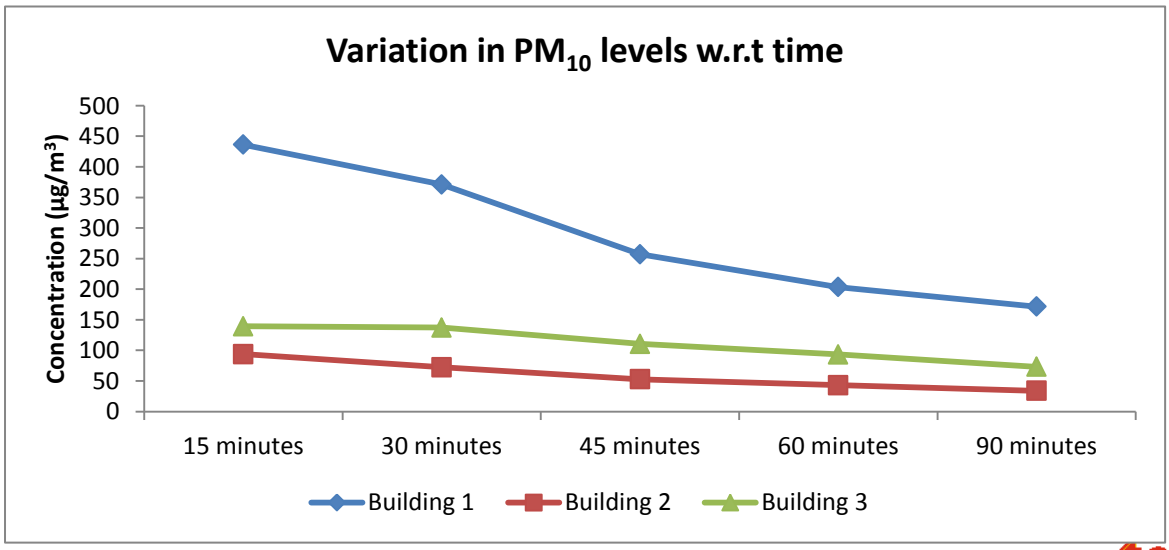


Figure 1: Variation in PM10 with different time intervals

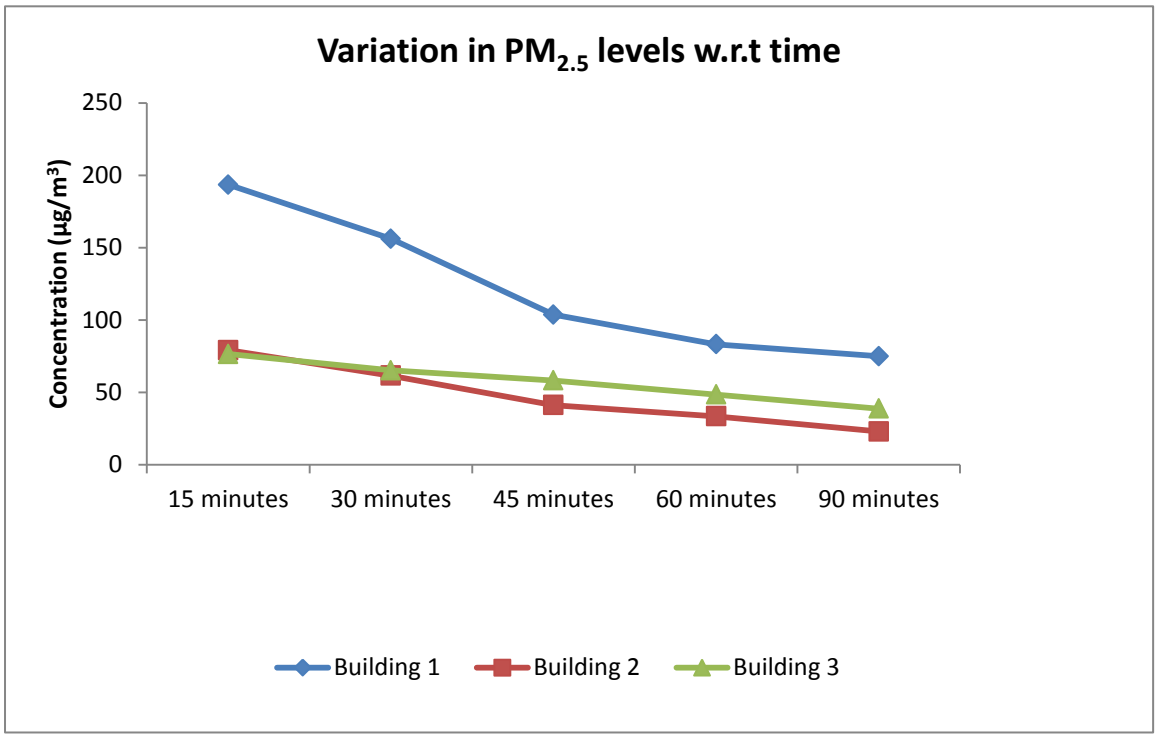


Figure 2: Variation in PM2.5 with different time intervals

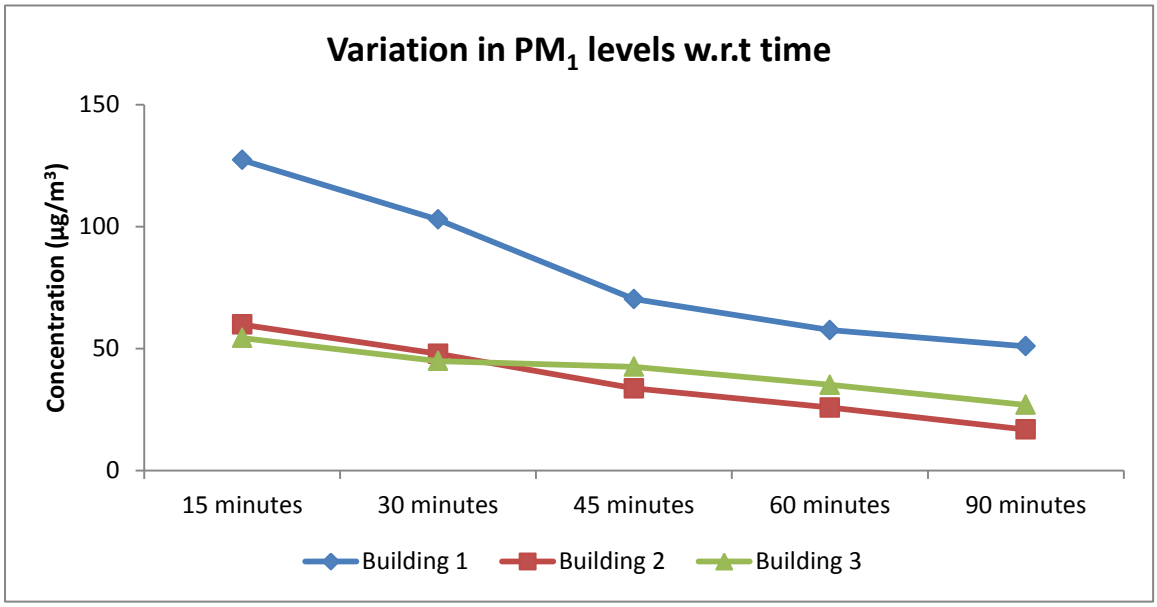


Figure 3: Variation in PM1 with different time intervals

It is evident from figure 1, 2 and 3 that the levels of PM_{10}, $PM_{2.5}$ and PM_1 at all the locations throughout the study period was found to be following a decreasing trend as time elapses which clearly indicates that irrespective of the building type, the performance of the air purifiers improves with time. The 15 minutes average concentration of PM in all the locations was found to be higher followed by 30 minutes, 45 minutes, 60 minutes and 90

minutes. The percentage reduction in PM_{10} (calculated from 15 minutes average and 90 minutes average levels) across the three locations (building 1, building 2 and building 3) varied between 41 and 64 while that of $PM_{2.5}$ ranged from 49-71 and for PM_1 the percentage reduction was found to be in the range 50-72. However more reduction can be achieved by ensuring minimum leakage and avoiding frequent opening of the doors.

The data collected with air purifier was then compared with the background levels (without air purifier) and are shown in figure 4, 5 and 6.

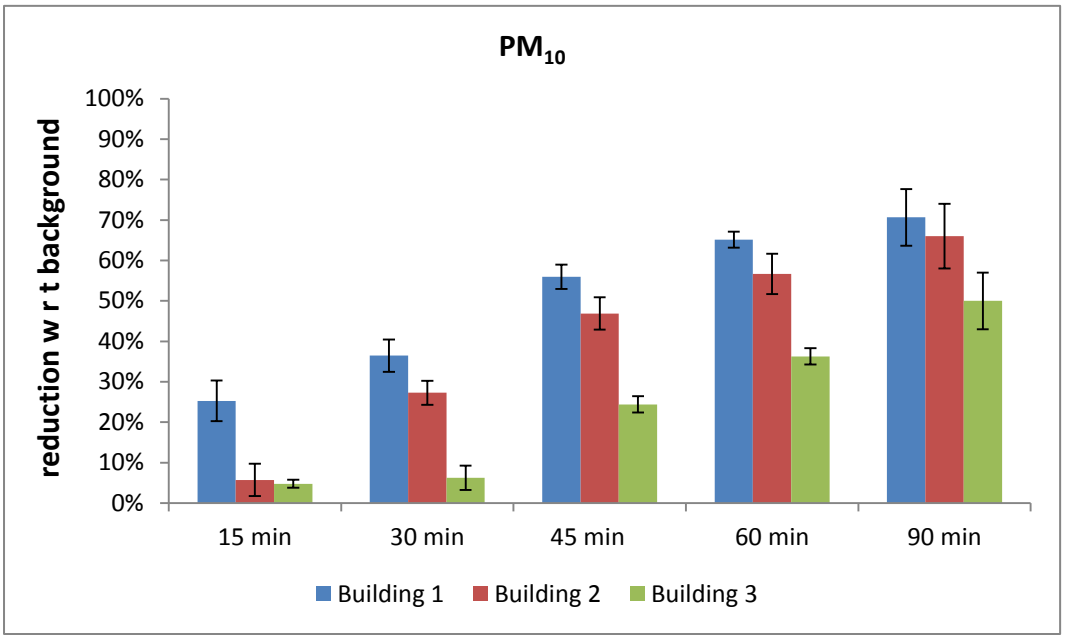


Figure 4: Reduction in PM10 using air purifier as against background levels

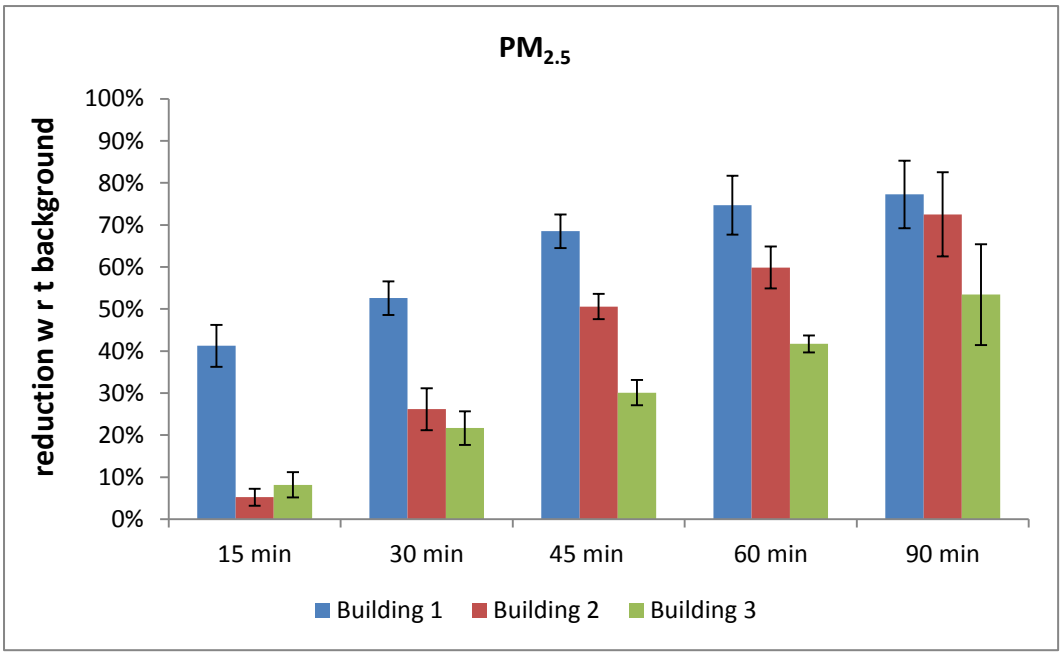


Figure 5: Reduction in PM2.5 using air purifier as against background levels

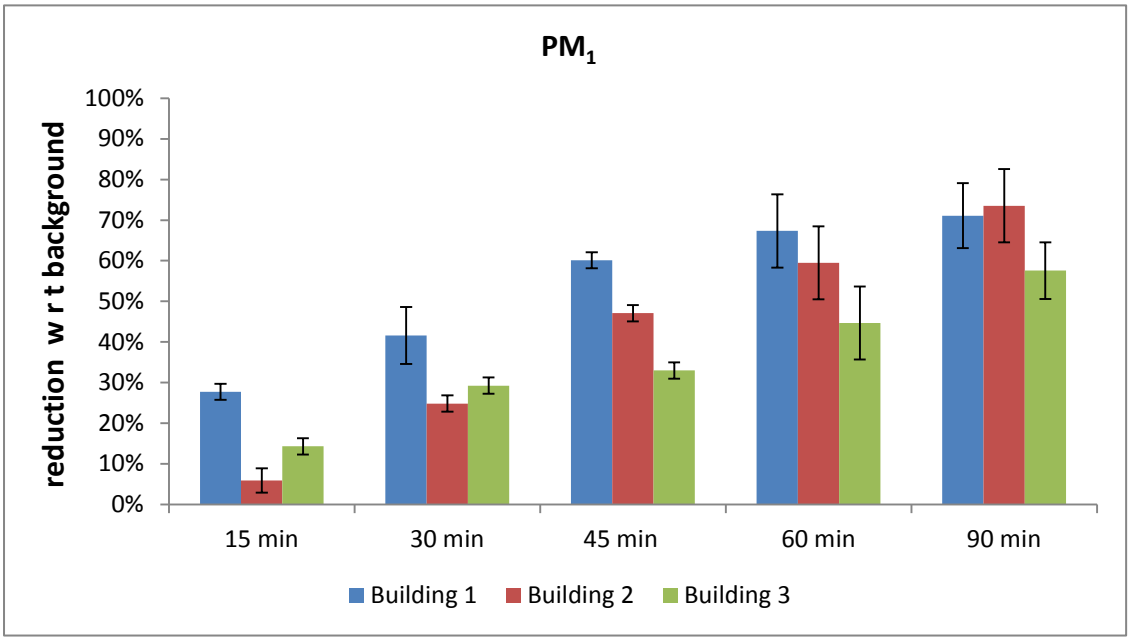


Figure 6: Reduction in PM1 using air purifier as against background levels

It is very much clear from figure 4, 5 and 6 that with the use of air purifiers, the levels of PM (PM_{10}, $PM_{2.5}$ and PM_1) were gradually reducing when compared with the background levels as time elapses and the maximum reduction in all the cases was observed when the air purifier run for 90 minutes. This clearly indicates, irrespective of the building type, the performance of air purifier was found to be improving over time. When the air purifier was run for 90 minutes, the reduction in PM across different locations was found to be in the range 50-71%, 53-77% and 58-74% for PM_{10}, $PM_{2.5}$ and PM_1 respectively. When compared with PM_{10}, finer particles ($PM_{2.5}$ and PM_1) show more reduction.

The overall reduction in PM_{10}, $PM_{2.5}$ and PM_1 with and without the use of air purifiers are plotted in Figure 7, 8 and 9

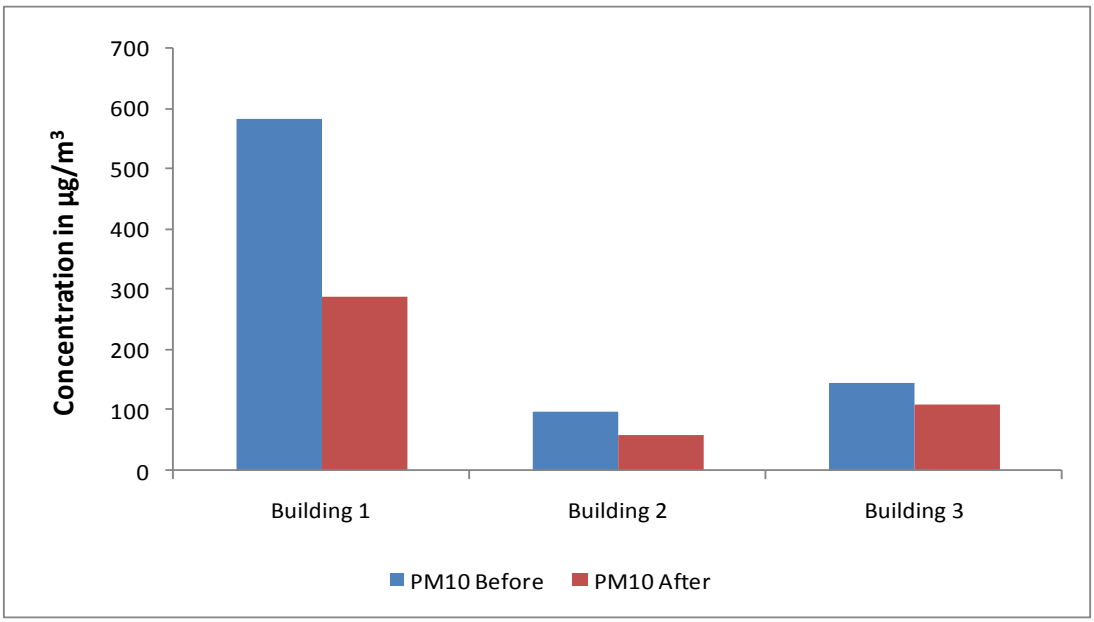


Figure 7: Comparison of PM10 with and without air purifier

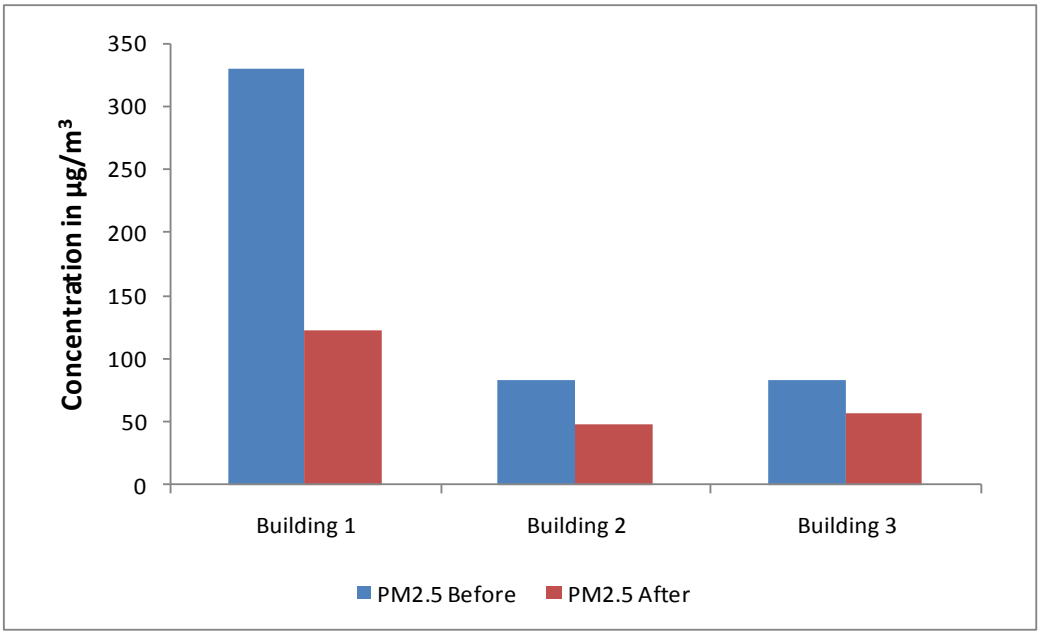


Figure 8: Comparison of PM2.5 with and without air purifier

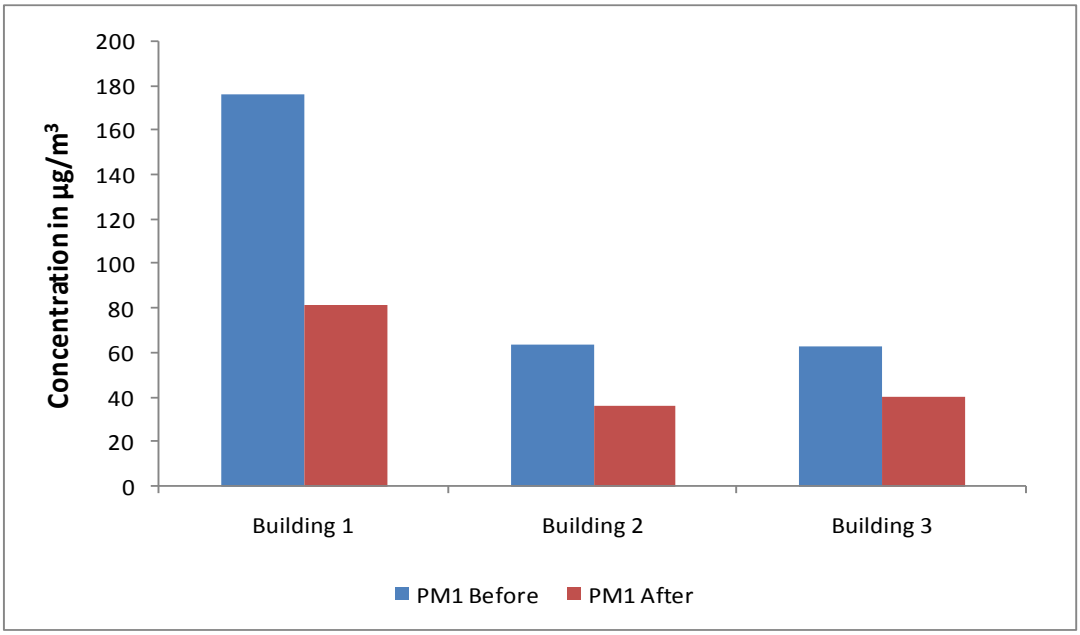


Figure 9: Comparison of PM_1 with and without air purifier

From figure 7, 8 and 9, it is clear that PM_{10}, $PM_{2.5}$ and PM_1 were found to be reduced with the use of air purifier when compared with the background levels. The reduction in PM across different building types varied between 24-51%, 31-63% and 36-54%for PM_{10}, $PM_{2.5}$ and PM_1 respectively. The overall reduction was also found be higher for finer particles namely $PM_{2.5}$ and PM_1.

b. Gaseous parameters:

Carbon monoxide:

Carbon monoxide (CO) is the product of any incomplete combustion. However, CO was not detected in two out of the three monitored locations throughout the study period. The minimum detection limit of the instrument used for measurement of CO was 0.1ppm. The variation in CO at Building 1 is shown in figure 10 and also in table 2.

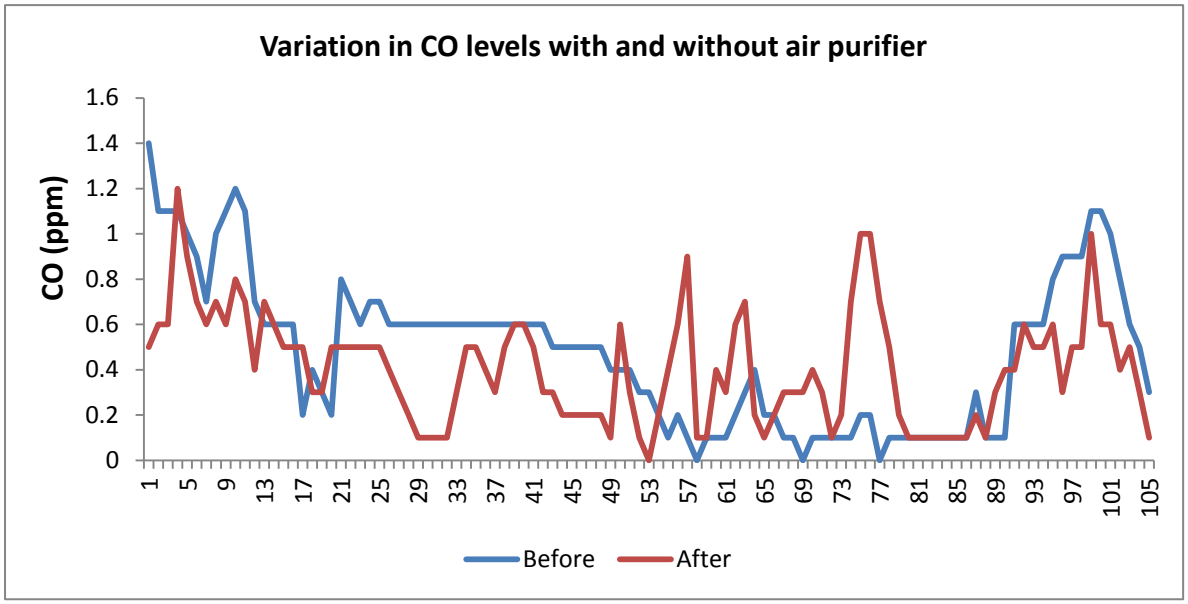


Figure 10: Variation in CO with and without air purifier at Building 1

Table 2: CO levels at different locations with and without air purifier

Location	CO (ppm)		% reduction
	Before	After	
Building 1	0-1.4 (0.48)	0-1.2 (0.41)	15
Building 2	< 0.1	< 0.1	--
Building 3	< 0.1	< 0.1	--

It is clear from table 2 that though building 1 shows a reduction of 15% in CO levels with the use of air purifier. Also, it is obvious from figure 10 that at most of the points there is a continuous reduction in CO with the use of air purifier. However, this needs to be studied further with simulation to confirm the findings because the levels of CO in indoor is already very low.

CO_2:

CO_2 detected at different locations with and without air purifier is shown in table 3

Table 3: CO2 levels at different locations with and without air purifier

Location	CO_2 (ppm)		% reduction
	Before	After	
Building 1	450-780 (646)	325-540 (419)	35

Location	CO_2 (ppm)		% reduction
Building 2	511-936 (645)	415-741 (495)	23
Building 3	521-888 (610)	445-698 (429)	30
ASHRAE Standard	1000		

Table 3 shows that the levels of CO_2 at different locations were reduced with the use of air purifiers and the percentage reduction in CO_2 across different building types varied between 23 and 35. However, in the absence of air purifier as well, the levels at all the measured locations were found to be well within the ASHRAE standard of 1000ppm.

NO_2 & HCHO

NO_2 and HCHCO levels across various locations with and without air purifier are shown in table 4 and 5 respectively.

Table 4: Levels of NO_2 at different locations

Location	NO_2 ($\mu g/m^3$)		% reduction
	Before	After	
Building 1	9-12 (11)	N D - 14 (9)	18
Building 2	6-13 (9)	N D - 14 (10)	--
Building 3	8-10 (10)	N D -14 (10)	--

ND – Not Detected

Though traces of NO_2 were found at all the locations throughout the study period, different buildings showed different trends for NO_2. However, at building 1 there is a reduction of about 18% in NO_2 level with the use of air purifier.

Table 5 shows that HCHO was detected at all the locations during the entire period of monitoring. The average HCHO levels without air purifier across different locations varied between 7-9 ppm whereas the corresponding levels across various monitored locations with air purifier ranged between 6-13 ppm.

Table 5: Levels of HCHO at various locations

Location	HCHO (ppm)		% reduction
	Before	After	
Building 1	4-9 (7)	N D-13 (7)	--
Building 2	8-10 (8)	7-15 (13)	--
Building 3	8-10 (9)	1-9 (6)	33

N D – Not Detected

There is no variation in HCHO levels with the use of air purifier in building 1 however building 3 showed a reduction of about 33% in the concentration of HCHO when compared with corresponding levels without air purifier.

NH_3:

Table 6: NH_3 levels at various locations

Location	NH_3 ($\mu g/m^3$)		% reduction
	Before	After	
Building 1	3-4 (3)	N D - 6 (4)	--
Building 2	1-4 (2)	N D - 3 (2)	--
Building 3	4-6 (6)	N D - 11 (6)	--

N D – Not Detected

Levels of NH_3 at various locations monitored with and without air purifier is shown in table 6. It is evident from table 6 that the levels are very low that one cannot arrive at a conclusion on the impact of air purifier on the NH_3 concentration.

5. Conclusions

The result of the impact evaluation of SHARP air purifier carried out at different locations in both the cities indicated that the particulate matter levels (irrespective of size range) were found to be reduced drastically with the use of SHARP air purifiers. However, more reduction can be achieved in a controlled environment by ensuring minimum leakage asleakages from the ambient air into the building have been identified as one of the sources of indoor air pollution. This may happen due to inadvertent structural defects and/or infiltration from open sources of outside air. Also the observations indicated that finer particles have more reduction with the use of air purifiers. It is a well-established fact that fine particulates can play a role in causing serious illness and death because they are small enough to be inhaled deep into the lungs. Therefore use of air purifiers in the long run may reduce the short term health effects such as eye, nose, throat and lung irritation, coughing, sneezing, runny nose, shortness of breath, etc. **This may leads to improved lung function and medical conditions such as asthma and heart diseases.**

Gaseous pollutants in terms of the monitored parameters also showed an overall reduction of 15%, 23-35%, 18% and 33% for CO, CO_2, NO_2 and HCHO respectively with the use of air purifiers. Though studies showing the association of gaseous air pollutants on asthma are scarce in India and abroad, there are few studies which showed that exposure to NO_2 have significant and positive association with asthma hospitalization. Therefore use of air purifier in the long run may reduce the gaseous pollutants like NO_2 substantially which in turn may improve the respiratory health of the occupants. However, more scientific studies are required to validate the positive associations between CO, HCHO, O_3 and asthma hospitalization.

Sustainable Building Science

One of the prime areas of activity within the Energy Environment Technology division is adoption of efficient and environment-friendly technologies in new and existing buildings. The activities of this area focus primarily on energy and resource use optimization in existing buildings and design of energy efficient sustainable habitats.

The Centre for Research on Sustainable Building Science (CRSBS) comprising architects , planners, engineers , environmental specialists , specialised in urban and rural planning, low energy architecture and electro-mechanical systems, water and waste management and renewable energy systems has been offering environmental design solutions for habitat and buildings of various complexities and functions for nearly two decades. The group also undertakes LEED facilitation for buildings.

The Green Rating for Integrated Habitat Assessment (GRIHA) cell, also comprising professionals from the above-mentioned fields is actively involved in facilitation of green rating for buildings under the GRIHA framework. Inputs from CRSBS feed into the processes undertaken at GRIHA cell. The different services offered by the Sustainable Building Science (CRSBS and GRIHA) are as follows:

Environmental design consultancy

 Specialised environmental design consultancy and building performance analysis are conducted. A wide range of computations and simulation tools including DOE2, TRNSYS, ECOTECT, RADIANCE, FLOVENT, AGI32, LUMEN DESIGNER, BLAST, Phoenics, RETScreen are used to assess the environmental and cost impact of the design decisions.

LEED and GRIHA facilitation

 The team has experience in technically facilitating LEED accreditation [LEED India for New Construction (LEED India NC) and LEED India for Core and Shell (LEED India CS)] for buildings. The group also assists and administers GRIHA, an indigenous green building rating system for buildings, developed at TERI. GRIHA has now been now endorsed by the Ministry of New and Renewable Energy, Government of India, as the national building rating system for India.

Energy audits and energy management programs

 Energy conservation studies for a large number of buildings are conducted. There exists a vast experience in conducting energy audits and evaluating a whole range of building upgrade options including envelope retrofit and system retrofit or changes in operational patterns. In addition to establishing operating efficiency of electrical, HVAC, lighting and thermal systems, recommendations to improve upon the same by suitable retrofit measures or by refinement of operational practices are also offered. The group also has expertise in development of energy management programs for service industries like hotels and the corporate sector.

Capacity building

 Capacity building for architects, building developers and service engineers on issues such as energy efficiency in building envelopes and systems has been undertaken. Over 1000 architects, developers and engineers in the area of green buildings, energy efficiency and sustainability aspects of built environment have been trained through training programmes, refresher courses, seminars and workshops.

Policy inputs

 Several policy initiatives at central and state governments' level towards mainstreaming high performance buildings in India have been successfully completed. Senior members of the group are members of the Committee of experts for development of the Energy Conservation Building Code (ECBC) of India (2007). The manual for environmental clearance of large construction for the Ministry of Environment and Forests, Government of India has also been developed at CRSBS.

November 2, 2009

For First Time Ever*[1], Plasmacluster*[2] Ions Shown to Inhibit Infectivity of New-Type H1N1 Influenza Virus in Both Stationary and Airborne Form

Verified in Collaboration with Retroscreen Virology Ltd.*[3] of the UK

Sharp Corporation, working in collaboration with Retroscreen Virology Ltd. founded by Professor John S. Oxford of the University of London, UK, has demonstrated for the first time in the world that high-density Plasmacluster ions can inhibit the infectivity of the new-type H1N1 influenza virus, whether it is airborne or stationary.

In the latest experiment, it was shown that Plasmacluster ions inhibit 99.9% of the new-type H1N1 influenza virus in stationary form (drops of the virus placed in a petri dish; concentration of 300,000 ions/cm^3) in 2 hours and 95% of the virus in airborne form (inside a box with a volume of 1 m^3; concentration of 25,000 ions/cm^3) in 40 minutes.

The airborne virus is in either droplet infection form or aerial infection form (droplet infection is when the airborne particles have a diameter of between 5 µm and 10 µm and are infectious; aerial infection is when the airborne particles have a diameter of between 1 µm and 5 µm and are infectious).

Since the year 2000, Sharp has used a "collaborative research approach to product marketing*[4]"— based on working with academic research organizations around the world—to demonstrate that Plasmacluster technology can remove 28 types of harmful microbes, including MRSA*[5]. The efficacy of Plasmacluster ions for inhibiting the infectivity of airborne viruses has been proven against the seasonal H1N1 human influenza virus, the H5N1 avian influenza virus, as well as Corona, SARS, Polio, and Coxsackie viruses.

In 2002, the safety of high-density Plasmacluster ions was also confirmed*[6]. In addition, in 2005, Sharp, working together with a number of academic institutions*[7], elucidated the mechanism behind the ability of Plasmacluster ions to destroy the spike-like proteins on the virus surface, which are the triggers for infections.

Sharp will continue to strive to create healthy environments by further advancing Plasmacluster technology and demonstrating its effectiveness.

Comments by Professor John S. Oxford

The new-type H1N1 influenza virus appeared almost out of nowhere and in just three months spread around the world, threatening us all. We can become infected with the virus by breathing it in or by coming into contact with it in a stationary form. Our experiment showed that Plasmacluster ions are effective against both routes of infection. The biggest advantage of this technology is that it can be applied for use against a wide range of viruses; as our experiment showed, it is effective against not just the H5N1 avian influenza virus but against the new-type H1N1 influenza virus as well. I believe that this technology is one of the measures we can take to protect ourselves from the threat of viruses, in addition to wearing facemasks and washing hands.

*1 As of November 2, 2009; according to Sharp.

*2 Plasmacluster and Plasmacluster ions are trademarks of Sharp Corporation.

*3 The OECD (Organisation for Economic Co-operation and Development) Principles of GLP (Good Laboratory Practice) is a set of standards intended to ensure the generation of high-quality and reliable test data through periodic reviews of operational organization and management, test apparatus and materials, study designs, internal audit controls, quality assurance systems, test data, etc., at all test facilities. Re-certification is required every three years.

*4 The “collaborative research approach to product marketing” verifies the effectiveness of a technology based on scientific data developed in collaboration with leading-edge academic research institutions. New products are then brought to market based on the results.

*5 MRSA is an acronym for methicillin-resistant Staphylococcus aureus, a bacterium responsible for difficult-to-treat infections in humans. MRSA typically infects humans with weakened immune systems, for example, patients in hospitals, and its resistance to a large group of antibiotics is a serious problem.

*6 Testing conducted by Mitsubishi Chemical Safety Institute Ltd. (inhalation toxicity, as well as eye and skin irritation/corrosion tests).

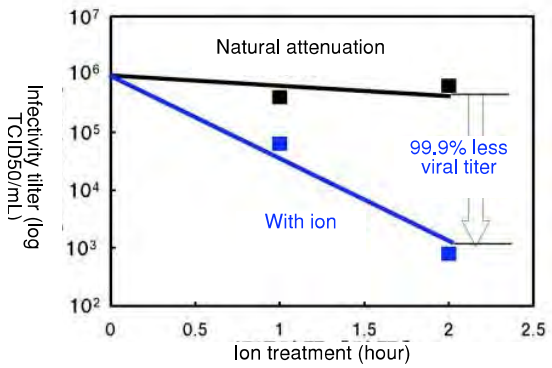
*7 Joint research conducted with Professor Gerhard Artmann, of Aachen University of Applied Sciences (2005).

Method of Testing Efficacy Against Stationary New-Type H1N1 Influenza Virus

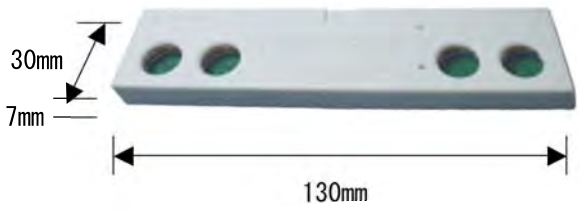
Using a high-density Plasmacluster ion generator, an ion concentration of approximately 300,000 ions/cm^3 was sprayed on the new-type H1N1 influenza virus in stationary form (drops of the virus placed in a plastic petri dish) for a set period of time.

The virus was collected after being sprayed for 2 hours, and the infectivity (viral infectivity titer*8) was studied using the TCID50 method*9 commonly used in the virology research field. As a result, the infectivity of the virus was 99.9% less than that of virus not treated with Plasmacluster ions and left to natural attenuation.

Change in infectivity titer of stationary new-type H1N1 influenza virus



High-density Plasmacluster ion generator



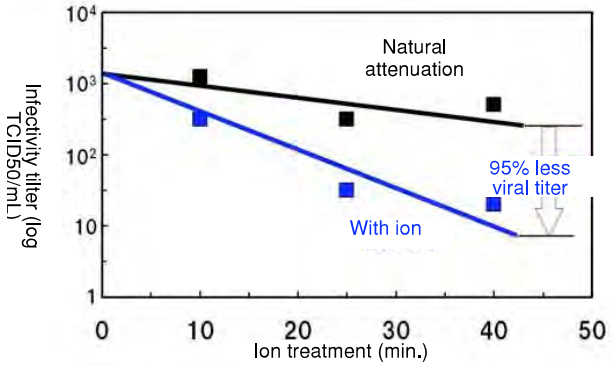
*8 A value indicating the capacity of a virus to infect cells.

*9 50% Tissue Culture Infective Dose method; a test protocol that examines the amount of a virus that will produce pathological change in 50% of cell cultures inoculated with a virus suspension diluted in stepwise increments.

Method of Testing Efficacy Against Airborne New-Type H1N1 Influenza Virus

A Plasmacluster ion generator was placed in a box having a volume of 1m^3. Plasmacluster ions were generated at a concentration of approximately 25,000 ions/cm^3 and the new-type H1N1 influenza virus was sprayed into the box (particle diameter: between 1 μm and 10 μm). After spraying for 40 minutes, the airborne virus in the box was collected and its infectivity was studied using the TCID50 method. As a result, the infectivity of the virus was 95% less than that of virus left to natural attenuation.

Change in infectivity titer of airborne new-type H1N1 influenza virus



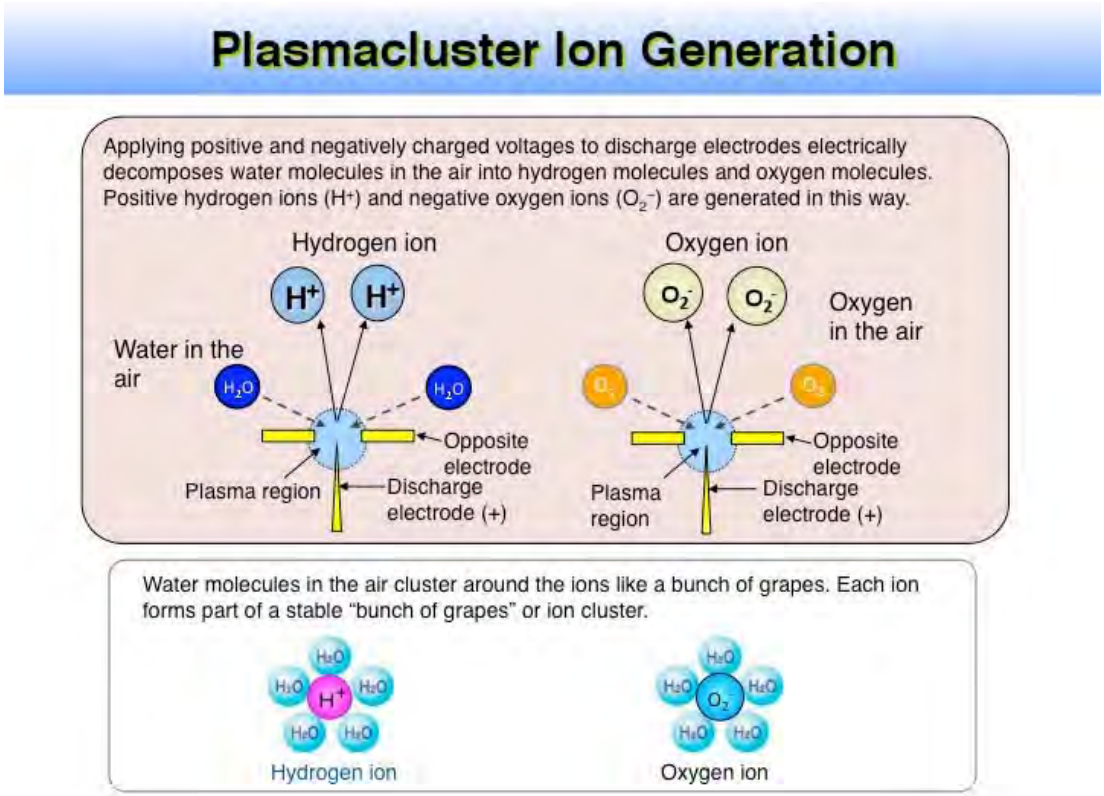
Profile of Professor John S. Oxford

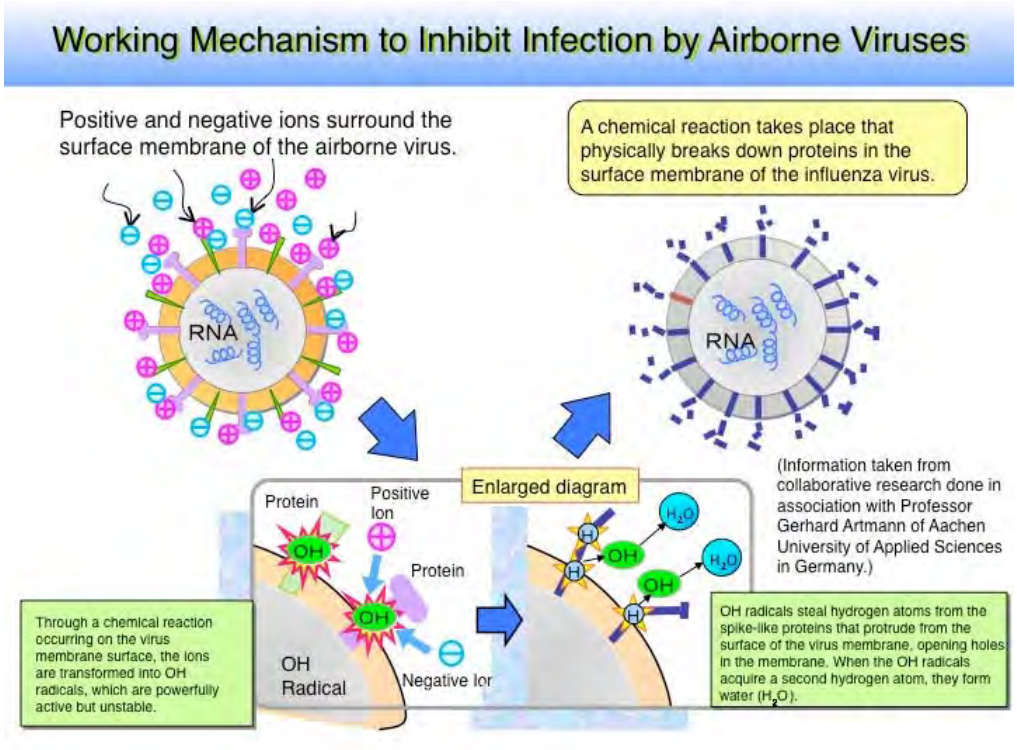
- Professor of Virology in the Institute of Cell and Molecular Science at St. Bartholomew's and the Royal London Hospital, Queen Mary's School of Medicine and Dentistry, University of London, UK
- Founder and Scientific Director of Retroscreen Virology Ltd.
- Has chaired numerous international academic conferences and meetings

Retroscreen Virology Ltd.

Retroscreen Virology Ltd. was founded by Professor John Oxford in 1989 to conduct R&D and verification testing related to viruses, drugs, and vaccines, and is well known as one of the leaders of its field. It is certified under GLP (Good Laboratory Practices), an international set of standards for maintaining high levels of reliability and safety in trials involving chemical substances. It is also ISO 9001-certified.

Overview of Plasmacluster Technology





RETROSCREEN VIROLOGY

Final Report

CONFIDENTIAL

Evaluation of the SHARP Plasmacluster Ions Air Purification Technology Product against the Avian Influenza virus H5N1 and Urbani SARS virus

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6/6/2005

Plasmacluster Ions®*1 Proven Effective Against Airborne Highly Pathogenic H5N1 Avian Influenza

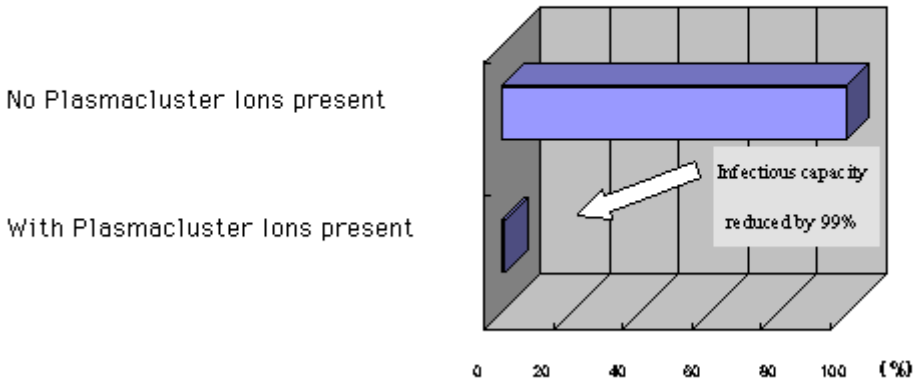
A World First Among Air Purification Technologies*2

Sharp Corporation has demonstrated that Plasmacluster Ions reduce activity of the highly fatal and highly pathogenic airborne H5N1 avian influenza ("bird flu") virus by 99%. This research was conducted in collaboration with Retroscreen Virology, Ltd., an organization which was established by one of the world's leading authorities on virology, Professor John S. Oxford of the University of London School of Medicine & Dentistry, and which works in compliance with Good Laboratory Practice*3 (GLP). Among the diverse range of air purification technologies available, Plasmacluster Ions are the first in the world to have been proven effective against this virus.

Plasmacluster Ion technology was developed in 2000 and is an air purification technology that disables airborne microorganisms by releasing positive and negative ions into the air. In the five years since its development, Sharp has been working together with academic research organizations around the world based on a "collaborative research approach to product marketing*4" and has demonstrated that Plasmacluster Ions are effective against a total of 26 kinds of harmful airborne substances, including bacteria, mold fungi, viruses and allergens. In addition, in November 2004, the mechanism by which Plasmacluster Ions cause cell death was explained: they damage the proteins on the cell membrane surface of bacteria. It has now been proven scientifically that they have the potential to be effective against a broad array of harmful airborne substances that have proteins on their cell surfaces.

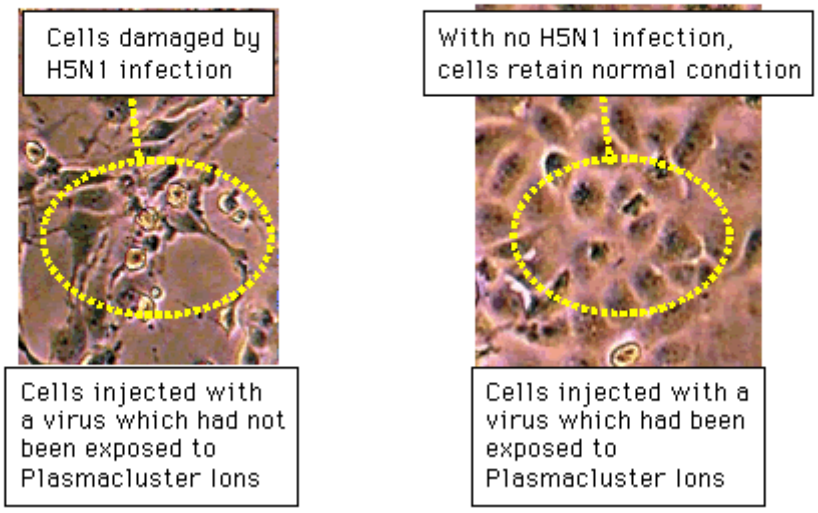
The type of avian influenza virus for which effectiveness has most recently been confirmed is the highly pathogenic H5N1 avian influenza virus, which has in fact taken a toll on human life. This research finding confirms that Plasmacluster Ions are effective against newly emerging viruses and has further expanded the fields in which Plasmacluster Ions demonstrate efficacy.

Efficacy Against H5N1 Avian Influenza Virus



Suppressive Effect on Viral Infection Using Cultured Cells (MDCK cells*5)

(Magnification: 40 times)



**1 Plasmacluster and Plasmacluster Ions are trademarks of Sharp Corporation.*

**2 As of June 6, 2005*

**3 In the OECD (Organization for Economic Co-operation and Development), Good Laboratory Practice is a set of standards intended to ensure the reliability of test results by reviewing operation management, test equipment, test design, internal audit controls, quality assurance systems, test results, etc., at all test facilities. Re-certification is required every three years.*

**4 The "collaborative research approach to product marketing" verifies the effectiveness of a technology based on scientific data developed in collaboration with leading-edge academic research institutions. New products are then brought to market based on the results.*

**5 Canine kidney cells*

Virus infection test using cultured cells
A Plasmacluster Ion Generator was placed in a box with a volume of one (1) m^3, and Plasmacluster Ions were generated (concentration: 7000 ions/cm^3). Then, aerosolized highly pathogenic avian influenza virus was sprayed into the box. Five minutes after the spraying was complete, the air in the box containing the airborne virus was sampled at 10-minute intervals. The virus was then extracted and injected into cell cultures. Changes in the cells were then observed over a four-day period.

Four days after injection, the cells injected with the virus that had not been exposed to Plasmacluster Ions were deformed and damaged. In contrast, cells injected with the virus that had been exposed to Plasmacluster Ions retained their normal condition with almost no change in evidence.

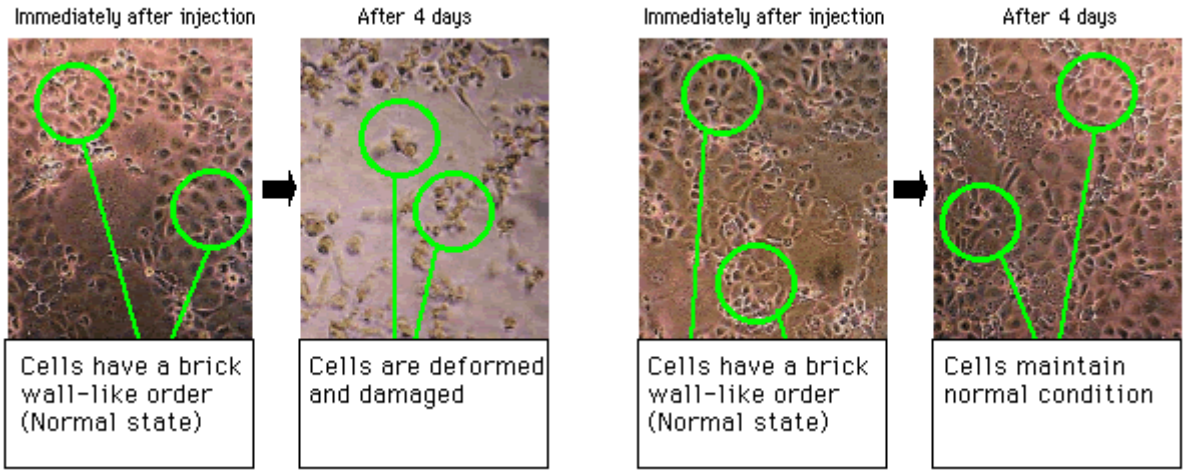
From this, it was confirmed that Plasmacluster Ions can reduce the activity of the virus by 99%. (The $TCID_{50}$ [Tissue Culture Infectious Dose 50%] assay, which is widely used in the field of virology, was used to evaluate the test results.)

Observation photographs of cells (MDCK cells) injected with virus samples

Cells injected with virus sample not exposed to Plasmacluster Ions

Cells injected with virus sample exposed to Plasmacluster Ions

(Magnification: 10 times)



Analysis of cell antibodies with the Fluorescent Antibody Technique
Both the virus samples, those exposed to Plasmacluster Ions and those not, were injected into cells and the cell reaction to the viral infection was evaluated. This examination was conducted using the Fluorescent Antibody Technique, a standard method in the field of virus research. The technique involves dyeing cells with fluorescence to identify whether or not the cell is infected; if the cell has been infected by the virus, it will radiate.

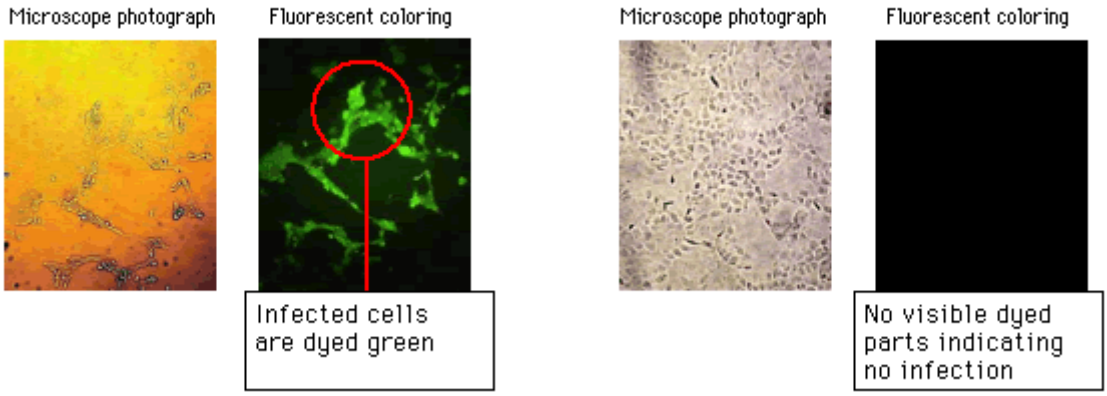
In cells injected with the virus “not exposed” to Plasmacluster Ions, fluorescent coloring indicative of a viral infection was present. And, in contrast, the coloring was not present in cells injected with the virus “exposed” to Plasmacluster Ions. From this analysis, the virus sampled in the presence of Plasmacluster Ions was verified to have lost its capacity for infection.

Fluorescent coloring photograph of cells (MDCK cells) injected with virus samples

Injected with a virus sample not exposed to Plasmacluster Ions

Injected with a virus sample exposed to Plasmacluster Ions

(Magnification: 7 times)



About Highly Pathogenic Avian Influenza ("Bird Flu")

Various types of influenza virus are classified according to two types of "spikes" on the virus surface (H: hemagglutinin and N: neuraminidase), and among these, viruses that infect poultry and cause illness and death are well known, such as H5N1, H7N7, H9N2, etc.

In contrast to mildly pathogenic influenza viruses which infect and proliferate only in the respiratory organs and intestinal tract and whose symptoms remain relatively minor, highly pathogenic influenza viruses infect and multiply throughout the entire body. In poultry, the mortality rate approaches 100%.

Since 1997, avian influenza has taken a tremendous toll on poultry in Hong Kong, the Netherlands, Vietnam, Cambodia, Thailand, Korea and Japan. Furthermore, in Vietnam, Cambodia and Thailand, its transmission to humans, who were previously not considered susceptible, has been confirmed with the occurrence of 97 patient cases and 53 deaths[*6]. This current research proves the efficacy of Plasmacluster Ions on the highly pathogenic H5N1 avian influenza virus, which has in fact taken a toll on human life.

**6 As of May 19, 2005; according to a news release from the World Health Organization (WHO).*

Overview of Plasmacluster Ion Technology

A plasma discharge generates positive ions (H^+) and negative ions (O_2^-) from water vapor in the air. These ions have the property of clustering around microparticles, and thus, they surround harmful substances such as airborne mold, viruses and allergens. At that point, a chemical reaction occurs on the cell membrane surface, and they are transformed into OH radicals, a powerfully active but unstable material, which robs the harmful substance of a hydrogen atom (H). As a result, they are inactivated by severing the protein on the cell membrane, opening holes. The OH radicals instantly bond with the removed hydrogen (H),

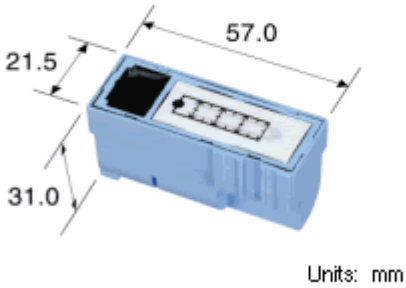
forming water vapor (H_2O), and return to the air.

1) The Plasmacluster Ions are the same positive and negative ions found in abundance in nature, for example, in woods and forests. They turn into OH radicals only on the surface of harmful substances to inactivate them, so they are completely harmless to the human body. The amount of ozone generated is less than 0.01 ppm, significantly below the 0.05-ppm value set as the standard for industry and for electrical equipment.

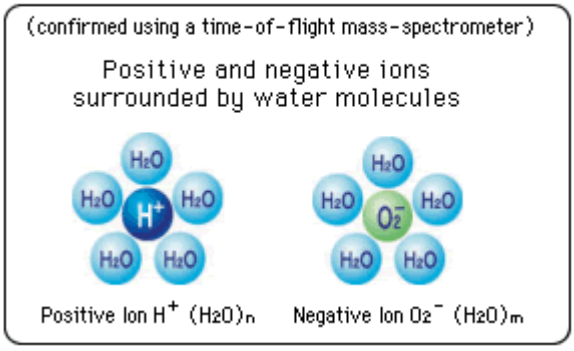
2) Compared to passive air cleaning systems that trap airborne contaminants by using a fan to draw air through a filter, air purification systems based on Plasmacluster Ions effectively eliminate bacteria by working directly on the air contained in the entire room.

3) The Plasmacluster Ion Generator never loses its effectiveness by becoming dirty and never needs replacing like filters. It consumes a miniscule amount of electricity (0.5 W). Annual electricity costs for continuous use are around ¥100.

Plasmacluster Ion Generator



Chemical Composition and Structure of Plasmacluster Ions



Efficacy of Plasmacluster Ions on Various Pathogens Confirmed Through Collaborative Research

Target Substance	Species	Testing & Verification Organization	Date of Announcement
Fungi	Cladosporium (black mold, mildew)	Ishikawa Health Service Association	September 2000
		Universitäklinikums Lübeck University Clinic (Germany) (proliferation control effect)	February 2002
		CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences)	November 2004
	Penicillium, Aspergillus	Universitäklinikums Lübeck University Clinic (Germany) (proliferation control effect)	February 2002
	Aspergillus, Penicillium (two species), Stachybotrys,	CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences)	November 2004

	Alternaria, Mucorales		
Bacteria	Coliform bacteria (E. coli)	Ishikawa Health Service Association	September 2000
	E. coli, Staphylococcus (aureus), Candida	Shanghai Municipal Center for Disease Control and Prevention, China	October 2001
	Bacillus subtilis	Kitasato Research Center of Environmental Sciences	September 2002
		CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences)	November 2004
	MRSA (methicillin-resistant Staphylococcus aureus)	Kitasato Research Center of Environmental Sciences	September 2002
		Kitasato Institute Medical Center Hospital	February 2004
	Pseudomonas, Enterococcus, Staphylococcus	Universitäklinikums Lübeck University Clinic (Germany)	February 2002
	Enterococcus, Staphylococcus, Sarcina, Micrococcus	CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences)	November 2004
Allergens	Mite allergen (dust from dead mite bodies and feces), pollen	Graduate School of Advanced Sciences of Matter, Hiroshima University	September 2003
	Airborne allergens	Asthma Society of Canada	April 2004
Viruses	H1N1 influenza virus	Kitasato Research Center of Environmental Sciences	September 2002
		Seoul University, Korea	September 2003
		Shanghai Municipal Center for Disease Control and Prevention, China	December 2003
		Kitasato Institute Medical Center Hospital	February 2004
	H5N1 avian influenza virus	Retroscreen Virology, Ltd, London, U.K.	May 2005
	Coxsackie virus (summer colds)	Kitasato Research Center of Environmental Sciences	September 2002
	Polio virus	Kitasato Research Center of Environmental Sciences	September 2002
	Corona virus	Kitasato Institute Medical Center Hospital	July 2004

Profile of Professor John S. Oxford

- World authority on virology

- Professor, Institute of Cell and Molecular Science at St. Bartholomew's and The Royal London Hospital, Queen Mary's School of Medicine and Dentistry, London, U.K.
- Founder and Scientific Director, Retroscreen Virology Ltd.,

Expertise
Virology

Publications
- Published over 250 scientific papers
- Co-authored three standard texts:
  1) Influenza, the Viruses and the Disease
  2) Human Virology, a Text for Students of Medicine, Dentistry and Microbiology
  3) Conquest of Viral Diseases

Other Professional Activities
- Appeared on numerous radio and TV programs (BBC, National Geographic, etc.)
- Served as chairman of numerous international scientific and academic conferences

Conferences where Prof. Oxford will serve as Chairman in the near future:
1) Second European Conference on Influenza, September 2005, Malta
2) Optimizing Antiviral Drug Therapy Symposium, October 2005, Berlin
3) The Central Role of Antivirals for the First Pandemic of the 21st Century, January 2006, London

About the University of London
Established in 1836 as England's national university, the University of London consists of 19 colleges with a total of 115,000 students, one of the largest student bodies in the world.

Queen Mary is one of the largest multi-faculty colleges of the University of London. Queen Mary merged with two distinguished medical colleges, St Bartholomew's Hospital Medical College, established in 1843, and the London Hospital Medical College, England's oldest medical school, founded in 1785, to form the School of Medicine & Dentistry. With nearly 8,800 students, the School provides education in a wide range of fields in addition to medicine and dentistry, including biology, chemistry, physics, electrical engineering, computer science, law, literature, and political science.

Dinstinguished Graduates
Alexander Graham Bell, Hirofumi Ito (first prime minister of Japan), John F. Kennedy, Mahatma Gandhi, H.G. Wells, Arthur C. Clarke; seven Nobel Prize winners.

About Retroscreen Virology, Ltd.
Founded in 1989 by Professor John Oxford, Retroscreen Virology Ltd. is a recognized leader in the research and testing of antiviral compounds and vaccines. In carrying out safety tests

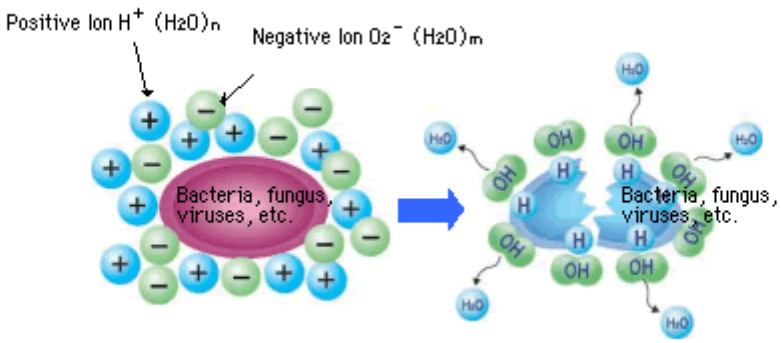
of chemical substances, the company works to extremely high standards in compliance with the principles of Good Laboratory Practice (GLP), an international management standard for maintaining high reliability, and has obtained accreditation under the quality control management standard ISO 9001.

Reference

Mechanism of Plasmacluster Ion for Inactivating Harmful Substances

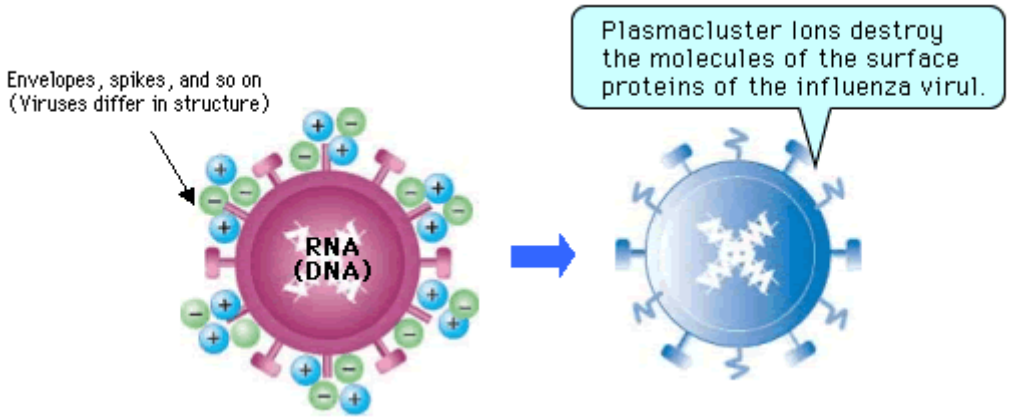
Mechanism for Inactivating Airborne Fungi

The positive (H^+) and negative (O_2^-) ions cluster together on the surface of airborne fungi, causing a chemical reaction that results in the creation of highly reactive OH groups called hydroxyl radicals (•OH). The hydroxyl radical will take a hydrogen molecule from the cell wall of an airborne fungi particle. Inhibits mold infestation as well as controls musty and household odors (caused in large part by mold fungi) as they occur.



Mechanism for Inactivating Airborne Virus

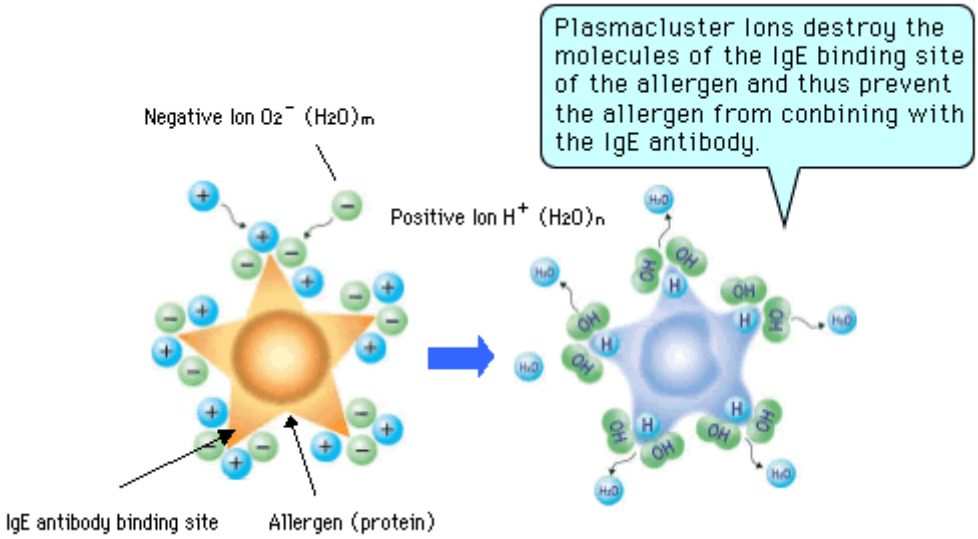
The positive (H^+) and negative (O_2^-) ions surround the hemagglutinin (surface proteins that form on organisms and trigger infections) and change into highly reactive OH groups called hydroxyl radicals (•OH). These take a hydrogen molecule from the hemagglutinin and change into water (H_2O). The ions destroy the virus surface structure, for example its envelopes and spikes, on a molecular level. As a result, the virus cannot infect even if it enters the body.



Mechanism for Deactivating Airborne Allergens

The positive (H^+) and negative (O_2^-) ions surround the airborne allergen and change into highly reactive hydroxyl radicals (•OH). The hydroxyls then deactivate the molecules of the

IgE antibody binding site of the allergen. No allergic symptoms occur even if allergens enter the body.



Research Proves for First Time Ever*[1] That Sharp's Plasmacluster*[2] Technology Inhibits Airborne Avian Influenza A (H7N9) Virus

Joint research conducted by Sharp Corporation and the Insitut Pasteur in Ho Chi Minh City, Vietnam has proven for the first time anywhere in the world that Plasmacluster technology*[3] can inhibit the infectiousness of the airborne avian influenza A (H7N9) virus. Tests conducted in a 1-m^3 box showed 99% inhibition of the virus in approximately 47 minutes.

In April 2013, the World Health Organization (WHO) first announced that the avian influenza A (H7N9) virus could infect humans. With the possibility that the avian influenza virus could mutate into a virus that could be transferred between humans and cause a pandemic, Japan's Ministry of Health, Labour and Welfare designated this H7N9 strain as a Category II infectious disease under Japan's Infectious Diseases Control Law.

This joint research centered on releasing Plasmacluster's positively charged hydrogen ions ($H^+(H_2O)_m$) and negatively charged oxygen ions (O_2^- $(H_2O)_n$) simultaneously into the air, which instantaneously bond on the surface of airborne substances such as viruses, becoming highly reactive OH radicals that break down the proteins on the surface of the viruses and inhibit virus activity. Sharp had previously proven that Plasmacluster technology can inhibit the effects of the H1N1*[4], H3N2*[5], and H5N1*[6] influenza viruses. The latest experiments show that Plasmacluster technology has the same inhibiting effects on another strain of avian influenza, H7N9, thus demonstrating that Plasmacluster is effective against a diverse range of influenza viruses.

Since introducing Plasmacluster technology in 2000, Sharp has conducted "academic marketing"*[7] in collaboration with some of the world's leading third-party scientific research organizations. So far, 25*[8] such organizations have shown the effectiveness of Plasmacluster in not only controlling harmful substances such as viruses, mold, bacteria, and allergens, but also in beautifying people's skin and hair. The clinical effectiveness and safety of Plasmacluster technology has also been proven*[9].

Sharp will continue to contribute to society through Plasmacluster by advancing this technology and proving even more ways that it can be effective.

The details of this joint research between Sharp and the Institut Pasteur will appear in the *Journal of Preventive Medicine* (ISSN 0868-2836) in December 2015, published by the Vietnam Association of Preventive Medicine.

Comment from the Institut Pasteur, Ho Chi Minh City, Vietnam

Our joint research revealed that Plasmacluster technology could inhibit the effects of the airborne avian influenza A (H7N9) virus. There currently exists the danger of a pandemic caused by a mutated strain of avian influenza. I believe that Plasmacluster can make an effective contribution to measures against such a pandemic.

For more information please contact (press only please)
Osaka: +81-6-6625-3006 Tokyo: +81-3-5446-8205

*1 For air purifying technologies using ion generation or filters. As of November 17, 2015, based on Sharp research.
*2 Plasmacluster is a registered trademark of Sharp Corporation.
*3 In an airtight 1-m^3 box and with an average ion density of approximately 100,000 ions/cm^3.
*4 Also known as the Spanish flu or the Russian flu, this subtype of influenza was the cause of the flu pandemic in 2009. It is also currently called a seasonal influenza.
*5 A subtype of influenza known as the Hong Kong flu. It is also currently called a seasonal influenza.
*6 A subtype of influenza known as the highly pathogenic avian influenza.
*7 Collaboration with leading third-party academic research institutions to gather and analyze scientific data in order to apply findings to new products.
*8 As of November 17, 2015.
*9 According to testing by LSI Medience Corporation (inhalation toxicity test, eye and skin irritation test, corrosivity test, teratogenicity test, and two-generation reproduction toxicity test).

● Proven Effect against Airborne Avian Influenza A (H7N9) Virus

A Plasmacluster ion generating unit was placed inside an airtight 1-m^3 box. The box was filled with Plasmacluster ions (at densities of 50,000 ions/cm^3, 100,000 ions/cm^3, and 200,000 ions/cm^3), and a mist of the avian influenza A (H7N9) virus was infused into the box. After a set amount of time of infusing the virus mist at each ion concentration, the airborne viruses were collected and their infectiousness (infectious titer*10) was determined using the $TCID_{50}$ assay*11, a widely used method in virus research. Results showed that compared to the control test (airflow containing no Plasmacluster ions), the presence of Plasmacluster ions inhibited 99% of the virus. It was also revealed that increasing ion concentration shortened the time it took to inhibit 99% of the virus.

*10 Infectious titer: A measure of the infectious level of a virus against cells.
*11 $TCID_{50}$ assay: A method of determining infectiousness of a virus by infecting cells with various dilutions of the virus.

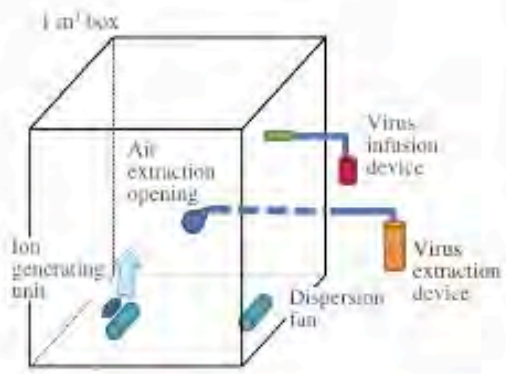


Figure 1: Testing device

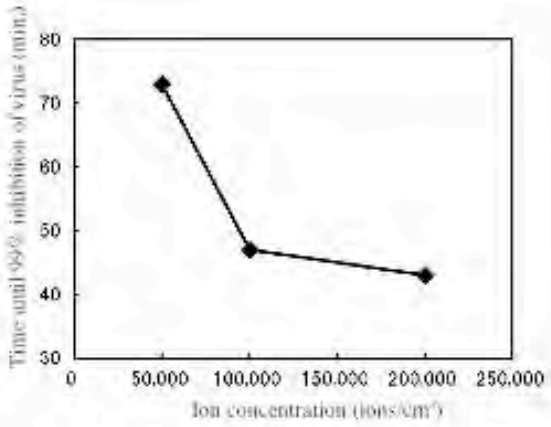


Figure 2: Relationship between ion concentration and time until 99% inhibition of virus

● About the Institut Pasteur, Ho Chi Minh City, Vietnam

Established in 1891 in Ho Chi Minh City, Vietnam as the first overseas branch of the Institut Pasteur, established in 1887 in Paris, France by Louis Pasteur, the father of modern bacteriology. The institute was the first in the world to take a sample of the highly pathogenic avian influenza infecting people. Today, under the authority of the Vietnamese Ministry of Health, it conducts a variety of research, mainly aimed at improving and raising the standard of public health in Vietnam.

Institut Pasteur, Ho Chi Minh City, Vietnam

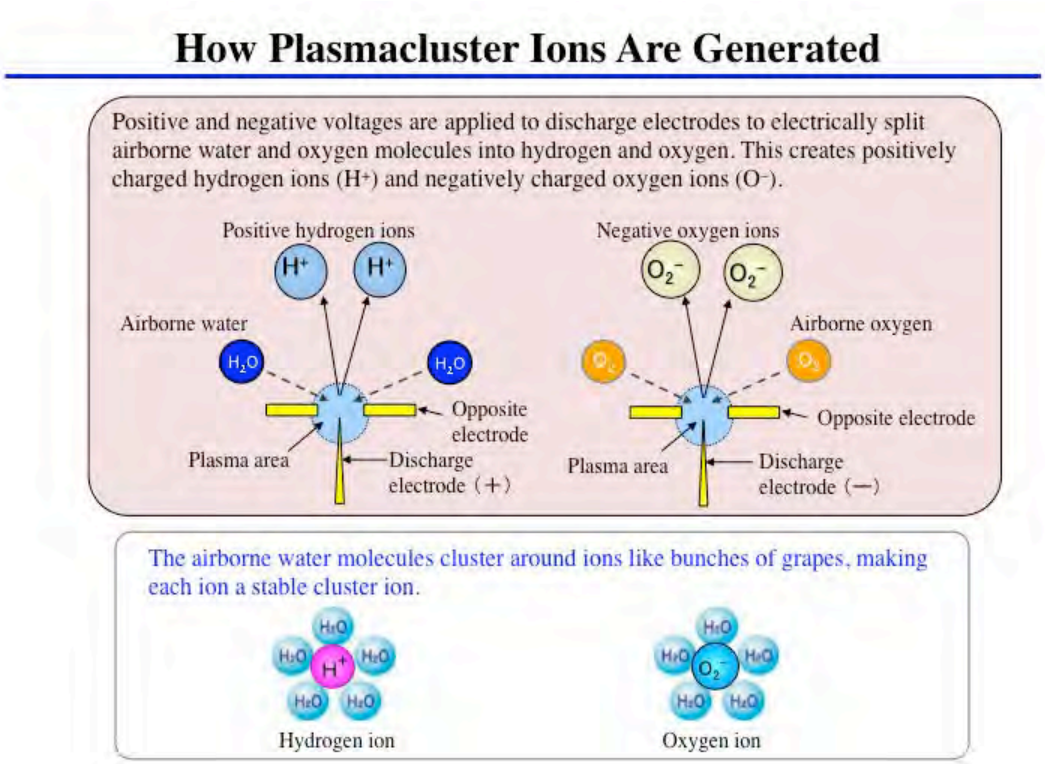
- **About Avian Influenza A (H7N9) Virus**

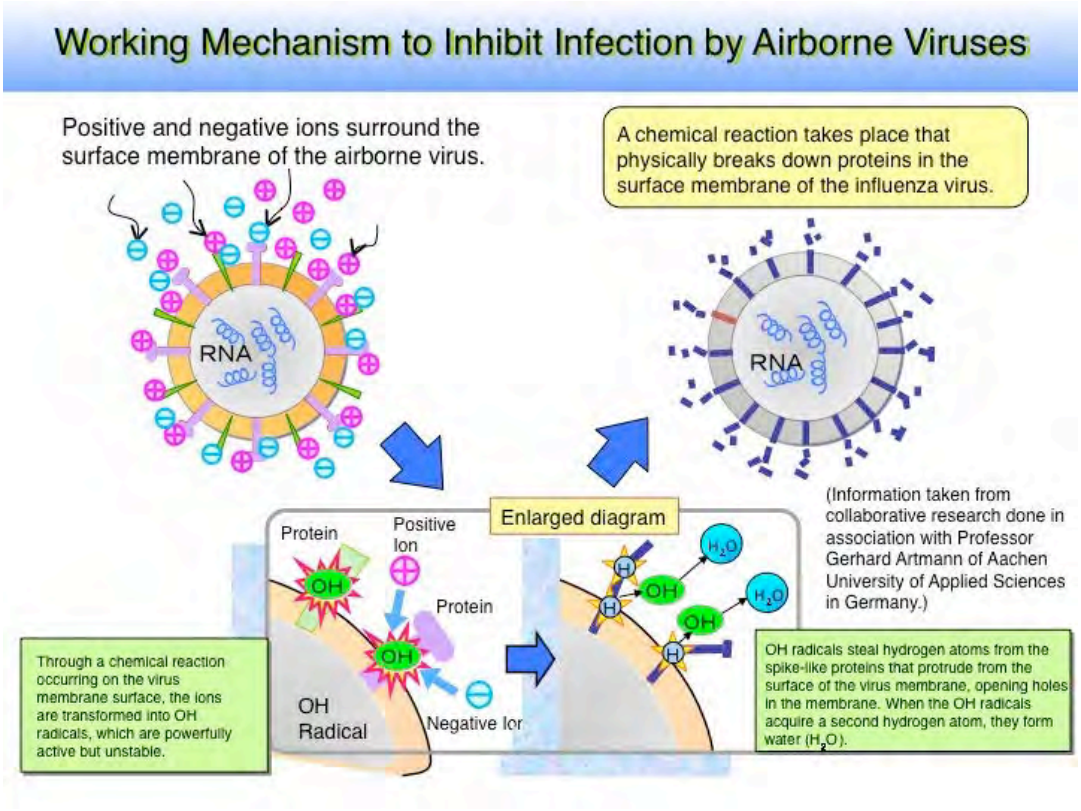
Avian influenza is an infectious disease spread by domestic poultry carrying the influenza A subtype. Originally, it was transferred between waterfowl such as ducks and geese with no symptoms, but now this virus has spread to chickens and other domestic poultry. The avian influenza A (H7N9) virus has a low lethality among chickens and is classified as a weakly pathogenic avian influenza. However, since the WHO first reported in April 2013 that it had infected humans, there has been an increase of the number of human cases reported. Because of the danger of the virus mutating into a new strain with the ability to quickly spread among people and cause a worldwide pandemic, Japan's Ministry of Health, Labour and Welfare has designated the H7N9 strain as a Category II infectious disease under Japan's Infectious Diseases Control Law.

Reference: See a video explaining avian flu and how to prevent it (in Japanese only).
http://nettv.gov-online.go.jp/prg/prg9687.html

- **About Plasmacluster Technology**

In Sharp's proprietary air purification technology, positively charged hydrogen ions ($H^+ (H_2O)_n$) and negatively charged oxygen ions ($O_2^- (H_2O)_m$) are discharged simultaneously. These positive and negative ions instantaneously bond on the surface of airborne substances such as bacteria, fungi, viruses, and allergens, becoming highly reactive OH radicals (hydroxyl radicals) that break down the proteins on the surface of these bacteria and other substances. By chemical reaction, the OH radicals work to suppress the activity of those substances.





Comparison of Oxidation

Positive and negative ions bond on the surface of airborne viruses and bacteria and react chemically to form OH radicals, which have high oxidation power (standard oxidation potential 2.81 V). These reduce the contagiousness of airborne viruses and the activity of bacteria.

Active Substances	Chemical Formula	Standard Oxidation Potential (V)
Hydroxyl radicals	OH	2.81
Oxygen atom	O	2.42
Ozone	O_3	2.07
Hydrogen peroxide	H_2O_2	1.78
Hydroperoxyl radical	OOH	1.7
Oxygen molecule	O_2	1.23

Source: *Fundamentals and Applications of Ozone*

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

Target	Testing and Verification Organization	Country
Efficacy proven in clinical trials	Graduate School of Medicine, University of Tokyo / Public Health Research Foundation	Japan
	Faculty of Science and Engineering, Chuo University / Clinical Research Support Center, University Hospital, University of Tokyo	Japan
	Animal Clinical Research Foundation	Japan
	Soiken Inc.	Japan
	School of Bioscience and Biotechnology, Tokyo University of Technology	Japan
	HARG Treatment Center, National Trust Co., Ltd.	Japan
Viruses	Kitasato Research Center of Environmental Sciences	Japan
	Seoul National University	Korea
	Shanghai Municipal Center for Disease Control and Prevention	China
	Kitasato Institute Medical Center Hospital	Japan
	Retroscreen Virology, Ltd.	UK
	Shokukanken Inc.	Japan
	Hanoi College of Technology, Vietnam National University	Vietnam
	Institut Pasteur, Ho Chi Minh City	Vietnam
Allergens	Graduate School of Advanced Sciences of Matter, Hiroshima University	Japan
	Department of Biochemistry and Molecular Pathology, Graduate School of Medicine, Osaka City University	Japan
Fungi	Ishikawa Health Service Association	Japan
	University of Lübeck	Germany
	Professor Gerhard Artmann, Aachen University of Applied Sciences	Germany
	Japan Food Research Laboratories	Japan
	Shokukanken Inc.	Japan
	Shanghai Municipal Center for Disease Control and Prevention	China
Bacteria	Ishikawa Health Service Association	Japan
	Shanghai Municipal Center for Disease Control and Prevention	China
	Kitasato Research Center of Environmental Sciences	Japan
	Kitasato Institute Medical Center Hospital	Japan
	Dr. Melvin W. First, Professor Emeritus, Harvard School of Public Health	US
	Animal Clinical Research Foundation	Japan
	University of Lübeck	Germany
	Professor Gerhard Artmann, Aachen University of Applied Sciences	Germany
	Japan Food Research Laboratories	Japan
	Shokukanken Inc.	Japan
Odors, pet smells	Boken Quality Evaluation Institute	Japan

Skin beautifying effects	School of Bioscience and Biotechnology, Tokyo University of Technology	Japan
Hair beautifying effects	Saticine Medical Co., Ltd.	Japan
	C.T.C Japan Ltd.	Japan
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	Japan
Working mechanism of skin moisturizing (water molecule coating) effect	Research Institute of Electrical Communication, Tohoku University	Japan

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FOR IMMEDIATE RELEASE
Press Release No. 04-026
Date: July 27, 2004

Plasmacluster Ions™*1 Inactivate an Airborne Corona Virus—A World First*2

Verification Research Conducted Jointly with the Kitasato Institute

Recently, new viral-based infectious diseases such as SARS (corona viruses) and avian influenza (orthomyxoviruses) have made their appearance, and cases that threaten human health are on the increase. In seeking new technologies for purifying the air, Sharp has systematically verified the efficacy of Plasmacluster Ions™ in deactivating harmful substances that are the cause of illnesses spread through the medium of the air.

Now, in collaboration with Director & Visiting Professor Tatsuo Suzuki PhD and Assistant Director Noritada Kobayashi PhD of the Kitasato Institute Medical Center Hospital, one of the world's most prestigious viral research organizations, we have verified that Plasmacluster Ions™ inactivate the feline corona virus (FCoV), a member of the Coronaviridae (corona virus) family. The results demonstrated that 99.7% of the virus is rendered inactive within 40 minutes. In other words, we proved that Plasmacluster Ions™ work to destroy the virus and control its capacity to infect.

Theses results have now enabled us to demonstrate the efficacy of Plasmacluster Ions™ against three basic types of major pathogenic viruses that infect by aerosol transmission (inhalation).

Plasmacluster Ion™ technology is Sharp's proprietary air purification technology in which large numbers of positive and negative ions are generated from airborne

water and oxygen molecules and then released back into the air in large quantities. These ions form clusters around microparticles such as airborne mold, influenza viruses and mite allergens, and render them inactive through a chemical reaction. Sharp developed this air purification technology in 2000, and is working with leading academic research institutions around the world to verify its effectiveness. Based on the scientific data that emerges from this industry-academia collaboration, Sharp will develop and introduce new products to the market.

New Points Verified at this Time

- Demonstrated that Plasmacluster Ions™ render inactive an airborne feline corona virus in the Coronaviridae family.
- Directly confirmed that the virus was in an inactive state using TEM (transmission electron microscopy).

Classification System for Viruses Against Which Plasmacluster Ions Have Proven Effective

Proven effective

Nucleic Acid	Family Name	Primary Viruses	Primary Disease/Disorder	Date of Announcement of Verification of Effectiveness
RNA	Picornaviridae	Polio virus	Infantile paralysis (poliomyelitis)	September 2002
		Coxsackie virus	Summer colds	September 2002
	Coronaviridae	Feline corona virus	Vomiting, diarrhea	July 2004
		Human corona virus	Colds	—
		SARS virus	Sudden Acute Respiratory Syndrome (SARS)	—
	Orthomyxoviridae	Influenza virus	Influenza	September 2002
DNA	(No DNA-based virus causing major illness infects through aerosol transmission.)			

Note: We are currently involved in verifying the effectiveness of Plasmacluster Ions™ to inactivate the airborne SARS virus.

*1 Plasmacluster and Plasmacluster Ion are trademarks of Sharp Corporation.

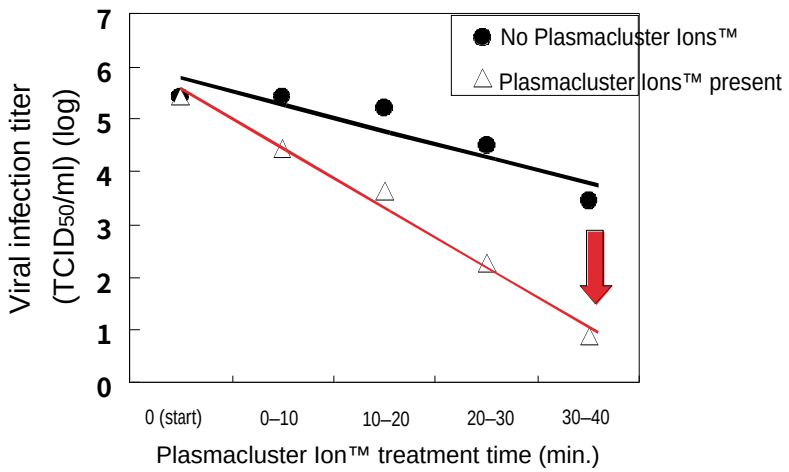
*2 Current as of July 27, 2004, using Plasmacluster Ion™ technology.

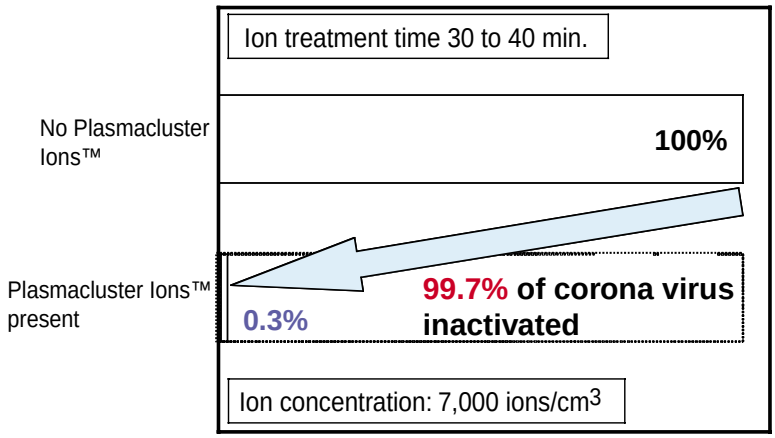
Method Used to Verify Inactivation of Airborne Corona Virus/Room Simulation Test

A test was conducted by preparing two boxes, each having a volume of one (1) m^3. A Plasmacluster Ion™ generator was placed in one box; the other box was left empty. An aerosolized mist of feline corona virus was sprayed into both boxes, and the respective inactivation effects compared. (The $TCID_{50}$ [Tissue Culture Infectious Dose 50%] assay was used to evaluate the test results. This assay measures the quantity of a virus suspension that will infect 50% of cell culture and is widely used in the field of virology.)

The results showed that 99.7% of the virus exposed to the ions was inactivated within 40 minutes. This is thought to be the result of ions damaging the virus by stealing hydrogen (H) from the peplomers ("spikes" made of protein) by which the virus infects cells. An inactivated corona virus cannot infect a host even when introduced into the body.

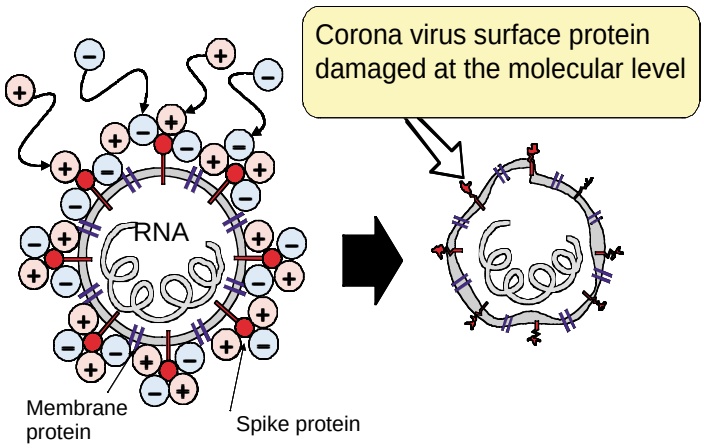
Evaluation of efficacy against airborne corona virus





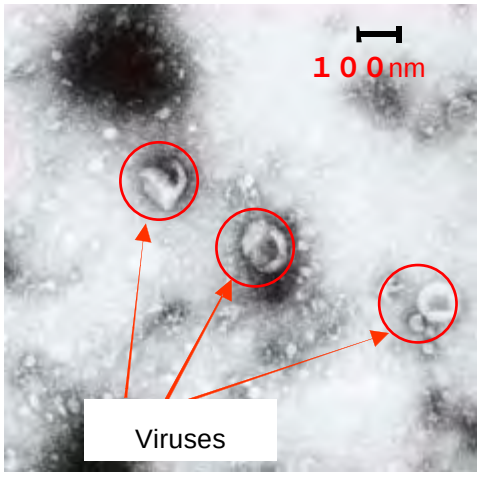
Inactivation mechanism

Positive ions (H^+) and negative ions (O_2^-) cluster around the spike protein (a surface protein that attaches to an organism and triggers the infection) of the airborne virus, and are converted to hydroxyl radicals (• OH), a powerfully active substance. By stealing H (hydrogen) from within the spike protein, the ions react and combine chemically to form water (H_2O). Because the spike protein is damaged, the virus cannot infect cells even when introduced into the body.



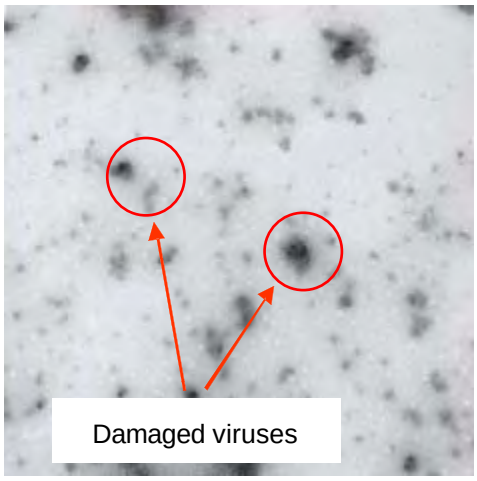
Electron microscope image showing inactivated state

Viruses **not** exposed to Plasmacluster Ions™



Corona virus when not exposed to the action of Plasmascluster Ions™
[retaining their normal shape]

Virus exposed to Plasmacluster Ions™



Corona virus when exposed to the action of Plasmascluster Ions™
[damaged and collapsed]

Comments by Doctors Tatsuo Suzuki and Noritada Kobayashi of the Kitasato Institute on Plasmacluster Ions™

In the electron microscope photograph, normal corona virus can be observed when no Plasmacluster Ion™ treatment is applied, but when exposed to Plasmacluster Ions™, no normal corona viruses can be observed, and what appears to be decomposed matter in which the spikes (protein protrusions) and envelope (surface membrane) on the virus surface are damaged is evident. This can be attributed to "the virus being decomposed by the Plasmacluster Ions™."

Prior to carrying out the test, we were skeptical that the Plasmacluster Ions™ would actually have an antimicrobial effect. But we maintained an open mind, and when we conducted the performance test, it was a fact that there was a dramatic reduction in bacteria and viruses in the presence of Plasmacluster Ions™. We can imagine that this technology will have tremendous utility and huge potential for practical applications.

Overview of Plasmacluster Ion™ Technology

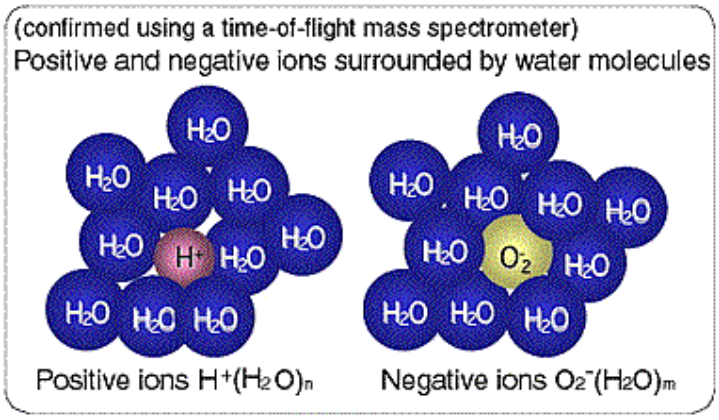
Positive (H^+) ions and negative (O_2^-) ions generated by a plasma discharge have the property of forming clusters around micro particles. They surround harmful substances such as airborne fungi, influenza viruses and mite allergens. At this point, a chemical reaction occurs, and the collision of two H^+ ions and an O_2^- ion creates highly reactive OH^- groups called hydroxyl radicals (• OH). A hydroxyl radical is unstable and to stabilize itself, it will rob one hydrogen (H) from any harmful airborne particle it encounters, inactivating it and forming water (H_2O) vapor in the process, which is returned to the air.

1. These positive and negative ions are the same ions found in abundance in nature, such as in the forest, and are completely harmless to humans. Ozone generation is less than 0.01 ppm, much lower than the industry and consumer electronics standard of 0.05 ppm.
2. Compared to passive air cleaning systems that filter out contaminants by using the power of a fan to pull air through a filter, air cleaning systems that utilize Plasmacluster Ion™ technology are significantly more effective in cleaning the air in the interior of an entire room, including stagnant air which is not able to go through a filter.
3. Plasmacluster Ion™ generating units are continuously effective, as they do not become clogged with dirt like a filter and do not require changing or cleaning filters. They are environmentally conscious devices that use water molecules in the air and save electricity costs (approx. 0.5W power consumption, annual electricity cost of approx. 100 yen [$0.91]).

Plasmacluster Ion™ Generating Device

Unit: mm

Chemical Composition and Structure of Plasmacluster Ions™



What is a corona virus?

The corona virus is spherical in shape with a diameter of from 60 to 220 nm. Its structure consists of an RNA nucleus enclosed within a sack-like envelope made of protein, along with spike-like protrusions on its surface approximately 20 nm in length consisting of a glycoprotein.

Various types of corona viruses infect humans as well as cats, birds, dogs and rodents. In animals, it causes diseases of the respiratory organs, intestinal tract, and internal organs such as the liver. In humans, it generally causes respiratory diseases, and is regarded as the cause of 10% to 30% of all colds.

Profile of the Kitasato Institute Medical Center, Research Division

The Kitasato Institute was founded in 1914 by Dr. Shibasaburo Kitasato to contribute to the improvement of the health of the nation by researching the causes of diseases and approaches to preventative treatments, and by operating medical treatment facilities. Dr. Kitasato gained world renown through his discovery of tetanus immune antibodies following on his success in growing a pure culture of the tetanus bacillus. He placed great importance on the ideas of the practical sciences, and devoted his time to public health propagation and development.

As a leader in advanced leading-edge medical treatment, the Research Division of the Kitasato Institute Medical Center Hospital is involved in numerous clinical investigations as well as basic research. As part of these programs, we established a Medical Environmental Science Center within the Institute in conjunction with setting up infection control hospital rooms. We are engaged in R&D with the goal of improving and enhancing the healthcare environment from a comprehensive perspective. To constantly maintain medical care at the highest levels, we have established a Biomedical Laboratory as a place where a large number of clinical investigations and basic research can be conducted. This laboratory maintains the highest standards of cleanliness, and incorporates facilities to enable a wide variety of research ranging from basic research to clinical studies, including in particular, laboratory animal facilities, as well as a cytology laboratory, physical science laboratory, nucleic acid laboratory, and cellular analysis laboratory. The laboratory serves as a pillar supporting advanced medicine. Research focuses on infectious diseases, cancer, and geriatrics, and is conducted by a staff who are highly knowledgeable in immunology and microbiology. In addition, we give the highest priority to the hospital environment, and we are also developing new chemotherapy agents and antiseptics, working within a framework of cooperation with the Medical Environmental Science Center of the Kitasato Institute.

Dr. Tatsuo Suzuki

Kitasato Institute Medical Center Hospital
Director, Medical Environmental Science Center
Chief, Division of Biomedical Research
Assistant to the Medical Director, Kitasato Institute Research Hospital
Visiting Professor, Kitasato University
(Specialties) Infection and immunology

Dr. Noritada Kobayashi

Kitasato Institute Medical Center Hospital, Research Division
Biomedical Laboratory, Assistant Director
Doctor of Medicine (M.D.)
(Specialties) Immunology, molecular immunology, microbiology

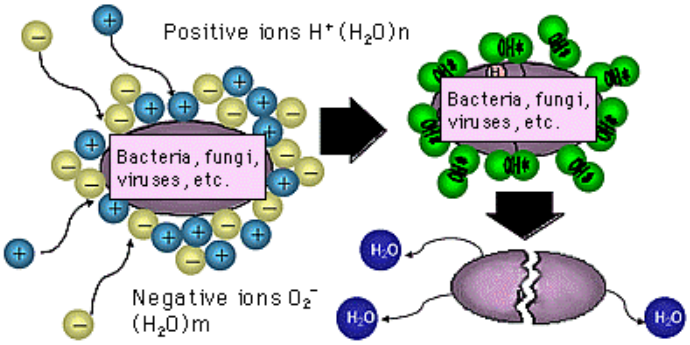
[Reference]

Mechanism for Inactivating Airborne Fungi

The positive and negative ions cluster together on the surface of airborne fungi, causing a chemical reaction that results in the creation of highly reactive OH groups called hydroxyl radicals (• OH).

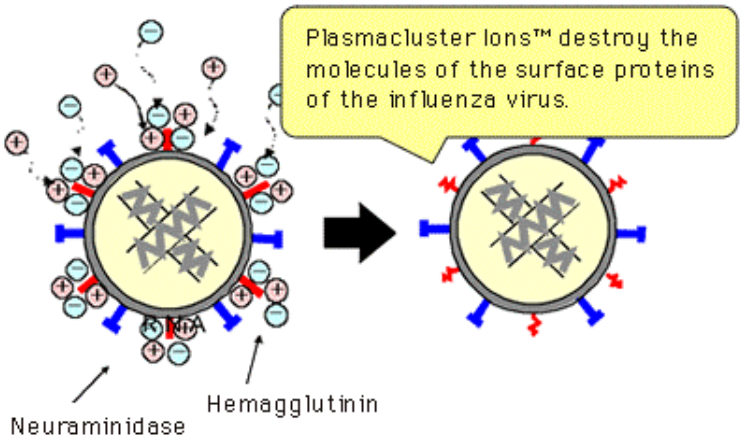
The hydroxyl radical will take a hydrogen molecule from the cell wall of an airborne fungi particle, thus inactivating it.

Inhibits mold infestation as well as controls musty and household odors (caused in large part by mold fungi) as they occur.



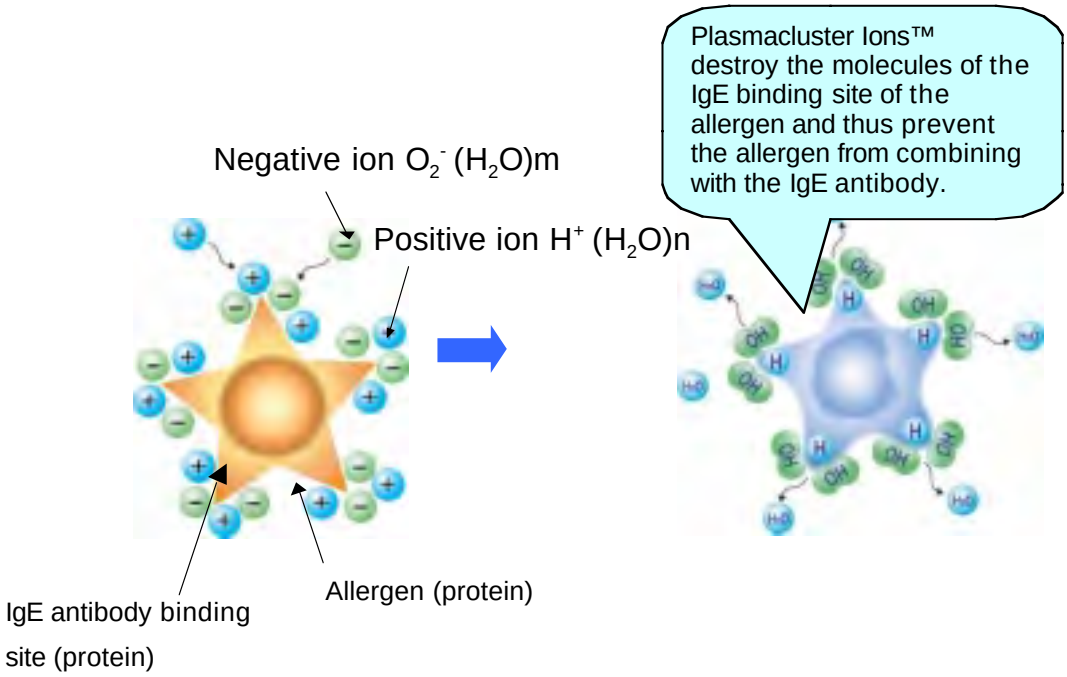
Mechanism for Inactivating Airborne Influenza Virus

The positive and negative ions surround the hemagglutinin (surface proteins that form on organisms and trigger infections) and change into highly reactive OH groups called hydroxyl radicals (• OH). These take a hydrogen molecule from the hemagglutinin and change into water (H_2O). The hemagglutinin molecules are destroyed so the virus cannot infect even if it enters someone's body.



Mechanism for Deactivating Airborne Allergens

Plasmacluster Ions™ surround the airborne allergen and change into highly reactive hydroxyl radicals (• OH). The hydroxyls then deactivate the molecules of the IgE antibody binding site of the allergen. No allergic symptoms occur even if allergens enter the body.



November 9, 2010

World's First[*1] Verification by Clinical Trial of the Effectiveness of High-Density Plasmacluster Ions[*2] in Decreasing the Rate of Influenza Virus Infection

Clinical Trial Conducted in Dialysis Hospitals Under the Supervision of Professor Yasuo Ohashi of The University of Tokyo's School of Public Health

Sharp Corporation's contracted research has proven, through the world's first verification by clinical trial[*3], that high-density Plasmacluster Ions (with an ion density of 10,000 ions/cm^3) tend to decrease the influenza virus infection rate. This was verified by professors from The University of Tokyo's School of Public Health, including Professor Yasuo Ohashi, whose specialty is biostatistics.

This clinical trial was carried out in the treatment rooms of Japanese dialysis hospitals, totaling 44 facilities that housed 3,407 patients and 745 Plasmacluster Ion Generators. The treatment rooms were divided into areas with ions and areas without ions. The trial lasted for around six months and used the double-blind method[*4], a common trial method, while examining the number of influenza cases that occurred among patients (management of the trial was consigned to the Public Health Research Foundation).

The trial results verified that the influenza virus infection rate decreased by approximately 30% in the areas where ions were present compared to areas with no ions. During the trial there were a total of 23 influenza cases (14 cases without ions and 9 cases with ions), proof of its tendency (one-sided $p = 0.10$) to be effective at decreasing the rate of influenza virus infection[*5].

It should also be noted that Professor Yasuo Ohashi of the School of Public Health of The University of Tokyo is scheduled to make a presentation about this trial at the annual Japan Epidemiological Association meeting on January 21 and 22, 2011.

Based on the results of its academic marketing[*6], Sharp, working in collaboration with academic research organizations around the world since the year 2000, has proven that Plasmacluster technology is effective in inhibiting the activity of 29 different kinds of harmful microorganisms, including viruses, bacteria, and

allergens. Furthermore, it has been proven safe to humans[*7]. This clinical trial effectively advanced these findings with a directly proven merit to human health.

In the future, Sharp will continue its efforts to advance Plasmacluster technology, further prove its efficacy, create a healthy environment, and contribute to society.

Comments by Mr. Yasuo Ohashi, Professor of the University of Tokyo's Public Health

This randomized double blind clinical trial on influenza virus infection prevention is truly unique, and these tests demonstrate a high level of leadership and pioneering spirit. The results suggest the possibility that Plasmacluster is able to reduce the risk of catching the influenza virus, which is said to infect 10 million people every year in Japan. I think that this clinical trial contributes to the development of methodology, and shows that Plasmacluster Technology will be a great contribution to society. Further clinical and epidemiological studies are still required, but I look forward to seeing Plasmacluster Technology as another step people can take in their daily lives to reduce the risk of influenza infection, much like gargling and hand-washing.

*1 As of November 9, 2010.
*2 Plasmacluster is a registered trademark of Sharp Corporation.
*3 This project was carried out in cooperation with the Ministry of Education's Translational Research Educational Program, a program that The University of Tokyo participates in.
*4 A widely used statistical examination method for clinical trials where neither the patient nor the doctor know whether a medicine or a placebo was used during the patient's treatment.
*5 Last season showed fewer signs of influenza infections than normal, affecting the number of infections during the clinical trial. For this reason, the trial was under-powered and the p-value (one-sided) did not reach to the statistically significant level ($p = 0.05$).
*6 A marketing technique where a product has its benefits scientifically verified in cooperation with top-of-the-line research facilities.
*7 Testing conducted by Mitsubishi Chemical Medience Corporation, including tests for inhalation toxicity and for skin and eye irritancy and corrosivity.

The Method Used to Verify Influenza Infection Inhibition Effectiveness in a Clinical Setting and the Results

Evaluation parameters	Number of cases of infection by the influenza virus (new strains and seasonal strains), and the total number of observation days
Examination facilities	Dialysis hospitals (44 facilities; 3,407 patients)
Duration	December 1, 2009 to June 30, 2010
Comparison method	Double-blind study that divided the treatment space into areas with ions and areas without ions
Ion density	10,000 ions/cm^3
Statistical analysis method	Cochran-Mantel-Haenszel (CMH) Test[*8], permutation test[*9]
Trial results	Found a 30% reduction in the rate of influenza virus infection; statistically confirmed this figure to have a 10% one-sided p-value Areas with ions: number of cases observed: 1,154 number of cases of influenza infection: 9 number of observation days: 219,057 (total) Areas without ions: number of cases observed: 1,274 number of cases of influenza infection: 14 number of observation days: 237,167 (total)

*8, 9 A statistical analysis method that measures the association between the intervention and the results.

Figure 1 Clinical Trial Timeline

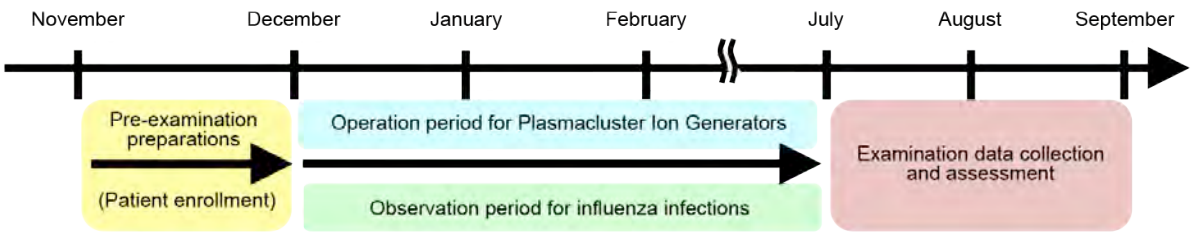
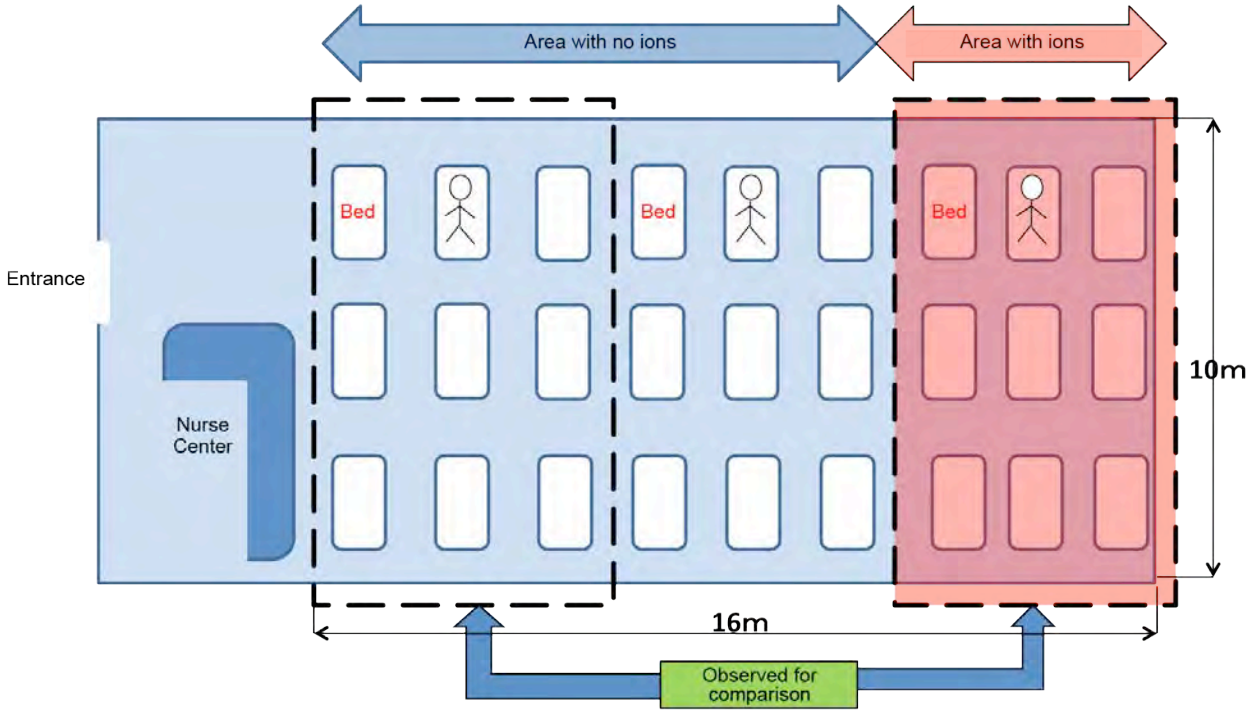


Figure 2 Examination Area Image



Picture A Dialysis Hospital

Profile of Mr. Yasuo Ohashi, Professor of Department of Biostatistics, School of Public Health, School of Public Health, The University of Tokyo

Professor for the Department of Biostatistics, School of Public Health, The University of Tokyo. He is the managing director of the Public Health Research Foundation and he is involved in a wide range of activities, including clinical trials and epidemiologic studies.

- Public Health Research Foundation
  Managing Director
- Non-Profit Organization Japan Clinical Research Support Unit
  The Chairman of the Board of Directors
- Statcom Company Limited
  Chairman
- Japan Medical and Scientific Communicators Association
  The Chairman of the Board of Directors
- Japan Society of Clinical Trials and Research
  The Chairman of the Board of Director

Profile of the Public Health Research Foundation

Established in 1984, the Public Health Research Foundation conducts stress and life science-related research. In addition, the foundation uses the results from their research to promote disease prevention methods, contributing to their main mission, better health for all. The Chairman is Takayasu Okushima.

With both biomedical and stress research institutes, the foundation is involved in health promotion business (health screening, health evaluation, health guidance), clinical research support (support for breast cancer research, optimum therapy for osteoporosis research, lifestyle disease related clinical research, health outcome research), public relations, as well as ethical review board on medical and mental health research.

Efficacy of Plasmacluster Ions in Inhibiting Activity of Various Pathogens Confirmed Through Collaborative Research

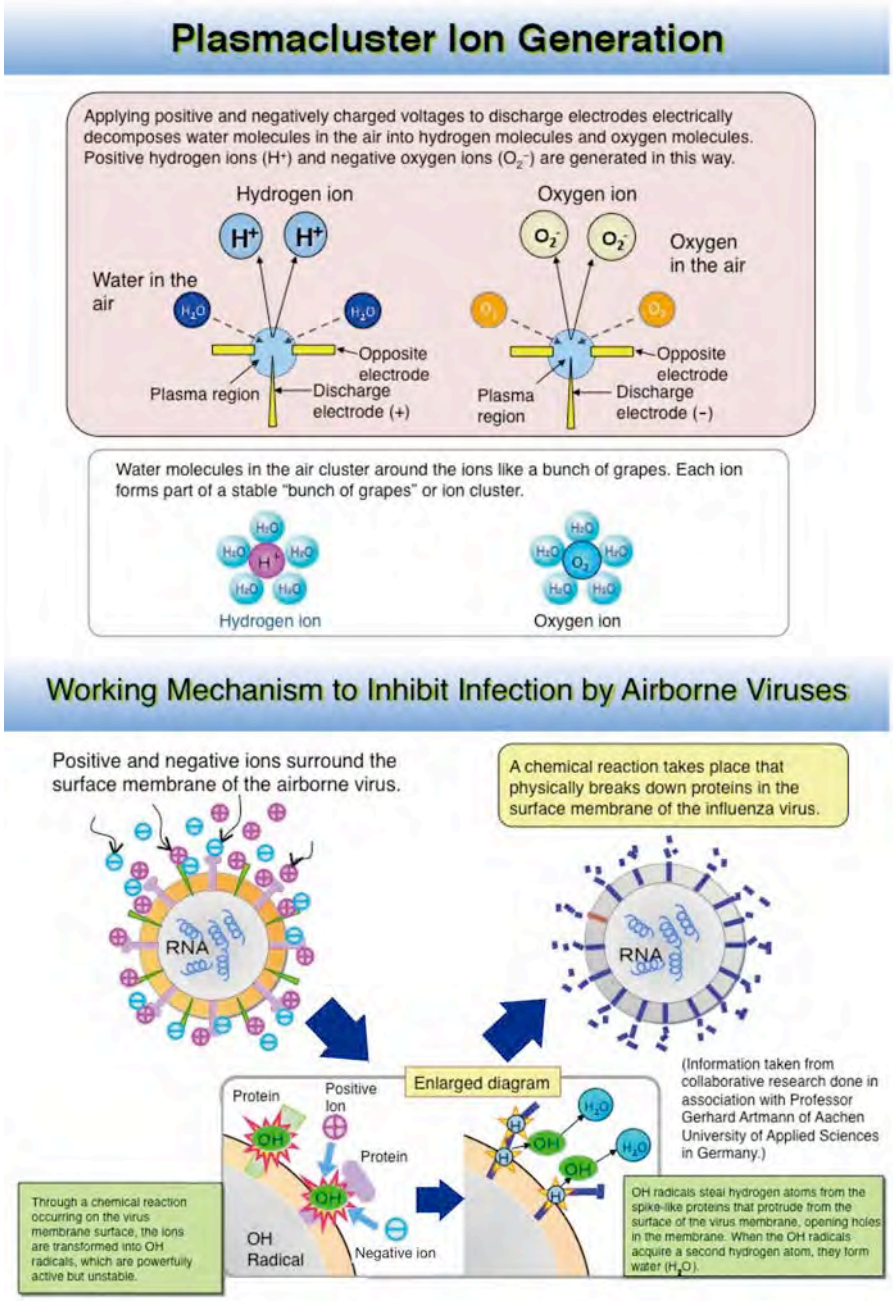
Target Substance	Species	Testing & Verification Organization
Bacteria	Serratia bacteria	Harvard School of Public Health (Dr. Melvin W. First, Professor Emeritus), U.S.
	Coliform bacteria (E. coli)	Ishikawa Health Service Association, Japan
	E. coli, Staphylococcus (aureus), Candida	Shanghai Municipal Center for Disease Control and Prevention, China
	Bacillus subtilis	Kitasato Research Center of Environmental Sciences, Japan
		CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences), Germany
	MRSA (methicillin-resistant Staphylococcus aureus)	Kitasato Research Center of Environmental Sciences, Japan
		Kitasato Institute Medical Center Hospital, Japan
	MDRP (multi-drug resistant Pseudomonas aeruginosa)	Kitasato Institute Medical Center Hospital, Japan
	Pseudomonas, Enterococcus, Staphylococcus	University of Lübeck, Germany
	Enterococcus, Staphylococcus, Sarcina, Micrococcus	CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences), Germany
Allergens	Mite allergens, pollen	Graduate School of Advanced Sciences of Matter, Hiroshima University, Japan
	Mite allergens	Osaka City University Medical School's Department of Biochemistry & Molecular Pathology, Japan

Fungi	Cladosporium	Ishikawa Health Service Association, Japan
		University of Lübeck, Germany (growth-suppressing effect)
		CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences), Germany
	Penicillium, Aspergillus	University of Lübeck, Germany (growth-suppressing effect)
	Aspergillus, Penicillium (two species), Stachybotrys, Alternaria, Mucorales	CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences), Germany
Viruses	H1N1 human influenza virus	Kitasato Research Center of Environmental Sciences, Japan
		Seoul University, Korea
		Shanghai Municipal Center for Disease Control and Prevention, China
		Kitasato Institute Medical Center Hospital, Japan
	H5N1 avian influenza virus	Retroscreen Virology, Ltd., London, U.K.
	New-type H1N1 influenza virus	Retroscreen Virology, Ltd., London, U.K.
	SARS virus	Retroscreen Virology, Ltd., London, U.K.
	Polio virus	Kitasato Research Center of Environmental Sciences, Japan
	Coxsackie virus	Kitasato Research Center of Environmental Sciences, Japan
		Kitasato Institute Medical Center Hospital, Japan
	Corona virus	Kitasato Institute Medical Center Hospital, Japan
	Canine Parvovirus	Shokukanken Inc., Japan

Note: Efficacy in inhibiting activity of the airborne target substances noted above was verified by exposing the substances to an ion concentration of at least 3,000 ions/cm^3.

Overview of Plasmacluster Technology

Sharp's proprietary air purification technology in which positive ions $[H^{+}(H_2O)_n]]$ and negative ions $[O_2^{-}(H_2O)_m]$ are released into the air simultaneously. These positive and negative ions instantly recombine on the surface of bacteria, mold fungus, viruses and allergens floating in the air to form hydroxyl (OH) radicals, which have extremely high oxidation ability, and this chemical reaction decomposes proteins on the surface of bacteria and other pathogens, thereby inhibiting their activity.



Oxidizing Substances Produced by Plasmacluster Ions

Plasmacluster Ions adhere to airborne viruses, and the positive and negative ions react to form OH (hydroxyl) radicals, which have the most powerful oxidation ability (standard oxidation potential of 2.81 V), thereby inhibiting the infectivity of the airborne virus.

Active Substance	Chemical Formula	Standard Oxidation Potential [V]
Hydroxyl radical	• OH	2.81
Oxygen atom	• O	2.42
Ozone	O_3	2.07
Hydrogen peroxide	H_2O_2	1.78
Hydroperoxide radical	• OOH	1.7
Oxygen molecule	O_2	1.23

Source: *Ozon no kiso to ouyou* [*Ozone—Its Basis and Applications*]

November 13, 2009

Sharp's Plasmacluster[*1] Technology Proven Effective in Inhibiting the Activity of Adherent and Airborne Methicillin-Resistant Staphylococcus Aureus[*3] (MRSA), a Typical Bacterial Cause of Hospital-Acquired Infections[*2]

Sharp Corporation, working together with the Kitasato Institute Medical Center Hospital at the Kitasato Institute of Kitasato University, has proven that High-Density Plasmacluster ions inhibit the activity of Methicillin-resistant Staphylococcus aureus (MRSA[*3]), a typical bacterial cause of hospital-acquired infections, both when airborne and when adhering to surfaces.

These experiments proved that high-density Plasmacluster ions (at an ion density of approximately 25,000 ions/cm^3) inhibit the activity of adherent MRSA (as plane state on a petri dish) by approximately 99.9% in eight hours, and the activity of airborne MRSA (as a suspension in a box having a volume of one cubic meter) by approximately 99.9% in 20 minutes.

Additional experiments verified the effectiveness of Plasmacluster ions in inhibiting the activity of airborne multidrug-resistant Pseudomonas aeruginosa[*4] (MDRP) by approximately 99.9%, and the viral infectivity of airborne Coxsackie virus[*5], by approximately 99.9% (see table below for more details on verified efficacy). Both of these microorganisms are similarly the source of hospital-acquired infections.

These experimental proofs demonstrated that high-density Plasmacluster ions have an inhibitory effect on the activity of adherent MRSA, as well as confirmed that the higher the ion density, the greater the inhibitory effect on the activity of airborne MRSA and MDRP and on the infectivity of airborne Coxsackie virus.

Sharp's collaborative research with academic and research organizations[*6] around the world began in 2000 and has since proven that Plasmacluster ions are effective in inhibiting the activity of 28 kinds of harmful substances, including the new-type H1N1 influenza virus[*7]. In 2002, research also confirmed the safety of high-density Plasmacluster ions with respect to human health[*8], and in 2004, joint research with an academic research institution[*9] elucidated the mechanism by which Plasmacluster ions destroy the proteins on the surface of microorganisms.

In the future, Sharp intends to further its efforts for improving the effectiveness of Plasmacluster technology to create a healthy environment.

Verified Effectiveness of Plasmacluster Ions

Target Substance	Ion Density (ions/cm^3)	Verified Effectiveness
Adherent MRSA	25,000	Reduced by approx. 99.9% in 8 hours
Airborne MRSA	25,000	Reduced by approx. 99.9% in 20 minutes
	7,000	Reduced by approx. 99.9% in 30 minutes
Airborne MDRP	25,000	Reduced by approx. 99.9% in 30 minutes
	7,000	Reduced by approx. 99.9% in 40 minutes
Airborne Coxsackie virus	25,000	Reduced by approx. 99.9% in 20 minutes
	7,000	Reduced by approx. 99.9% in 30 minutes

*1 Plasmacluster and Plasmacluster ions are trademarks of Sharp Corporation.

*2 Microorganisms that cause hospital-acquired infections (known as nosocomial infections) include bacteria, viruses and other pathogens that are the source of infections occurring in patients in the clinical setting (hospitals, healthcare facilities, etc.).

*3 MRSA is an acronym for methicillin-resistant Staphylococcus aureus, a bacterium responsible for difficult-to-treat infections in humans. MRSA typically infects humans with weakened immune systems, for example, patients in hospitals, and its resistance to a large group of antibiotics is a serious problem.

*4 MDRP is an acronym for multidrug-resistant Pseudomonas aeruginosa. MDRP infections in critically ill patients have become a serious clinical problem in hospitals and other health care settings because of the limited number of antibiotics that are effective against this bacteria.

*5 Coxsackie virus is a group of human pathogens that can cause nonspecific febrile illnesses (called "summer colds" in Japan), upper respiratory tract disease and meningitis.

*6 Sharp has adopted a collaborative research approach to product marketing in which the effectiveness of a technology is verified based on scientific data developed in collaboration with leading-edge academic research institutions. New products are then brought to market based on the results.

*7 A new-type H1N1 influenza virus first confirmed in Mexico and the US in 2009, which is now causing a global pandemic.

*8 Testing conducted by Mitsubishi Chemical Medience Corporation. (inhalation toxicity, as well as eye and skin irritation/corrosion tests).

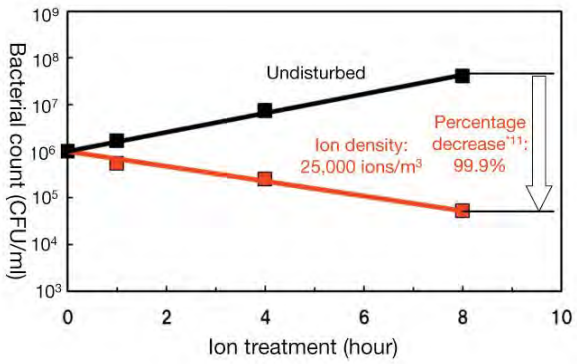
*9 Joint research conducted with Professor Gerhard Artmann, of Aachen University of Applied Sciences.

Method for Proving Effectiveness Against Adherent Methicillin-resistant Staphylococcus aureus (MRSA)

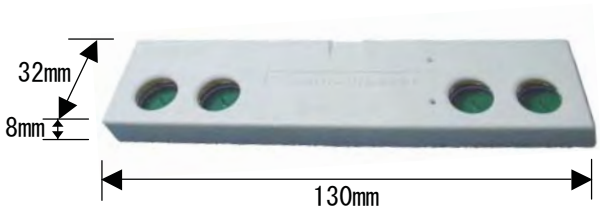
Adherent MRSA bacteria (in the form of an emulsion dripped onto a plastic petri dish) was exposed for a prescribed length of time to Plasmacluster ions generated by a high-density Plasmacluster ion generator at a density of approximately 25,000 ions/cm^3.

After eight hours of exposure, the adherent MRSA bacteria was collected and a study done to count the number of microorganisms using a culture technique[*10] commonly employed in the field of microbiology research. The results confirmed that the number of bacteria decreased by approximately 99.9% compared to the natural state not exposed to Plasmacluster ions.

Change over time in numbers of adherent MRSA



High-Density Plasmacluster Ion Generator



*10 A method of inoculating a medium with bacteria and then studying the number of bacterial colonies that form (bacterial count).

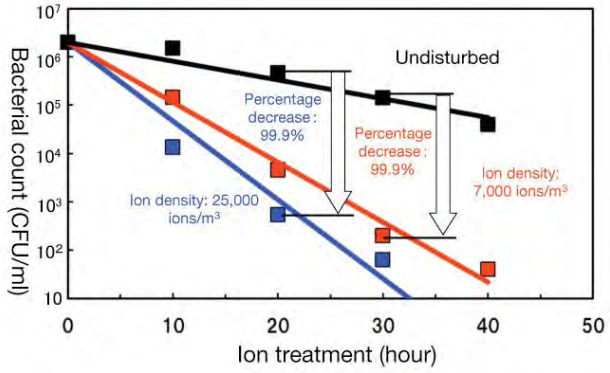
*11 Stated as the percentage of decrease in the bacteria count resulting from exposure to Plasmacluster ions compared to the count of bacteria left undisturbed in their natural state.

Method for Proving Effectiveness Against Airborne Methicillin-resistant Staphylococcus aureus (MRSA), Multidrug-resistant Pseudomonas aeruginosa (MDRP), and Coxsackie Virus

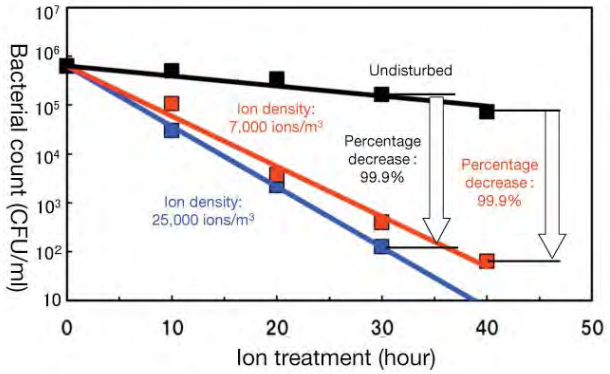
A high-density Plasmacluster ion generator was placed in a box having a volume of 1 m^3. Plasmacluster ions were generated (at densities of 25,000 ions/cm^3 and 7,000 ions/cm^3) and MRSA, MDRP and the Coxsackie virus were separately sprayed in mist form into the box. After a prescribed time, samples of the airborne microorganisms inside the box were collected, and studies were done, in the case of the bacterial substances, using the culture method to obtain a bacterial count, and in the case of the virus, using the $TCID_{50}$ method[*12] commonly used in the virology research field to obtain a measure of infectivity (viral

infectivity titer). The results confirmed that the higher the ion density, the greater the inhibitory effect on the activity of airborne MRSA and MDRP, and on the viral infectivity of airborne Coxsackie virus.

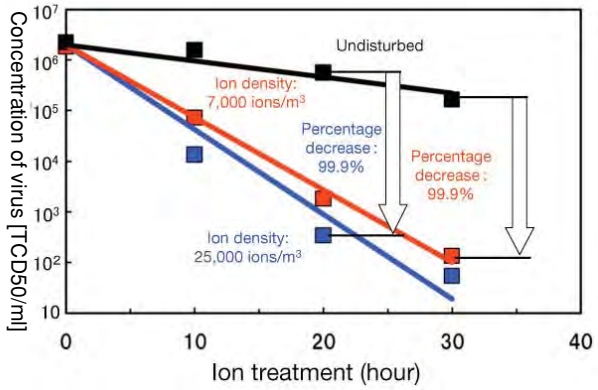
Change over time in bacterial count of airborne MRSA



Change over time in bacterial count of airborne MDRP



Change over time in viral titer of airborne Coxsackie virus



About the Kitasato Institute Medical Center Hospital, Research Division

The Kitasato Institute was founded in 1914 by Dr. Shibasaburo Kitasato to contribute to the improvement of the health of the nation by researching the causes of diseases and approaches to preventative treatments, and by operating medical treatment facilities. The Research Division of the Kitasato Institute Medical Center Hospital is involved in numerous clinical investigations as well as basic research. As part of these programs, a Medical Environmental Science Center was established within the Institute along with construction of hospital rooms specially designed to prevent the spread of infection. The Research Division is engaged in R&D with the goal of improving and enhancing the healthcare environment from a comprehensive perspective.

*12 TCID50 (50% Tissue Culture Infective Dose) method is a test protocol that examines the amount of a virus that will produce pathological change in 50% of cell cultures inoculated with a virus suspension diluted in stepwise increments.

FINAL REPORT:

VERIFICATION OF EFFICACY
SHARP PLASMACLUSTER IONS TECHNOLOGY
AGAINST
AIRBORNE *Serratia marcescens*
USING AIR PURIFIER MODEL: FU-S51CX
(without active carbon filter and HEPA filter)

(Study No. MF01-2007)

March 9, 2007

Melvin W. First

Professor of Environmental Health Engineering, Emeritus

Harvard School of Public Health

Melvin W. First

CELL & TISSUE TECHNOLOGY

Rotbendenstr. 17a
52076 Aachen, Germany

tel.: 0049 170 7732709
e-mail: g.artmann@gmx.net

-Report-

Specific protein and DNA damages in bacterial cells exposed to Plasma-Generated Cluster Ions (Task 3)

October 1, 2003 - September 30, 2004

Aachen, October 2004

Prof. Dr. habil. G.M. Artmann
(Cell and Tissue Technology)

Joint Research with Hiroshima University Proves Plasmacluster Technology*[1] Suppresses Effects of Airborne Fungi Allergens*[2]

Joint research conducted by Sharp Corporation and Hiroshima University (Graduate School of Advanced Sciences of Matter) has demonstrated that Plasmacluster technology can reduce the amount of a major allergen contained in the crude allergens*[3] of *Aspergillus fumigatus* (hereinafter, *Aspergillus*), a type of airborne fungus. The research also showed that Plasmacluster technology inhibits the reactivity to IgE antibodies*[4] in the serum of *Aspergillus* allergy patients.

Fungi are all around us and cause allergic reactions when breathed in. The *Aspergillus* tested in this research is, along with house dust mite, one of the major airborne triggers of allergies.

Sharp has previously proved that Plasmacluster technology can suppress the effects of house dust mite allergens*[5]. By proving that Plasmacluster is effective in suppressing airborne *Aspergillus* allergens as well, this latest research further raises the promise of Sharp's proprietary air technology for fighting allergies.

Since introducing Plasmacluster technology in 2000, Sharp has conducted academic marketing*[6] in collaboration with some of the world's leading third-party scientific research organizations. So far, 23*[7] such organizations have shown the effectiveness of Plasmacluster in not only controlling harmful substances such as viruses, bacteria, and allergens, but also in beautifying people's skin and hair in a proven safe*[8] manner.

Sharp will continue to create healthy environments by advancing Plasmacluster technology and conducting testing to show its effectiveness.

This research is scheduled to be presented at the EAACI (European Academy of Allergy and Clinical Immunology) Congress 2014 held June 7 to 11 in Copenhagen, Denmark.

1. Reduction effect of Plasmacluster ions on the amount of major allergen Asp f 1*[9] contained in crude *Aspergillus* allergens

Test Space	Bombardment Period	Reduction Rate
8.7-liter cylindrical container measuring 14.5 cm (diameter) x 52.5 cm (length)	Approx. 7 min.	Approx. 76%

2. Inhibitory effect of Plasmacluster ions on crude *Aspergillus* allergens (suppression of their binding to IgE antibodies in the sera of *Aspergillus*-allergic patients)

Test Space	Bombardment Period	Inhibition Rate
8.7-liter cylindrical container measuring 14.5 cm (diameter) x 52.5 cm (length)	Approx. 7 min.	Approx. 56%

For more information please contact (press only please)
Osaka: +81-6-6621-1272 Tokyo: +81-3-5446-8205

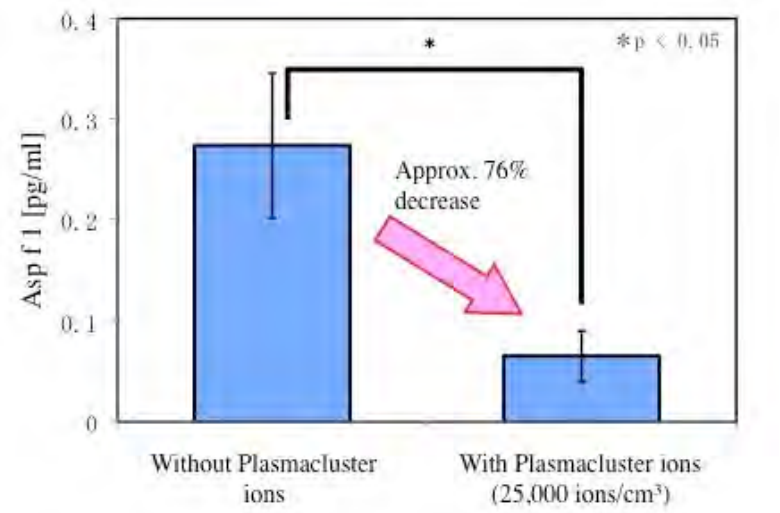
*1 Plasmacluster is a registered trademark of Sharp Corporation.
*2 Allergens are substances that cause allergic reactions; they are found in house dust mite, pollen, fungi, and other proallergic substances.
*3 Crude allergens of *Aspergillus* contain multiple allergen molecules. By contrast, a purified allergen is a specific allergen molecule that has been purified through biochemical separation procedures.
*4 An antibody is a class of protein that specifically binds to certain target antigens. IgE (immunoglobulin E) is an antibody isotype that causes allergic reactions.
*5 Announced on September 3, 2003.
*6 Collaboration with leading third-party academic research institutions to gather and analyze scientific data in order to apply findings to new products.
*7 As of April 10, 2014.
*8 According to testing by LSI Medience Corporation (inhalation toxicity test, eye and skin irritation test, and corrosivity test).
*9 The major allergen Asp f 1 is one of the main allergens of *Aspergillus* allergens. Its molecular structure has been elucidated, and it has been registered with the WHO (World Health Organization).

1. Reduction effect of Plasmacluster ions on the amount of protein in major allergen Asp f 1 in crude *Aspergillus* allergens

Verification methods

- Test institution: Hiroshima University (Graduate School of Advanced Sciences of Matter)
- Test space: 8.7-liter cylindrical container measuring 14.5 cm (diameter) x 52.5 cm (length)
- Allergen tested: Major allergen Asp f 1 contained in crude allergens of *Aspergillus fumigatus*
- Test device: Plasmacluster ion generating unit (attached to inside of cylindrical container)
- Plasmacluster ion density: Average of 25,000 ions/cm^3 in cylindrical container
- Plasmacluster ion bombardment period: Approx. 7 min.
- Control test: Cylindrical container with no Plasmacluster ion generating unit
- Test and analytical methods:
  A Plasmacluster ion generator was attached to the inside of the cylindrical container. The container was filled with Plasmacluster ions. A mist of crude *Aspergillus* allergens was infused into the upper part of the container. The ion-treated and sham-treated allergens were collected at the bottom of the container, and the amount of protein in the major allergen Asp f 1 was quantified using the sandwich ELISA*[10] method.

Results
Compared to the control test (*i.e.* without Plasmacluster ion generating unit), treatment with Plasmacluster ions significantly reduced the amount of protein in the major allergen Asp f 1 (an approximate 76% reduction) in the crude *Aspergillus* allergens.



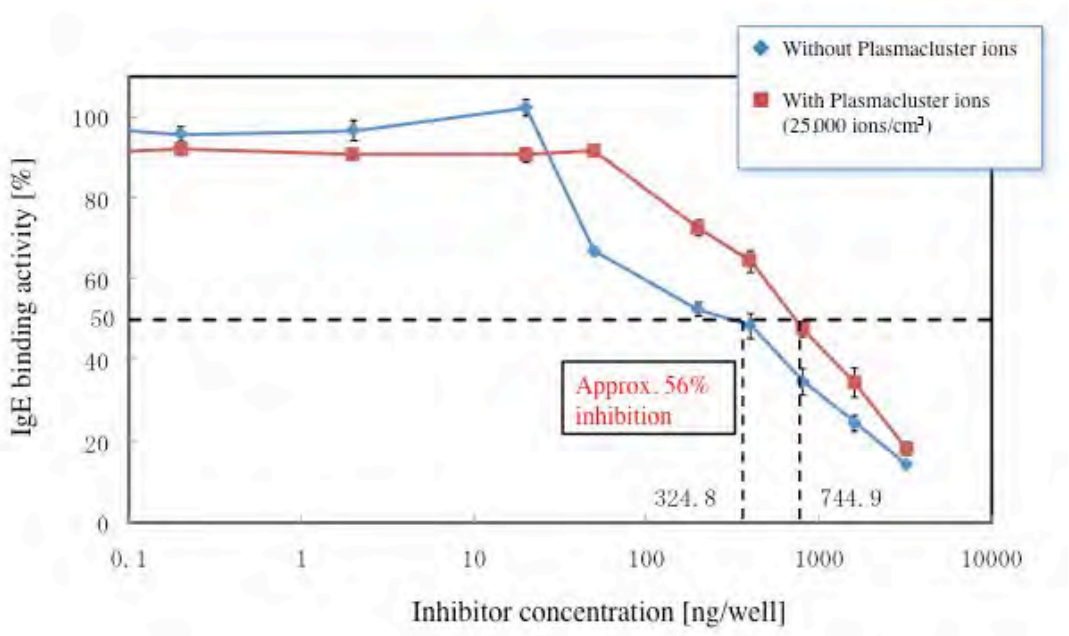
*10 Sandwich ELISA method: A method of measuring the amount of biopolymers such as allergens.

2. Inhibitory effect of Plasmacluster ions on the binding capacity of crude *Aspergillus* allergens to IgE antibodies in the sera of *Aspergillus*-allergic patients

Verification methods

- Test institution: Hiroshima University (Graduate School of Advanced Sciences of Matter)
- Test space: 8.7-liter cylindrical container measuring 14.5 cm (diameter) x 52.5 cm (length)
- Allergen tested: Crude allergens of *Aspergillus fumigatus*
- Test device: Plasmacluster ion generating unit (attached to inside of cylindrical container)
- Plasmacluster ion density: Average of 25,000 ions/cm^3 in cylindrical container
- Plasmacluster ion bombardment period: Approx. 7 min.
- Control test: Cylindrical container with no Plasmacluster ion generating unit
- Test and analytical methods:
  A Plasmacluster ion generator was attached to the inside of the cylindrical container. The container was filled with Plasmacluster ions. A mist of crude *Aspergillus* allergens was infused into the upper part of the container. The ion-treated and sham-treated allergens were collected at the bottom of the container, and their reactivity to IgE antibodies in the sera of *Aspergillus*-allergic patients was analyzed using the ELISA inhibition*[11] method.

Results
Compared to the control test (*i.e.* without Plasmacluster ion generating unit), treatment with Plasmacluster ions significantly impaired the reactivity to IgE antibodies in the sera of *Aspergillus*-allergic patients (an approximate 56% inhibition; assessed at inhibition rate of 50%*[12]).



*11 ELISA inhibition method: A method in which competitive inhibition of antigen-antibody reactions is used to conduct a quantitative comparative analysis of the antibody binding activity of antigens, including allergens.
In these tests, a comparison was done on the reactivity of allergens and IgE antibodies in two cases: one in which exogenously added allergens (herein referred to as 'inhibitor') were collected in the presence of Plasmacluster ions; and the other in which the added inhibitor allergens were collected without Plasmacluster ions. If the allergenicity of the inhibitor is lowered as a result of treatment with Plasmacluster ions, a much larger amount of inhibitor must be exogenously added to achieve the same inhibitory action as that of a sham-treated inhibitor. (*i.e.* The graph shifts to the right.)

*12 Inhibition rate of 50%: The point at which IgE antibody reactivity (binding activity) to immobilized allergen is inhibited by 50% (reduced by half) upon adding the inhibitor (shown by a dotted line on the graph).

- **Comment from Dr. Seiji Kawamoto, Associate Professor, Graduate School of Advanced Sciences of Matter, Hiroshima University**

The increase in allergies is a serious social problem, but no radical treatment is available right now for allergic disorders. Thus, the most effective way to prevent allergies is still avoidance and/or elimination of environmental allergens. Through this joint research, we confirmed that Plasmacluster technology is effective in reducing and inhibiting allergens that originate from fungi. This knowledge provides insight into dealing with indoor-environment allergies.

- **Overview of the Department of Molecular Biology, Graduate School of Advanced Sciences of Matter, Hiroshima University**

Research in the Department of Molecular Biotechnology covers the entire spectrum, from fundamental research in the mechanisms of life sciences, to research that applies these fundamental research findings. The department has achieved world-class research successes through its innovative ideas and wealth of research facilities. The department's goal is to foster outstanding researchers and advanced technology specialists by conducting state-of-the-art research aimed at achieving new discoveries and applications in molecular biotechnology that result in improving people's well-being.

- **Associate Professor Seiji Kawamoto**

Affiliation: Department of Molecular Biology, Graduate School of Advanced Sciences of Matter, Hiroshima University

Specialties: Immunology, Animal cell technology, Applied microbiology, Applied molecular cell biology

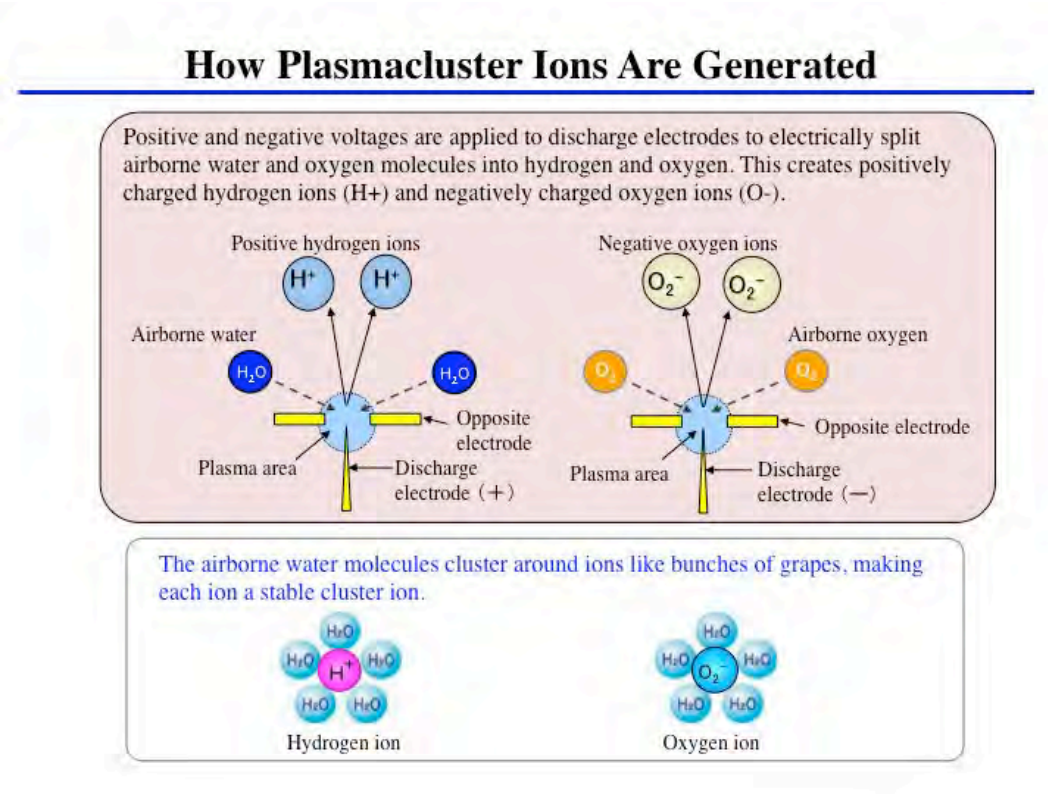
History
1996: Research Fellow, Japan Society for the Promotion of Science
1997: Assistant Professor, Faculty of Engineering, Hiroshima University
1999: Assistant Professor, Graduate School of Advanced Sciences of Matter, Hiroshima University
2002: Visiting Research Fellow, Harvard Medical School, USA (Research Fellow, Japan Society for the Promotion of Science Postdoctoral Fellowships for Research Abroad)
2008: Current position

- ***Aspergillus***

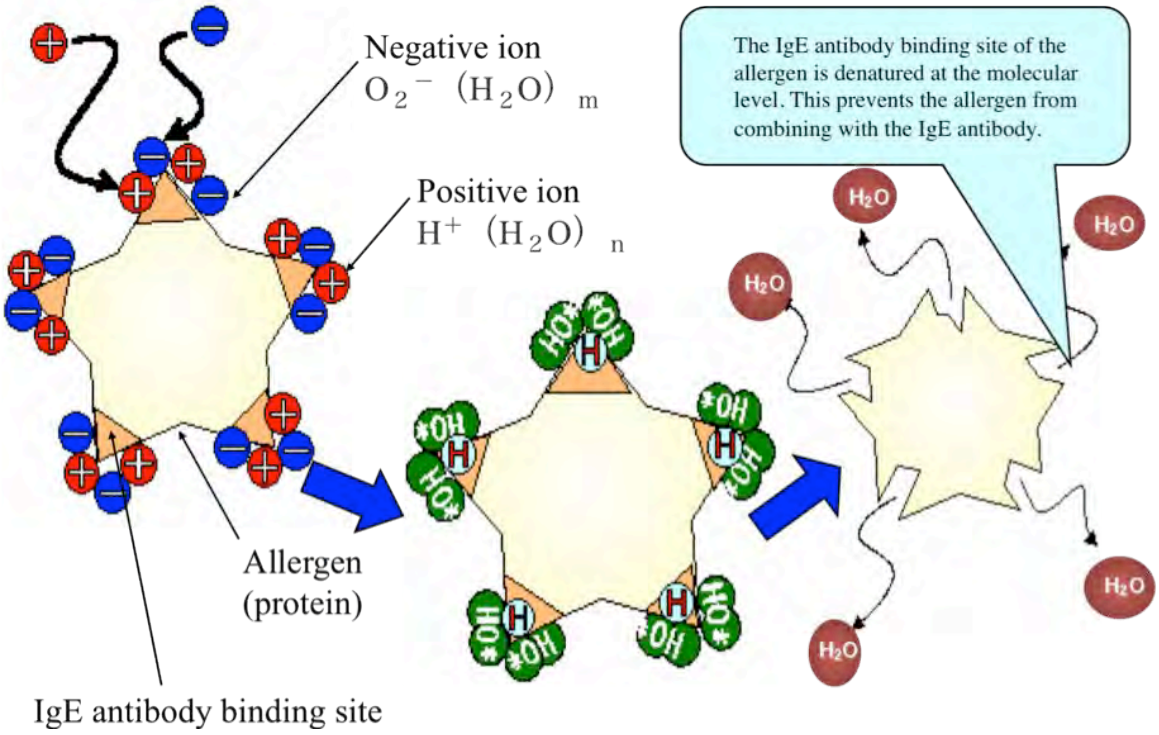
A common species of fungi occurring in the natural environment; *e.g.* in food, dust, and soil. *Aspergillus fumigatus* is a pathogenic type of *Aspergillus* known to cause allergic bronchitis (bronchopulmonary aspergillosis).

About Plasmacluster Technology

In Sharp's proprietary air purification technology, positively charged hydrogen ions ($H^+ (H_2O)_n$) and negatively charged oxygen ions ($O_2^- (H_2O)_m$) are discharged simultaneously. These positive and negative ions instantaneously bond on the surface of airborne substances such as bacteria, fungi, viruses, and allergens, becoming highly reactive OH radicals (hydroxyl radicals) that break down the proteins on the surface of these bacteria and other substances. By chemical reaction, the OH radicals work to suppress the activity of those substances.



Mechanism for Decomposing Allergens*[13]



As Plasmacluster Ions surround airborne allergens, they are transformed into OH (hydroxyl) radicals, a powerful activated substance. These OH radicals denature the allergen's IgE antibody binding site at the molecular level. Thus, even if these allergens were to enter the body, the body would not react with allergic symptoms.

*13 July 21, 2006 press release: Mechanism for Suppressing Mite Allergens by Plasmacluster Ions Explained

Comparison of Oxidation

Positive and negative ions bond on the surface of airborne viruses and bacteria and react chemically to form OH radicals, which have high oxidation power (standard oxidation potential 2.81 V). These reduce the contagiousness of airborne viruses and the activity of bacteria.

Active Substances	Chemical Formula	Standard Oxidation Potential (V)
Hydroxyl radicals	OH	2.81
Oxygen atom	O	2.42
Ozone	O_3	2.07
Hydrogen peroxide	H_2O_2	1.78
Hydroperoxyl radical	OOH	1.7
Oxygen molecule	O_2	1.23

Source: *Fundamentals and Applications of Ozone*

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

Target Substance	Testing and Verification Organization
Viruses	Kitasato Research Center of Environmental Sciences, Japan
	Seoul National University, Korea
	Shanghai Municipal Center for Disease Control and Prevention, China
	Kitasato Institute Medical Center Hospital, Japan
	Retroscreen Virology, Ltd., UK
	Shokukanken Inc., Japan
	Hanoi College of Technology, Vietnam National University, Vietnam
	Pasteur Institute of Ho Chi Minh City, Vietnam
	Public Health Research Foundation, Graduate School of Medicine, Tokyo University
Allergens	Graduate School of Advanced Sciences of Matter, Hiroshima University, Japan
	Department of Biochemistry and Molecular Pathology, Graduate School of Medicine, Osaka City University, Japan
	Soiken Inc., Japan
Fungi	Ishikawa Health Service Association, Japan
	University of Lübeck, Germany
	Professor Gerhard Artmann, Aachen University of Applied Sciences, Germany
	Japan Food Research Laboratories, Japan
	Shokukanken Inc., Japan
Bacteria	Ishikawa Health Service Association, Japan
	Shanghai Municipal Center for Disease Control and Prevention, China
	Kitasato Research Center of Environmental Sciences, Japan
	Kitasato Institute Medical Center Hospital, Japan
	Dr. Melvin W. First, Professor Emeritus, Harvard School of Public Health, US
	Animal Clinical Research Foundation, Japan
	University of Lübeck, Germany
	Professor Gerhard Artmann, Aachen University of Applied Sciences, Germany
	Japan Food Research Laboratories, Japan
	Shokukanken Inc., Japan
Organic chemicals	Sumika Chemical Analysis Service, Ltd., Japan
Odors, pet smells	Boken Quality Evaluation Institute, Japan
	Animal Clinical Research Foundation, Japan
Skin beautifying effects	Soiken Inc., Japan
Hair beautifying effects	Saticine Medical Co., Ltd.
	C.T.C Japan Ltd.

Inhibitory effects on viruses, fungi, and bacteria	Professor Gerhard Artmann, Aachen University of Applied Sciences, Germany
Inhibitory effects on allergens	Graduate School of Advanced Sciences of Matter, Hiroshima University, Japan
Skin moisturizing (water molecule coating) effect	Research Institute of Electrical Communication, Tohoku University, Japan

In collaboration with 23 research organizations, Sharp has proven the efficacy and working mechanism of Plasmacluster ions against 34 types of harmful substances (viruses, allergens, fungi, and bacteria) and in neutralizing five types of odors, beautifying skin and hair, and controlling static electricity. The efficacy of Plasmacluster ions against two types of organic chemicals has also been proven.

Prof. Dr. med. W. Solbach
Director of the Institute of Medical Microbiology and Hygiene of the Lübeck University Clinic

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Fax: 0451/500-2749

Prof. Dr. med. W. Solbach o Ratzburger Allee 160 o 23538 Lübeck

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www.hygiene.mu-luebeck de
filename gutachten/sharp1

22 April 2002

Expert Report

Testing of the fungistatic and bacteriostatic/bactericidal action of plasma cluster ions, generated by the plasma cluster generator 1 (from Sharp), in a test chamber under static test conditions

T №004268

SHARP

SHARP CORPORATION
Head Office: 22-22 Nagaike-cho, Abeno-ku,
Osaka 545-8522, Japan
http://sharp-world.com

News Release

July 27, 2009
FOR IMMEDIATE RELEASE

Joint Research with Osaka City University Medical School Validates Inhibitory Effects of Sharp's High-Density Plasmacluster Ions*[1] on Allergic Reactions

……

Through joint research with the Osaka City University Medical School's Department of Biochemistry & Molecular Pathology, Sharp Corporation has validated that high-density Plasmacluster Ions are remarkably effective in inhibiting the binding of airborne mite allergens (dust containing dead mites and mite feces) and IgE antibodies[*2] derived from mite-sensitized mice. In other words, this achievement is a biological-level demonstration of the capability of high-density Plasmacluster Ions to remove airborne mite allergens[*3].

The joint research demonstrated that Plasmacluster Ions generated at a rate of 50,000 ions per cm^3 for 15 minutes in a space (with a volume of 1 m^3) where mite allergens have been kept airborne, successfully inhibited the binding of sampled mite allergens and IgE antibodies derived from the antiserum of mite-sensitized mice by approximately 97%. In addition, Plasmacluster Ions generated at a rate of approximately 25,000 ions per cm^3 were also confirmed to be capable of inhibiting antigen-antibody reactions by approximately 84%, indicating that the higher the density of Plasmacluster Ions, the more effective they are in inhibiting reactions.

These results suggest the potential of high-density Plasmacluster Ions to alleviate allergic symptoms.

Sharp Corporation will jointly announce the validations with Osaka City University Medical School at the 59th Annual Meeting of the Japanese Society of Allergology to be held in Japan from October 29.

Sharp's collaborative research with academic and research organizations around the world began in 2000 and has since proven that Plasmacluster Ions are effective in removing 28 kinds of harmful airborne microorganisms, including MRSA[*4]. The research has also confirmed the safety of high-density Plasmacluster Ions with respect to human health[*5].

For more information please contact (press only please)
Osaka +81-6-6625-3006 Tokyo: +81-3-3260-1870

Sharp intends to further its efforts for improving the effectiveness of Plasmacluster Ion technology and to pass those benefits on to society.

From the observations of Prof. Masayasu Inoue, Osaka City University Medical School

The Japanese Ministry of Health, Labour and Welfare reports that one of every three Japanese citizens has allergic symptoms.

Sharp research has demonstrated the potential of Plasmacluster Ion technology to alleviate allergic symptoms.

Typical actions taken to combat allergies include diligent cleaning with active ventilation and, in the field of medicine, prescribing drugs (antihistamines or steroids), or the use of high-performance face masks. Plasmacluster Ion technology is on a par with these conventional measures, and offers a promising new technique to help tackle the problem of allergies.

*1 Plasmacluster and Plasmacluster Ion are the trademarks of Sharp Corporation.
*2 Proteins that combine with allergens and cause allergic reactions.
*3 Allergenic substances contained in dead dust mites or dust mite feces.
*4 MRSA is an acronym for methicillin-resistant *Staphylococcus aureus*, a bacterium responsible for difficult-to-treat infections in humans. MRSA typically infects humans with weakened immune systems, such as patients in hospitals, and its resistance to a large group of antibiotics is a serious problem.
*5 Testing conducted by Mitsubishi Chemical Medience Corporation (inhalation toxicity as well as eye and skin irritation/corrosion tests).

Method for Proving Effectiveness in Removing Airborne Mite Allergens and the Results

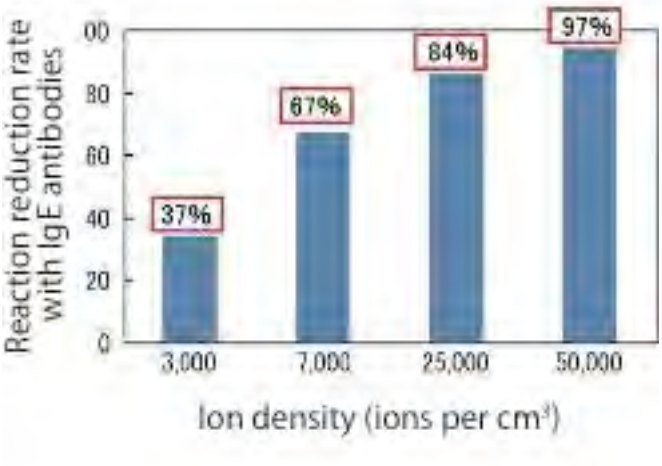
<Proving Effectiveness>

- Prepare two boxes, each having a volume of 1 m^3. Place a high-density Plasmacluster Ion generator unit in one box.
- Spray mite dust (dust containing dead mites and mite feces) into both boxes. After 15 minutes, sample airborne dust mites from both boxes.
- Draw IgE antibodies from the antiserum of two mice that have been made allergic to dust mites over several weeks.
- Apply the IgE antibodies from the two mice to dust mites sampled from the two boxes.

<Results Figure 1>

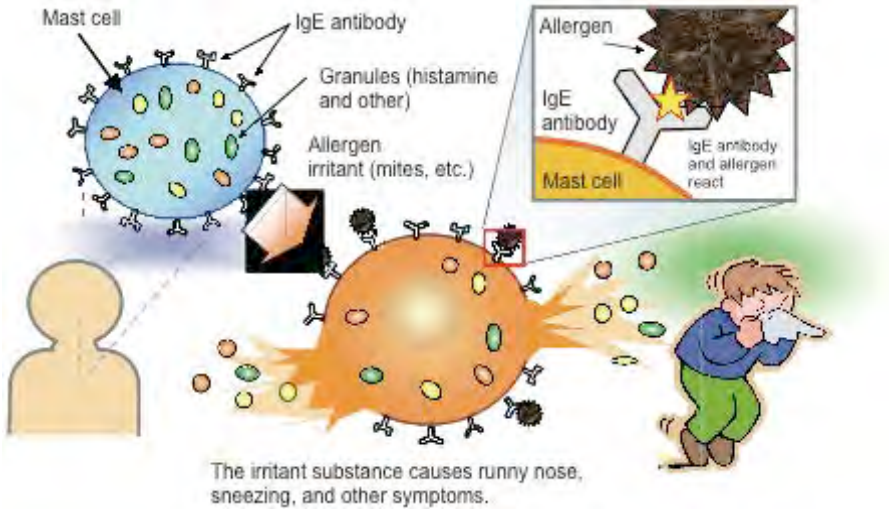
Based on the premise that when no Plasmacluster Ions are present, the rate of reaction between the allergen and the IgE antibodies would be 100%, it was found that the presence of Plasmacluster Ions generated for 15 minutes at a rate of 50,000 ions per cm^3 successfully inhibited the occurrence of allergic reactions by 96.6%. In addition, it was confirmed that high-density Plasmacluster Ions generated at a rate of approximately 25,000 ions per cm^3 inhibited allergic reactions by approximately 84%, and those generated at a rate of 7,000 ions per cm^3 inhibited allergic reactions by 67%. This indicates that the higher the density of Plasmacluster Ions, the more effective they are in inhibiting allergic reactions.

Figure 1



How Allergies Occur

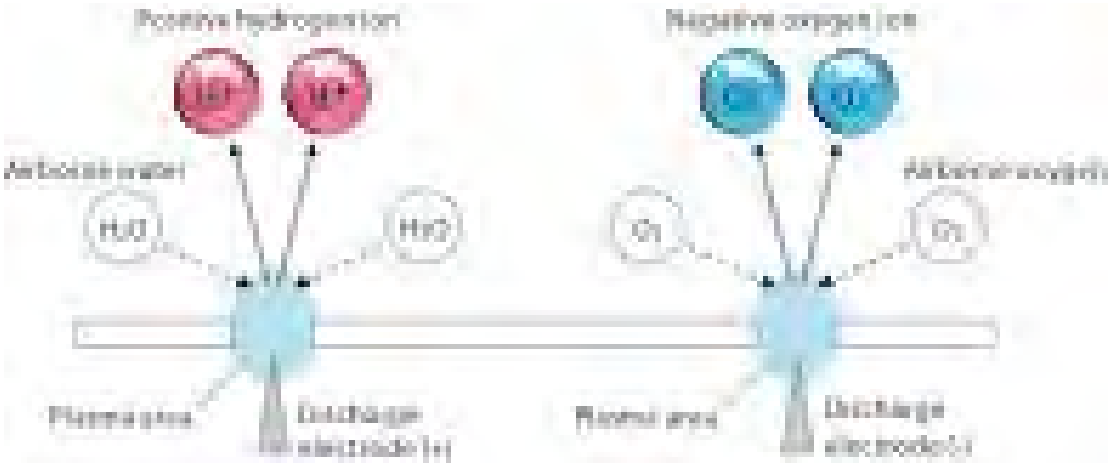
When an allergen first enters the human body, the body creates IgE antibodies, which combine with mast cells. Newly entering allergens bind with the combined IgE antibodies, causing the mast cells to release irritant substances such as histamine. The histamine irritates tissues such as the mucosa of the throat and nose, evoking an allergic reaction with syptoms such as coughing, sneezing, and runny nose.



Explanation of Terms	
Allergen (antigen)	A foreign substance, such as mite dust, pollen, fungi, etc., that causes an allergic reaction.
IgE antibody	Immunoglobulin E antibody; binds to foreign substances (antigens) and causes allergic reactions.
Mast cell	A cell in mucosal surfaces and tissue that produces irritant substances such as histamine. A mast cell has a diameter of 10 to 30 µm. IgE antibodies adhere to its cell surface. When allergens combine with the IgE antibodies, the mast cell releases irritant substances such as histamine that cause an allergic reaction.

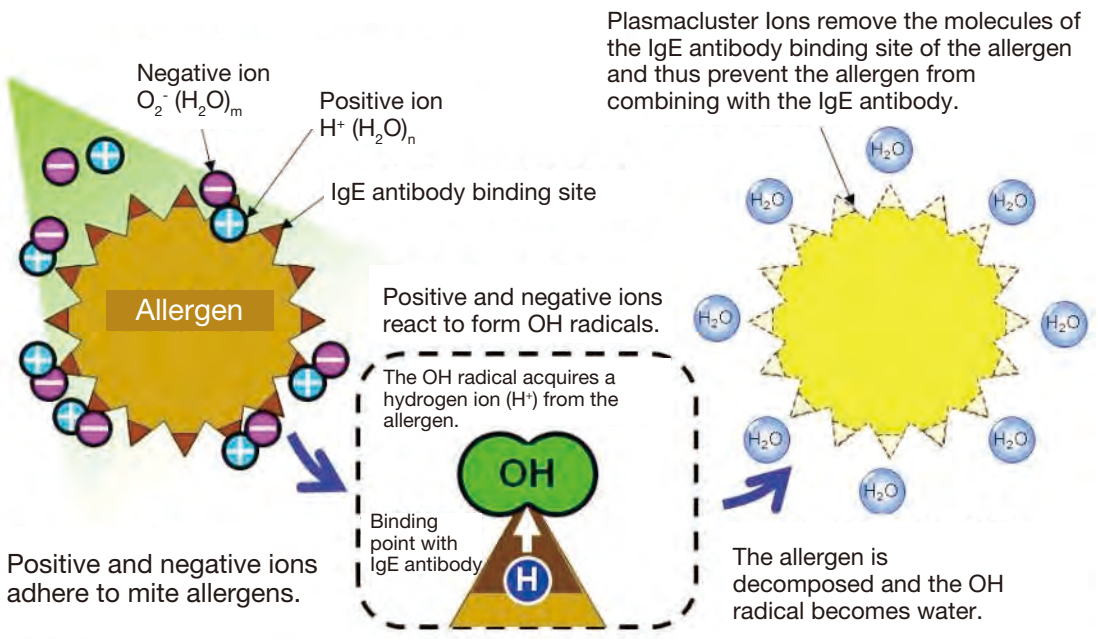
How Plasmacluster Ions Are Generated

Applying positive and negatively charged voltages to discharge electrodes electrically decomposes water molecules in the air into hydrogen molecules and oxygen molecules. Positive hydrogen ions (H^+) and negative oxygen ions (O_2^-) are generated in this way.



Mechanism of Plasmacluster Ion Allergen Removal

As Plasmacluster Ions surround airborne allergens, they are transformed into OH (hydroxyl) radicals, a powerful activated substance. When an OH radical acquires a hydrogen ion (H^+) from the protein on the surface of the allergens (combined IgE antibody), the proteins are decomposed and denatured at the molecular level. Thus, even if these allergens were to enter the body, the body would not react with allergic symptoms.



Profile of Prof. Masayasu Inoue, Osaka City University Medical School

Professor, M.D., Department of Biochemistry & Molecular Pathology, Osaka City University Medical School.

[Specialty] Reactive oxygen species, molecular pathology

[Professional career]

1983 – 1992: Associate Professor, Kumamoto University Medical School (Biochemistry)
1989 – present: Visiting Professor, Tufts University Medical School (Molecular Physiology)
1992 – present: Professor, Osaka City University Medical School (Biochemistry)
2000 – present: Vice President, Biomedical Research Institute, Kurashiki Medical Center

[Activities]

Member, Japanese Society of Biochemistry
Member, Japanese Society of Inflammation
Member, Japanese Society of Hepatology
Member, Japan Society of Molecular Medicine
Member, Japan Society of Drug Delivery System
Member, Society for Free Radical Research (Asian Representative)
Member, New York Academy of Science

Efficacy of Plasmacluster Ions Against Various Pathogens Confirmed Through Collaborative Research

Target Substance	Species	Testing & Verification Organization	Date of Announcement
Bacteria	*Serratia* bacteria	Harvard School of Public Health (Dr. Melvin W. First, Professor Emeritus), United States	March 2007
	Coliform bacteria (*E. coli*)	Ishikawa Health Service Association, Japan	September 2000
	E. coli, *Staphylococcus* (*aureus*), Candida	Shanghai Municipal Center for Disease Control and Prevention, China	October 2001
	Bacillus subtilis	Kitasato Research Center of Environmental Sciences, Japan	September 2002
		CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences), Germany	November, 2004
	MRSA (methicillin-resistant *Staphylococcus aureus*)	Kitasato Research Center of Environmental Sciences, Japan	September 2002
		Kitasato Institute Medical Center Hospital, Japan	February 2004
	Pseudomonas, Enterococcus, Staphylococcus	University of Lübeck, Germany	February 2002
	Enterococcus, Staphylococcus, Sarcina, Micrococcus	CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences), Germany	November 2004
Allergens	Mite allergens, pollen	Graduate School of Advanced Sciences of Matter, Hiroshima University, Japan	September 2003
	Mite allergens	Osaka City University Medical School	July 2009
Fungi	Cladosporium	Ishikawa Health Service Association, Japan	September 2000
		University of Lübeck, Germany (growth-suppressing effect)	February 2002
		CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences), Germany	November 2004

	Penicillium, Aspergillus	University of Lübeck, Germany (growth-suppressing effect)	February 2002
	Aspergillus, Penicillium (two species), Stachybotrys, Alternaria, Mucorales	CT&T (Professor Gerhard Artmann, Aachen University of Applied Sciences), Germany	November 2004
Viruses	H1N1 human influenza virus	Kitasato Research Center of Environmental Sciences, Japan	September 2002
		Seoul University, Korea	September 2003
		Shanghai Municipal Center for Disease Control and Prevention, China	December 2003
		Kitasato Institute Medical Center Hospital, Japan	February 2004
	H5N1 avian influenza virus	Retroscreen Virology, Ltd., London, UK	May 2005 August 2008
	Coxsackie virus	Kitasato Research Center of Environmental Sciences, Japan	September 2002
	Polio virus	Kitasato Research Center of Environmental Sciences, Japan	September 2002
	Corona virus	Kitasato Institute Medical Center Hospital, Japan	July 2004

Note: Efficacy in inhibiting activity of the airborne target substances noted above was verified by exposing the substances to an ion concentration of at least 3,000 ions/cm^3.

November 5, 2010

Sharp Proves Ability of High-Density Plasmacluster Ions[*1] to Eliminate (in a 1-m^3 box) Airborne Bacteria and Odors, as well as Inhibit Infectivity of Canine Parvovirus[*2] in an Animal Hospital

Sharp Corporation, in cooperation with the Animal Clinical Research Foundation[*3] (Yoshihisa Yamane, President; and Kazuaki Takashima, General Manager), has proved in an animal hospital that high-density Plasmacluster Ions (ion concentration: 25,000 ions/cm^3) reduce airborne bacteria and ammonia odors, which are the main causes of pet odors.

In addition, they proved that high-density Plasmacluster Ions (ion concentration: 25,000 ions/cm^3) can inhibit infectivity of airborne canine parvovirus (in a test using a 1-m^3 box, which conducted by Shokukanken Inc.[*4]).

Through these tests, it has been verified that high-density Plasmacluster Ions can contribute to a healthy and pleasant living environment not only for pets but also for pet owners.

The results of these studies will be presented at *the 31st Annual Meeting of Japanese Society of Clinical Veterinary Medicine* starting on November 19, 2010.

Based on the academic marketing[*5], Sharp is working in collaboration with academic research organizations around the world since the year 2000, has proven that Plasmacluster technology is effective in inhibiting the activity of 29 different kinds of harmful microorganisms, including viruses, bacteria, and allergens. Furthermore, it has been proven safe to humans[*6]. This time, Sharp has for the first time proved the multiple effect of Plasmacluster Ions in the field of pet care, increasing further the value of the technology. Sharp will continue to further evolve and verify Plasmacluster technology for the creation of healthier living environments.

Comments by Yoshihisa Yamane, President, and Kazuaki Takashima, General Manager, of the Animal Clinical Research Foundation

This time, the effect of Plasmacluster Ions in reducing airborne bacteria and odors was tested in an area where dogs are kept (of an animal hospital). In the future, Plasmacluster technology is expected to be applied to improve the environment of places such as operating rooms and examination rooms of animal hospitals, indoor pet breeding, and, the health and amenity of pet owners.

Furthermore, since it has been confirmed that Plasmacluster technology can inhibit canine parvovirus infectivity, which is feared by animal health care worker, this technology is expected to be used for not only protecting dogs' lives but also for protecting veterinary institutions from the spread of infectious diseases.

*1 Plasmacluster is a registered trademark of Sharp Corporation.
*2 A virus contagious among pets. Infection can result in death.
*3 A clinical research institute studying veterinary science.
*4 A research institute studying food and the environment, including areas such as microbiological inspection, food ingredient analysis, and sanitary surveys.
*5 A marketing technique where a product has its benefits scientifically verified in cooperation with top-of-the-line research facilities.
*6 Testing conducted by Mitsubishi Chemical Medience Corporation, including tests for inhalation toxicity and for skin and eye irritancy and corrosivity.

1. Verification of effect of high-density Plasmacluster Ions in reducing airborne bacteria and odors in veterinary hospitals

In the center of an 8.8-m^2 laboratory, a double-deck cage[*7] was installed. Two beagles were placed in the cage, one on each deck, and ion generators were installed on opposite walls on either side of the cage (Fig. 1 and 3).

* 7 A breeder's loft for pet animals.

Verification of Airborne Bacteria Reduction

Evaluation item:	Amount of airborne bacteria (bacteria collected with an air sampler[*8] was counted)
Methods:	Over a period of 12 days, the ion generators were turned on or off for two or three days at a time. During this time, the increase and decrease in the amount of airborne bacteria under each condition ("with ions" or "without ions") were compared.
Results:	Under the "with ions" condition (ion concentration: 25,000 ions/cm^3), the amount of bacteria always decreased compared to the "without ions" condition (Fig. 2). The "with ions" conditions all achieved class 10,000 of the NASA Standard Assay [*9] (amount of airborne bacteria is no more than 17.7 CFU/m^3). This is considered to be the acceptable level for general operating rooms.

*8 An apparatus that collects air for measuring the amount of airborne bacteria.
*9 A standard for the purity of air in biological clean rooms.

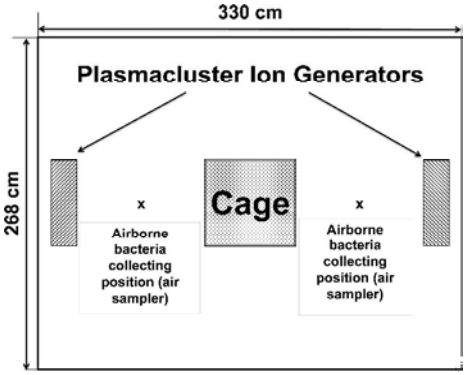


Fig. 1 Laboratory layout

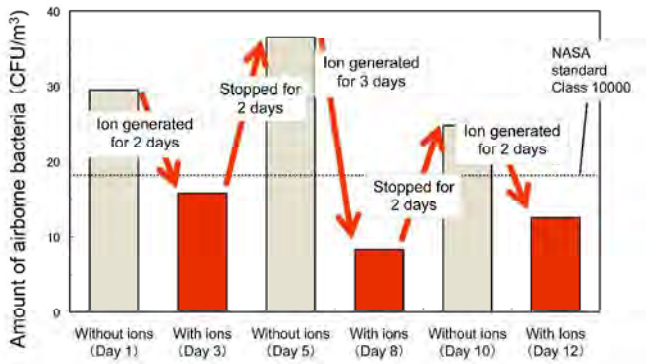


Fig. 2 The Changes in amount of airborne bacteria

Verification of Decrease in Ammonia Concentration

Evaluation item:	Ammonia concentration in air (measured with a gas detector tube[*10])
Methods:	Plasmacluster Ions were generated (ion concentration: 25,000 ions/cm^3) in a room. During this time, the concentration of ammonia under each condition ("with ions" and "without ions") was compared.
Results:	Under the "without ions" condition, the ammonia concentration was 2.25 ppm. After ion generation started, the ammonia concentration gradually decreased, and after 29 days, the ammonia concentration had dropped to 0.56 ppm After 37 days, the ammonia concentration dropped to 0.34 ppm. (Fig. 4). The odors decreased from a level corresponding to odor intensity 3 ("easily detectable" on the six-level odor intensity indication method[*11]) to less than a level corresponding to odor intensity 2 ("faint but identifiable").

*10 An apparatus that measures the concentration of a specific substance in the air. For this test, an apparatus for measuring ammonia concentration was used.

*11 A method commonly used in Japan for ranking odor intensity.

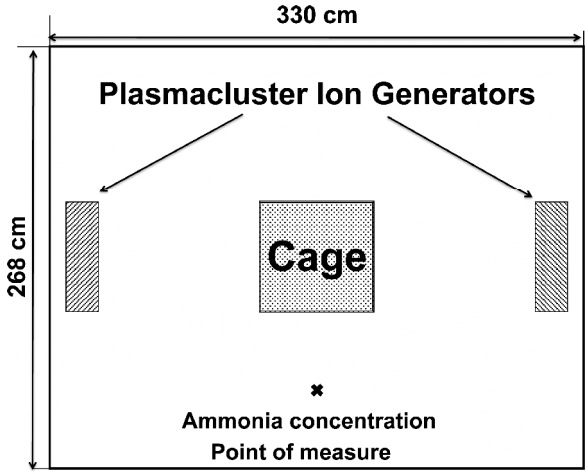


Fig. 3 Laboratory layout

Relation Between Ammonia Concentration and Six-Level Odor Intensity Indication Method

Ammonia concentration (ppm)	Odor intensity	Description
40	5	Very strong odor
10	4	Strong odor
2	3	Easily recognizable odor
0.6	2	Recognizable slight odor
0.1	1	Barely sensed odor
—	0	No odor

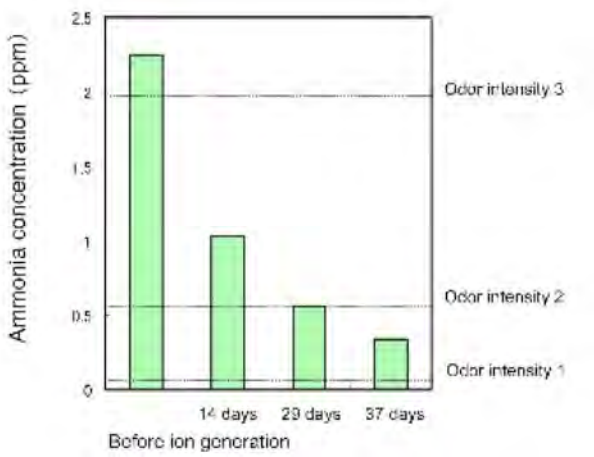


Fig. 4 The changes in ammonia concentration

2. Verification of Effect of High-Density Plasmacluster Ions Effectiveness at Inhibiting Canine Parvovirus in a 1-m^3 box

Evaluation Item:	Infectivity of canine parvovirus (as per TCID50 assay *12)
Test environment:	Plasmacluster Ion generator was placed in a 1-m^3 box, and ions were generated (ion concentration: 25,000 ions/cm^3).
Methods:	Canine parvovirus was sprayed in the box, and the conditions of “without ions” and “with ions” (after ion generation for five minutes) were compared for infectivity of the virus.
Results:	Compared to the “without ions” condition, infectivity of the virus was reduced by at least 99.8% for the “with ions” condition.

*12 An assay to check infectivity by inoculating a cell with the virus in the form of a virus solution that has been diluted in stages.

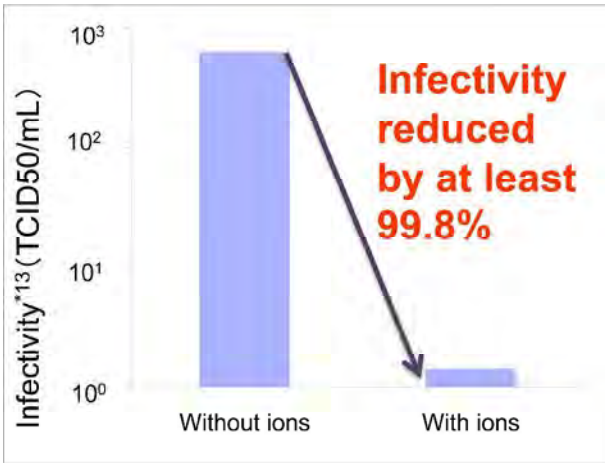


Fig. 5 The change in airborne canine parvovirus infectivity

*13 Value showing infectivity of virus cells; calculated using the TCID50 assay.

Animal Clinical Research Foundation

Established on April 1, 1991, the Foundation conducts clinical research into veterinary medicine. Other wide-ranging activities include publication of books on veterinary medicine, provision of information on academic conferences and lectures, human resource development including education and training of veterinary care staffs, and protection of natural resources through wild animal preservation management. Since 1996, the Foundation has also sponsored the *Annual Meeting of Japanese Society of Clinical Veterinary Medicine*, an event that is registered with the Science Council of Japan.

Yoshihisa Yamane, DVM, PhD, President of Animal Clinical Research Foundation

President of the Japan Veterinary Medical Association and Professor Emeritus.of Agriculture and Technology at Tokyo University. He created an ultra-compact artificial cardiopulmonary unit for animals in 1989 for the first time in the world and reported a successful operation with cardiopulmonary bypass, and is an authority on circulatory system in veterinary medicine. He became General Manager of Animal Clinical Research Foundation in 1991 and President of the foundation in 1996. In 2004, he became President of the Japan Veterinary Medical Association.

Kazuaki Takashima, DVM, PhD, General Manager of Animal Clinical Research Foundation

Director of the Japanese Society of Clinical Veterinary Medicine and General Director of Kurayoshi Animal Medical Center and Yonago Animal Medical Center.

June 4, 2010

Sharp Confirms Three Skin Beautifying Effects from Water Molecule Coating— Preserves Skin Moisture as Well as Improves Skin Elasticity and Texture

Mechanism Behind Skin Moisture Preservation by High-Density Plasmacluster Ions*1 (25,000 Ions/cm^3)*2 Explained

Sharp Corporation, in collaboration with Professor Michio Niwano of the Research Institute of Electrical Communication at Tohoku University, has proven that the skin moisture preservation effect of high-density Plasmacluster Ions (density of 25,000 ions/cm^3) announced in February of this year*3 is based on a mechanism in which the water molecules of the ions form a “water molecule coating” on the surface of the skin.

Further, through testing commissioned to Soiken Inc.*4, it was proven in actual living spaces (floor area of approximately 9.8 m^2 to 13.2 m^2) that three skin beautifying effects*5 can be obtained based on the water molecule coating function. The three effects are retaining skin moisture*3 (previously announced), improving skin elasticity, and improving skin texture.

Plasmacluster is Sharp’s proprietary air purification technology based on positive and negative ions generated by applying a plasma discharge to the moisture and oxygen in the air. Working with academic research organizations around the world, Sharp has thus far proven that Plasmacluster technology is effective against 28 kinds of harmful substances. Research has also confirmed its safety*6.

Sharp currently has 11 of its own Plasmacluster-application products, and 24 companies in other business fields have also adopted Plasmacluster technology for use in products*7 as diverse as railway coaches and car air conditioners. In addition, the use of in-vehicle and professional-use Plasmacluster products is expanding to a wide variety of spaces including hotels, daycare facilities, and taxi interiors.

Sharp will use this new proven efficacy of Plasmacluster Ions to work toward even more widespread use of products incorporating Plasmacluster technology in the home, as well as in the office and in vehicles.

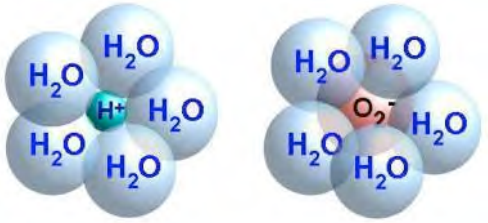
*1 Plasmacluster Ion and Plasmacluster are trademarks of Sharp Corporation.
*2 A measure of the number of ions/cm^3 emitted into the air measured at a point near the center of a room (at a height of about 1.2 m from the floor) having an appropriate floor surface area, during operation at the “high” airstream setting, when the high-density Plasmacluster Ion generator is placed near a wall.
*3 Announced on February 17, 2010.
*4 Soiken Inc. conducts clinical trials on a contract basis for the development of pharmaceuticals and foods.
*5 Effect will vary depending on the individual.
*6 Testing conducted by Mitsubishi Chemical Medience Corporation, including tests for inhalation toxicity and for skin and eye irritancy and corrosivity.
*7 Ion density differs with each product.

1. Mechanism for preserving skin moisture by high-density Plasmacluster Ions (25,000 ions/cm^3) explained

The positive and negative ions generated by the plasma discharge are surrounded by water molecules, and remain suspended in the air (Figure 1). Working in collaboration with Professor Michio Niwano of the Research Institute of Electrical Communication at Tohoku University, it was confirmed that the water molecules surrounding the ions adhered to the surface of a substance simulating human skin, forming a “water molecule coating.” As a result, the mechanism by which the evaporation of water molecules from the skin is inhibited, thereby making it possible to obtain a moisturizing effect, was revealed. (Figure 2)

In testing, a Plasmacluster Ion generator was placed in a spectroscopic instrument to analyze the molecules of water. Infrared absorption spectroscopy (IRAS) with multiple internal reflection (MIR) geometry*8 was used to confirm the presence of a water molecular layer (water molecule coating)*9 on the surface of a plate designed to simulate human skin*10 when ions were being generated and when they were not being generated. It was confirmed that, when no ions were generated, there was no adhesion of water molecules. In contrast, when ions were being generated, the adhesion of water molecules was confirmed after approximately ten minutes*9 of ion generation, and it was shown that, after the generation of ions was stopped at approximately 80 minutes, the water molecule coating function persisted for several dozen minutes. (Figure 3)

*8 A method to detect chemical substances adhering to solid surfaces with high sensitivity.
*9 A plate made of a silicone is used.
*10 The water molecule layer is several nanometers (nm) thick; 1 nm = 1 millionth of a mm.



Water molecules in the air surround the positive and negative ions, forming stable cluster ions*11.

Figure 1: Schematic drawing of Plasmacluster Ions (conceptual rendering)

*11 These ions are shaped like clusters of grapes.

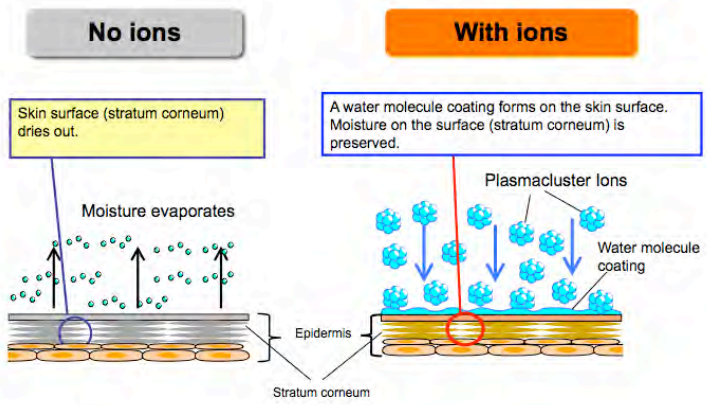


Figure 2: Skin moisture preservation mechanism (conceptual rendering)
Water molecule coating function

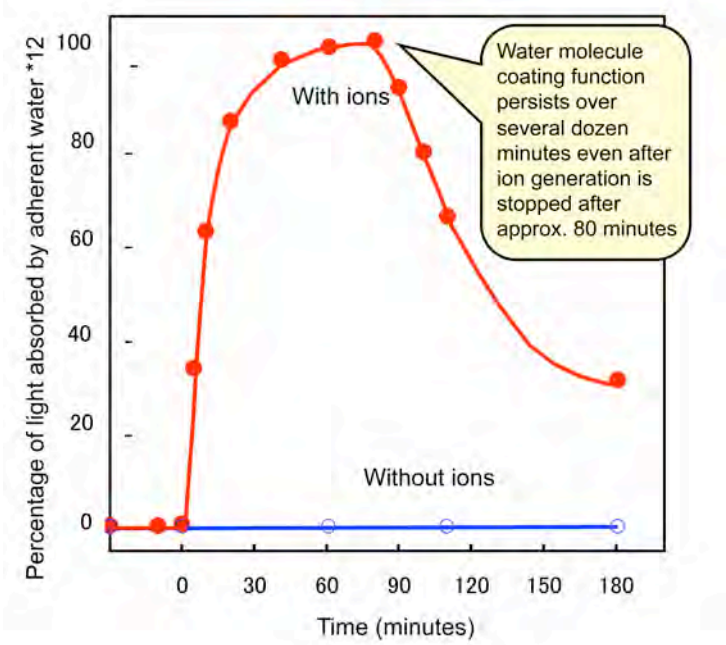


Figure 3: Change over time in percentage of light absorbed as a result of adherent water

*12 The higher the percentage of light absorbed by adherent water, the more water molecules attached to the skin.

Comments by Professor Michio Niwano of the Research Institute of Electrical Communication at Tohoku University

It was quite surprising that Plasmacluster Ions surrounded by water molecules adhered to the surface so readily. We also confirmed that Plasmacluster Ions readily adhere to surfaces where proteins have adsorbed, so the moisturizing effect of Plasmacluster Ions on the skin can be fully accepted. I hold out great expectations that this Plasmacluster technology will be able to find even wider application in the health-related field.

About the Research Institute of Electrical Communication at Tohoku University

The Research Institute of Electrical Communication (RIEC) was established in 1935 as a research institute affiliated with Tohoku Imperial University to study the theory of higher-order information and communication technologies and their practical application. The Institute takes the view that everything from the basic science of materials and information, to devices, circuitry, architectures, and software to generate, identify, transmit, store, process, and control information forms an integrated system. Based on organized collaboration with researchers inside and outside the Institute, it strives to extend its research findings to other areas and integrate its activities with groups working in other fields.

2. Proof of three skin beautifying effects based on the water molecule coating function of high-density Plasmacluster Ions (25,000 ions/cm^3)

1) Preserves skin moisture*[13]

The graph at the right shows the moisture preservation effect announced on February 17, 2010.

The fact that it is based on this water molecule coating function has now been explained.

*13 Test conditions for confirming the skin moisture preservation effect: a Plasmacluster Ion generator was set up in a testing room having a floor area of approximately 9.8 m^2 with the temperature adjusted to 28°C and humidity around 40% relative humidity (RH). Tests were conducted on 13 healthy female subjects ranging from 20 to 65 years of age. Announced on February 17, 2010.

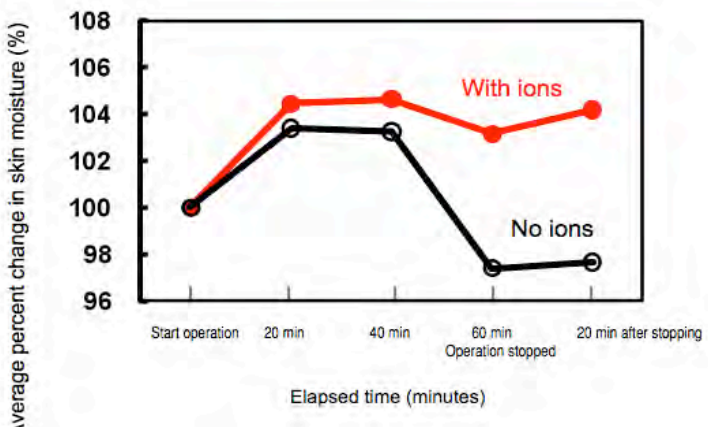


Figure 4: Change in skin moisture

2) Improves skin elasticity*[14]

A Plasmacluster Ion generator was used daily upon retiring at night. The elasticity of the skin was measured using a Cutometer® MPA580*[15], an instrument commonly employed in medical research, at 14 days and 28 days after the start of use. The results confirmed that the elasticity of the skin in the cheek area of the face, which is regarded as an indicator of skin age*[16], improved when the Plasmacluster Ion generator was used. (Figure 5)

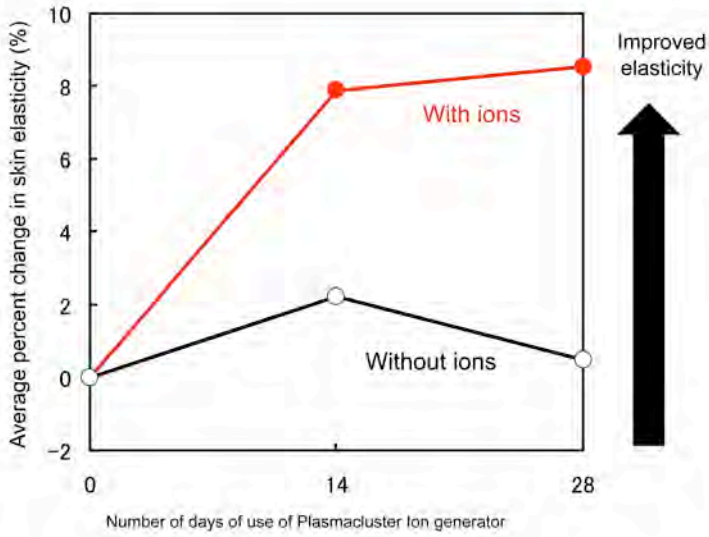


Figure 5: Change in skin elasticity

*14 A Plasmacluster Ion generator was set up in actual living spaces having floor areas of approximately 9.8 m^2 to 13.2 m^2. Tests were conducted on 24 healthy female subjects ranging from 30 to 65 years of age. The Plasmacluster Ion generator was used at bedtime every day for a period of 28 days, the time required for the skin to renew itself through natural cellular metabolism.

*15 Manufactured by Courage + Khazaka Electronic Gmbh.

*16 "Skin age" is an indication of the level of skin aging, for example, the degree to which the skin is firm and healthy looking, etc., expressed in number of years, and is used as guideline for skin care.

3) Improves skin texture*[14]

Test subjects used a Plasmacluster Ion generator on a daily basis only upon retiring at night. After 28 days of use (the time required for the skin to renew itself through natural cellular metabolism), the condition of the skin underneath the outer corner of the eye was examined by microscope. As a result, it was confirmed that skin texture improved after use of the Plasmacluster Ion generator. (Figure 6)

Figure 6: Example of change in skin condition (30X photomicrograph)

In addition, an opinion questionnaire using a Visual Analogue Scale (VAS) survey instrument*[17] was administered to the 24 test subjects to elicit their subjective responses to the test.
As a result, statistically significant responses were obtained for items such as “The skin is moister,” “Make-up goes on more smoothly and evenly,” and “The skin feels soft” after the Plasmacluster Ion generator had been used, when compared to not having used the Plasmacluster Ion generator.

*17 A method employed in the medical field that uses numerical values to objectively evaluate subjective perceptions, such as the severity of pain.

Comment by Mr. Tomohiro Sugino, Representative Director of Soiken Inc.
Following on the skin moisturizing effect announced in February of this year, these current tests prove the effectiveness of Plasmacluster Ions in improving skin elasticity and skin texture. It is believed that these effects are the result of the skin being coated with water from Plasmacluster Ions. Based on this proof, Plasmacluster technology can be expected to be one measure for skin care.

About Soiken Inc.
Soiken was founded as Soiken Limited in 1994 and underwent reorganization to become Soiken Inc. in 2001. The company has since been developing businesses related to medical marketing support and providing specific health care advice related to lifestyle diseases, as well as conducting clinical trials of foods and devices, making use of its independently developed technologies for biomarkers and assay systems.

August 5, 2010

Sharp's High-Density Plasmacluster Ions*[1] Proven Effective on Human Skin in Controlling *Staphylococcus Aureus*[*2], a Cause of Rough Skin, and in Curbing Excess Sebum, a Cause of Undesirable Oily Surface Shine on the Skin

……

Through testing commissioned to Soiken Inc.*[3], Sharp Corporation has proven on human skin that high-density Plasmacluster Ions (approximately 100,000 ions/cm^3) are effective in controlling the growth of *Staphylococcus aureus*, a bacteria that causes rough skin*[4].

In addition, Sharp has confirmed that the "water molecule coating" function*[5] of high-density Plasmacluster Ions is effective in curbing excess sebum on the skin*[4].

Through testing also conducted by Soiken Inc., Sharp has previously proven three skin beautification effects: better moisture retention*[6], improved skin elasticity*[5], and improved skin texture*[5]. These two new proven effects will further heighten Plasmacluster's value in providing skin beautification effects.

Details of these proven effects will be announced at the 28th Meeting of the Japanese Society of Aesthetic Dermatology to be held on August 7, 2010.

Based on the results of "academic marketing", a collaborative research approach to product marketing*[7], Sharp has proven that Plasmacluster technology is effective against 28 kinds of harmful substances, including new strains of influenza*[8], since this technology was first introduced in 2000. Research has also confirmed its safety*[9]. In 2004, working with an academic research organization*[10], the mechanism for inhibiting the activity of bacteria was explained.

Sharp will continue to push the evolution of Plasmacluster technology forward and work to further validate its effectiveness with the aim of creating a healthy living environment.

*1 Plasmacluster Ion and Plasmacluster are trademarks of Sharp Corporation.
*2 Bacteria that cause inflammation of the skin.
*3 Soiken Inc. conducts clinical trials on a contract basis for the development of pharmaceuticals and foods.
*4 Effect will vary depending on the individual.
*5 Announced on June 4, 2010.
*6 Announced on February 17, 2010.
*7 A marketing method that obtains scientific proof of the effectiveness of a certain technology through collaborative research with leading academic institutions and develops consumer products based on this proof.
*8 H1N1 influenza virus, a new strain of virus that caused a global pandemic after the first outbreaks were confirmed in Mexico and the US in 2009.
*9 Testing conducted by Mitsubishi Chemical Medience Corporation, including tests for inhalation toxicity and for skin and eye irritancy and corrosivity.
*10 Joint research with Professor Gerhard Artmann, Aachen University of Applied Sciences, Germany.

Methodology to Test the Effectiveness of High-Density Plasmacluster Ions in Controlling Skin-Adherent Bacteria and Curbing Excess Sebum

Bacteria adhering to the cheek area of the face (*Staphylococcus aureus* and *Staphylococcus epidermidis*) were sampled under two conditions: when Plasmacluster Ions (at an ion density of approximately 100,000 ions/cm^3) were generated and when no ions were generated. Changes in the bacteria counts over time were measured, as well as the percent change in skin sebum levels (amount of oil on the skin).

A Plasmacluster Ion generator was set up at a distance of 50 cm in front of the subject in a testing room having a floor area of 9.8 m^2 and adjusted to a temperature of 26° to 28°C and a relative humidity of 40% to 60%. The test subjects were 15 healthy females ranging from 30 to 65 years of age who performed light tasks using a computer during the test. This was a double-blind*[11] test in which neither the subjects nor the test administrators knew whether Plasmacluster Ions were being generated or not.

*11 A technique used in medical clinical trials. An objective test methodology designed to eliminate any subjective bias on the part of the test subject or the test administrator.

• Effect in Controlling *Staphylococcus aureus* Bacteria on the Skin

Staphylococcus aureus is well known as a harmful bacteria that causes rough skin. It is also said to be related to skin disorders such as atopic dermatitis, rashes, and impetigo*[12].

With ions present, the bacteria count decreased with the passage of time compared to when no ions were present, and a statistically significant difference was confirmed after four hours. As a result, it was confirmed that High Density Plasmacluster Ions are effective in controlling *Staphylococcus aureus* bacteria on the skin.

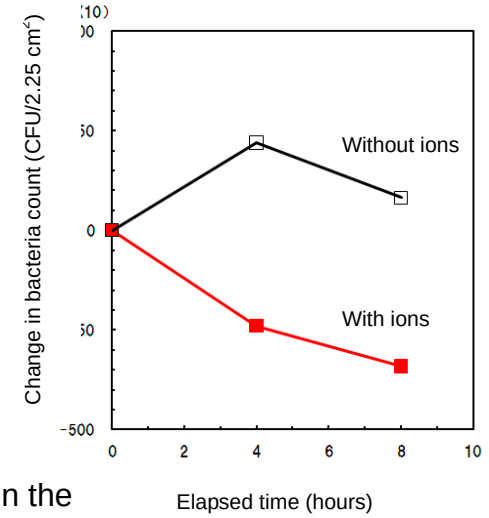


Figure 1: Change in the number of *Staphylococcus aureus* bacteria on the skin

*12 See *Biyo no igaku — Biyo hifu kagaku jiten* ("Cosmetic Medicine — Dictionary of Cosmetic Dermatology"), edited by Yasuo Asada, published by Chuo Shoin; and *Jintai jozai-kin no hanashi* ("A Discussion of Human Indigenous Bacteria"), by Akira Aoki, published by Shueisha.

It should also be noted that *Staphylococcus epidermidis* is said to be a "good bacteria" that plays a role in protecting the skin and preventing pathogens from invading the body*[13]. No statistically significant difference in changes in the bacteria count of this microorganism was observed, with or without the presence of Plasmacluster Ions.

*13 See *Jintai jozai-kin no hanashi* ("A Discussion of Human Indigenous Bacteria"), by Akira Aoki, published by Shueisha.

• Effect in Curbing Excess Sebum

It was confirmed that the presence of Plasmacluster Ions curbed increases in the amount of sebum on the skin after eight hours compared to when no ions were present. As a result, the effectiveness of the water molecule coating function of Plasmacluster Ions in curbing excess sebum, a cause of undesirable oily surface shine on the skin, was confirmed.

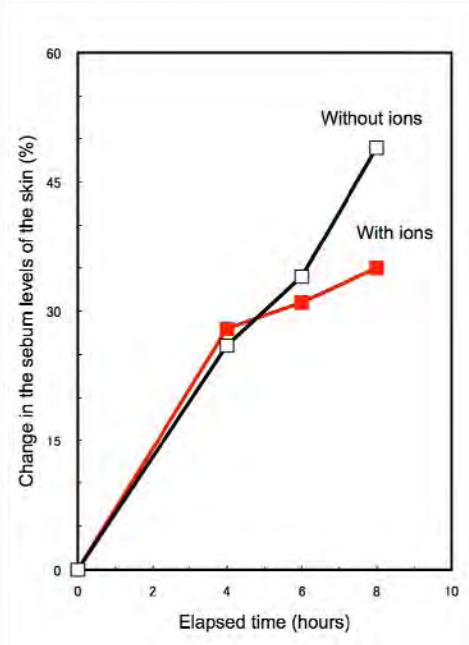


Figure 2: Change in the amount of sebum on the skin

Mechanism by which Plasmacluster Ions Inactivate Bacteria

Plasmacluster Ions are composed of positive and negative ions, and float in the air surrounded by water molecules. They surround bacteria adhering to the skin and, reacting only on the surface of the bacteria, form OH radicals that rob the cell membrane protein of hydrogen (H). This severs the protein, causing the cell membrane to fail and inactivating the bacteria. The OH radicals bond with the liberated hydrogen (H) to form water molecules (H_2O), and return to the air.

Plasmacluster Ions are the same kind of ions that exist in nature, and their safety has been confirmed by independent organizations.

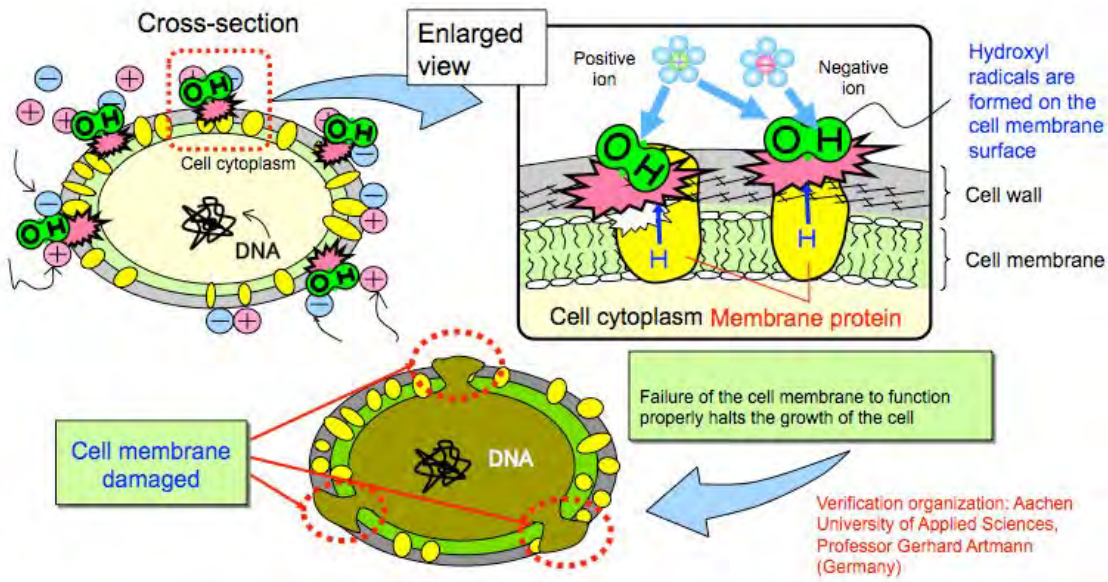


Figure 3: Mechanism by which bacteria are inactivated

Positive and negative ions decompose the bacteria by severing the protein in the cell membrane on the surface of the bacteria, thereby inhibiting its activity.

Comment by Mr. Tomohiro Sugino, Representative Director of Soiken Inc.
The effectiveness of Plasmacluster Ions in inhibiting the growth of harmful bacteria that are the cause of rough skin without affecting the state of the friendly bacteria that maintains skin health was confirmed. Based on these tests, Plasmacluster technology can be expected to be one measure to maintain the health and integrity of the skin.

About Soiken Inc.
Soiken was founded as Soiken Limited in 1994 and underwent reorganization to become Soiken Inc. in 2001. The company has since been developing businesses related to medical marketing support and providing specific health care advice related to lifestyle diseases, as well as conducting clinical trials of foods and devices, making use of its independently developed technologies for biomarkers and assay systems.

Plasmacluster Ion Technology*[1] Shown to Promote Hair Growth by Improving Barrier Function of Scalp*[2] (Improving Scalp Environment)

Sharp Corporation has shown that Plasmacluster ion technology is effective in improving the barrier function of scalp and promoting hair growth in tests conducted on patients undergoing mesotherapy*[3] for hair growth. Tests were commissioned to National Trust Co., Ltd. (head office: Minato-ku, Tokyo; president: Hideki Setoyama), and conducted at the Shinjuku Ouka Clinic of the HARG Treatment Center (location: Shinjuku-ku, Tokyo; chief physician: Hirotaro Fukuoka) using an ion-generating device for clinical testing (ion concentration of approx. 1.5 million ions/cm^3).

In addition, in tests commissioned to Soiken Inc. (head office: Toyonaka City, Osaka Prefecture; CEO: Tomohiro Sugino), a hair and beauty care testing device for clinical testing (ion concentration of approx. 3.3 million ions/cm^3) was used on healthy women. Results showed an improvement in the barrier function of the scalp, a decrease of scalp oil, and a decrease in the microorganism (malassezia fungi) causing dandruff and itching. Many of the test subjects surveyed after the tests said that they no longer had problems with itchy scalp and that it felt like their hair had more volume.

There has been a focus in recent years on preventing baldness and caring for the scalp in response to people's hair concerns as they get older. Against this background, Sharp looked at the water molecule clusters that make up the company's Plasmacluster ions. In 2010, in joint tests conducted with Professor Michio Niwano of the Research Institute of Electrical Communication, Tohoku University, it was shown*[4] that the water molecules of Plasmacluster ions form a water molecule coat on the skin. Joint tests with Soiken showed*[5] that the water coating function of the water molecules has beautifying effects (moisture retention*[6], resilience improvement*[7], smoothness and radiance improvement*[7], and oil reducing effect*[7]), and the effect of reducing bacteria that cause rough skin.

Since 2000, Sharp has been conducting academic marketing*[8] showing the effects of Plasmacluster ions in collaboration with world-class third-party test institutes. So far, Sharp and numerous third-party test institutes*[9] have shown beautifying effects, such as beautification of skin and hair, and have confirmed the safety*[10] of Plasmacluster ions. As Plasmacluster ion technology advances, Sharp will continue to prove its effects in order to contribute to the field of beauty and hair care.

For more information please contact (press only please)
Osaka: +81-6-6796-1462 Tokyo: +81-3-5446-8205

Comment from Hideki Setoyama, President, National Trust Co., Ltd.

The tests confirmed that patients undergoing mesotherapy for hair growth exposed to Plasmacluster ions showed a trend of reduced transpiration of moisture from the scalp, as well as a significant increase in the number of hairs that grew. It is thus very probable that Plasmacluster ion technology can help improve the scalp environment.

Comment from Tomohiro Sugino, CEO, Soiken Inc.

In double-blind tests, Plasmacluster ion technology was found to improve scalp functions, and test subjects surveyed after the tests said that they no longer had problems with itchy scalp and that it felt like their hair had more volume. This shows that Plasmacluster ion technology constitutes effective treatment in the field of hair and beauty care. Plasmacluster ion technology thus holds promise for improving the scalp environment and helping provide customers with healthy, sanitary hair and beauty care.

*1 Plasmacluster is a registered trademark of Sharp Corporation.
*2 The function of retaining moisture in the scalp.
*3 A type of hair loss treatment.
*4 Announced on June 4, 2010.
*5 Announced on August 5, 2010.
*6 Announced on February 17, 2010.
*7 Announced on June 4, 2010.
*8 A marketing method in which a company collaborates with a leading research institute to gather and verify data on the effects of a certain technology, and then uses this data as the basis for commercialization of the technology.
*9 Current as of October 13, 2016.
*10 According to tests conducted by LSI Medience Corporation (inhalation toxicity test, eye and skin irritation/corrosion tests, teratogenicity test, and two-generation reproduction toxicity test).

■ Hair Growth Promotion Verification Test

● Clinical testing institutes
National Trust Co., Ltd.
Shinjuku Ouka Clinic, HARG Treatment Center

● Test conditions

• Test subjects: Patients undergoing mesotherapy for hair growth (115 men and women in their 20s to 70s)

• Assessment criteria: Number of hairs, amount of transpiration of moisture from the scalp

• Test period: Approx. 3 months

• Test method: To assess the number of hairs that grow in the same spot, a 2-centimeter round spot was shaved on the right and left sides of the subjects' heads, and a tattoo was painted in the center of each shaved spot. Using an ion-generating device for clinical testing, the shaved spot on the right side was exposed to ions (ion concentration of approx. 1.5 million ions/cm^3) for approximately 20 minutes each day. Once a month, mesotherapy was performed on the shaved spots on the right and left sides. Each month, the number of hairs that grew in both the shaved spots (surface area of 160 mm^2) was counted.

● Test results

After three months, the number of hairs that grew on the shaved spots on the right side of the head, which were exposed to Plasmacluster ions, was found to be 2.5 times that of the shaved spots on the left side, showing a statistically significant increase*[11].

Photo 1: Clinical testing

Average number of hairs (Hair/160 mm^2)

	Initially	After 1 month	After 2 months	After 3 months	Increase in number of hairs after 3 months
Right side (exposed to ions)	224.0	233.3	232.1	244.9	20.9
Left side (not exposed to ions)	219.0	226.9	224.7	227.2	8.2
Right-left difference	5.0	6.4	7.4	17.7	–

Test result 1—Subject: Female aged 50–59

Test result 2—Subject: Male aged 30–39

Left photos: Before start of test; right photos: after 3 months of exposure to ions

■ Scalp Environment Improvement Verification Test

● Clinical testing institute
Soiken Inc.

● Test conditions

• Test subjects: 59 healthy people (women aged 40 to 63)

• Assessment criteria: Amount of transpiration of moisture from scalp, amount of scalp oil, amount of malassezia fungi on the scalp, visual analogue scale (VAS)*[12]

• Test period: Approx. 3 months

• Test method: In a randomized, double-blind, parallel group, comparative study*[13], two groups were exposed to airflow from a hair and beauty care testing device for clinical testing for 5 minutes a day for 12 continuous weeks. The test group of 29 people was exposed to airflow containing ions (concentration of 3.3 million ions/cm^3) and the control group of 30 people was exposed to airflow containing no ions. The two groups were compared on the assessment criteria.

Photo 2: Using a hair and beauty care testing device for clinical testing

Photo 3: Measuring the scalp environment

Test results

Compared to the test subjects exposed only to airflow containing no ions, the test subjects exposed to airflow containing ions showed lower levels of transpiration of moisture from the scalp, scalp oil, and the microorganism (malassezia fungi) that causes dandruff and itching.

In response to a VAS questionnaire administered before and after the test, compared to the test subjects exposed only to airflow containing no ions, the test subjects exposed to airflow containing ions showed a positive trend in the difference in value*[14] on questionnaire items for "increased hair volume," "dandruff concerns," "scalp itchiness concerns," "gray hair concerns," "scalp odor concerns," "and hair part concerns." Likewise, on the questionnaire item "hair-loss concerns," test subjects exposed to ions showed a positive trend in the difference in responses before and after the test*[14].

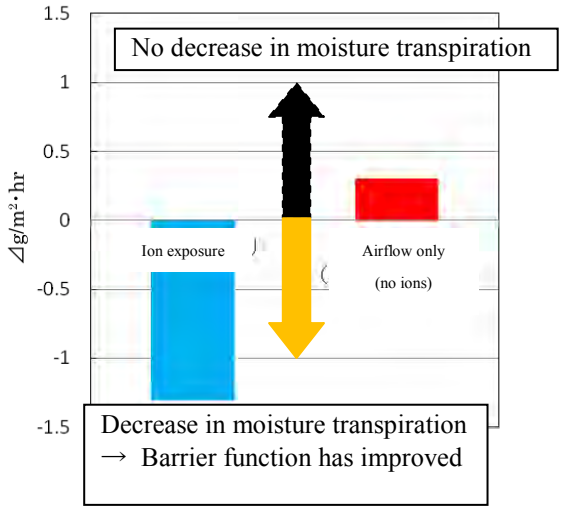


Chart 1: Comparison of transpiration of moisture from scalp (scalp barrier function)

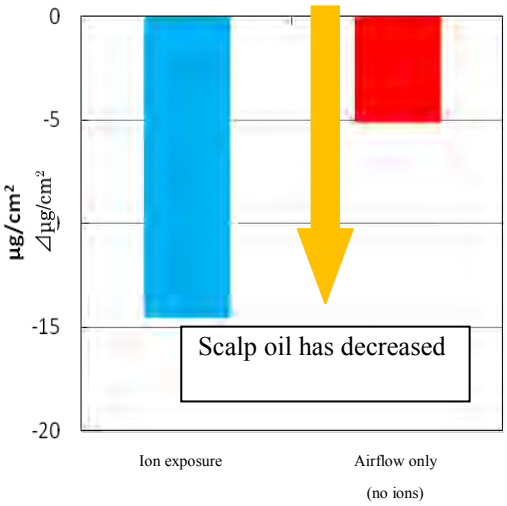


Chart 2: Comparison of amount of scalp oil

*11 Test results confirmed a statistically significant p-value of 0.05 or less.
*12 Visual analogue scale (VAS): A measurement of how the test subjects feel about the test (subjective measurement).
*13 Randomized, double-blind, parallel group, comparative study: Test subjects and evaluators take the test without being told whether the airflow contains ions. This clinical testing method eliminates bias between test subjects and evaluators and allows for the objective discovery of the effect of the intervention.
*14 Although the test results did not reach the statistically significant p-value of 0.05 or less, they reached a p-value of less than 0.20 or less, enough to confirm a positive trend for these questionnaire items.

■ National Trust Co., Ltd.

Established in 1998. Started Japan's first financial scheme for the liquidation of compensation and receivables in the medical care field. Its main areas of business are management support for healthcare organizations, management turnaround of facilities, new business startup, and business succession.

■ Shinjuku Ouka Clinic, HARG Treatment Center

Opened in 2012 as the Ouka Clinic, Oukaikai Medical Corporation. Specializes in HARG*[15] (hair regenerative therapy) treatment, while instructing clinics around Japan in HARG treatment.

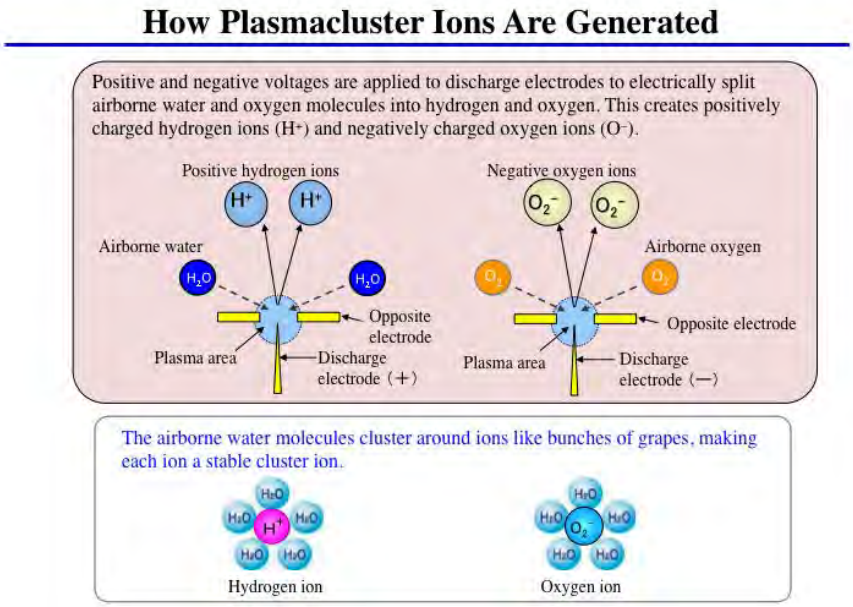
*15 HARG: A regenerative method in which AAPE (Advanced Adipose-Derived Stem Cell Protein Extract), which includes more than 150 types of growth factors and extracted from stem cells (the starting point of all cells in the human body) is injected directly into the scalp to restore hair growth functions.

■ Soiken Inc.

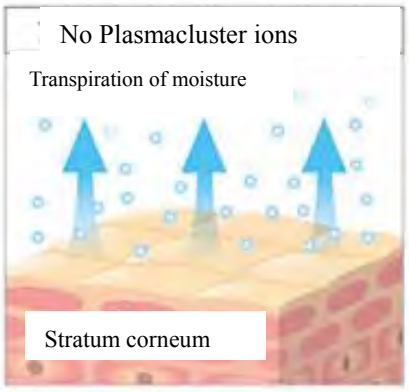
Established in 2007. Conducts clinical evaluation tests for foods and equipment using in-house-developed biomarkers and evaluation systems, provides pharmaceutical marketing support, and carries out specific health guidance.

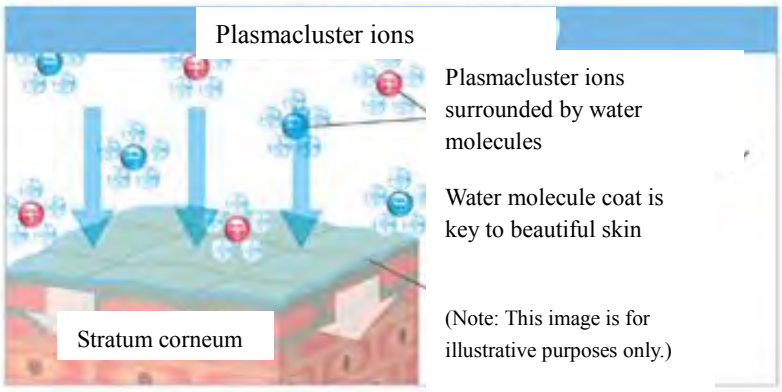
■ About Plasmacluster Technology

In Sharp's proprietary air purification technology, positively charged hydrogen ions ($H^+ (H_2O)_n$) and negatively charged oxygen ions ($O_2^- (H_2O)_m$) are discharged simultaneously. These positive and negative ions instantaneously bond on the surface of airborne substances such as bacteria, fungi, viruses, and allergens, becoming highly reactive OH radicals (hydroxyl radicals) that break down the proteins on the surface of these bacteria and other substances. By chemical reaction, the OH radicals work to suppress the activity of those substances.



How a water molecule coat is formed with Plasmacluster ions





Skin surface (stratum corneum) dries out

Skin surface (stratum corneum) retains its moisture

• Test institute: Research Institute of Electrical Communication, Tohoku University

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

Target	Testing and Verification Organization	Country
Efficacy proven in clinical trials	Graduate School of Medicine, University of Tokyo / Public Health Research Foundation	Japan
	Faculty of Science and Engineering, Chuo University / Clinical Research Support Center, University Hospital, University of Tokyo	Japan
	Animal Clinical Research Foundation	Japan
	Soiken Inc.	Japan
	School of Bioscience and Biotechnology, Tokyo University of Technology	Japan
	National Trust Co., Ltd. / HARG Treatment Center	Japan
	National Center of Tuberculosis and Lung Diseases	Georgia
Viruses	Kitasato Research Center of Environmental Sciences	Japan
	Seoul National University	Korea
	Shanghai Municipal Center for Disease Control and Prevention	China
	Kitasato Institute Medical Center Hospital	Japan
	Retroscreen Virology, Ltd.	UK
	Shokukanken Inc.	Japan
	University of Indonesia	Indonesia
	Hanoi College of Technology, Vietnam National University	Vietnam
	Institut Pasteur, Ho Chi Minh City	Vietnam
Allergens	Graduate School of Advanced Sciences of Matter, Hiroshima University	Japan
	Department of Biochemistry and Molecular Pathology, Graduate School of Medicine, Osaka City University	Japan
Fungi	Ishikawa Health Service Association	Japan
	University of Lübeck	Germany

	Professor Gerhard Artmann, Aachen University of Applied Sciences	Germany
	Japan Food Research Laboratories	Japan
	Shokukanken Inc.	Japan
	Shanghai Municipal Center for Disease Control and Prevention	China
Bacteria	Ishikawa Health Service Association	Japan
	Shanghai Municipal Center for Disease Control and Prevention	China
	Kitasato Research Center of Environmental Sciences	Japan
	Kitasato Institute Medical Center Hospital	Japan
	Dr. Melvin W. First, Professor Emeritus, Harvard School of Public Health	US
	Animal Clinical Research Foundation	Japan
	University of Lübeck	Germany
	Professor Gerhard Artmann, Aachen University of Applied Sciences	Germany
	Japan Food Research Laboratories	Japan
	Shokukanken Inc.	Japan
	Chest Disease Institute	Thailand
Odors, pet smells	Boken Quality Evaluation Institute	Japan
Skin beautifying effects	School of Bioscience and Biotechnology, Tokyo University of Technology	Japan
Hair beautifying effects	Saticine Medical Co., Ltd.	Japan
	C.T.C Japan Ltd.	Japan
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	Japan
Working mechanism of skin moisturizing (water molecule coating) effect	Research Institute of Electrical Communication, Tohoku University	Japan

No. 2012-11-141B
Nr.
N°.

SHARP

Declaration of Conformity

Konformitätserklärung
Déclaration de Conformité

CE

Manufacturer: Hersteller: Producteur:	SHARP Corporation 22-22, Nagaike-cho, Abeno-ku, Osaka 545-8522, Japon 22-22, Nagaike-cho, Abeno-ku, Osaka 545-8522, Japan 22-22, Nagaike-cho, Abeno-ku, Osaka 545-8522, Le Japon
Authorized Representative: Bevollmächtigter: Représentant autorisé:	SHARP Electronics (Europe) GmbH Sonninstraße 3, 20097 Hamburg, Germany Sonninstraße 3, 20097 Hamburg, Deutschland Sonninstraße 3, 20097 Hamburg, L'Allemagne
Product Description: Produktbezeichnung: Descriptif du produit:	Air Purifier with humidifying function KC-A60EU-W KC-A50EU-W KC-A40EU-W

The object of the declaration described above is in conformity with the requirements of the following documents:
Das oben beschriebene Produkt ist konform mit den Anforderungen der folgenden Dokumente:
L'objet de cette déclaration est en conformité avec les exigences des documents suivants:

2011/65/EU 2011/65/EU 2011/65/CE	RoHS Directive RoHS Richtlinie Directive RoHS
2004/108/EC 2004/108/EG 2004/108/CE	EMC Directive EMV Richtlinie Directive CEM
2006/95/EC 2006/95/EG 2006/95/CE	Low Voltage Directive Niederspannungsrichtlinie Directive Basse Tension