

Messages from Modern Inventors to the Next Generation

Season 2

3. *Plasmacluster* - Mr. Kazuo Nishikawa, Manager, Engineering Section III, Plasmacluster Equipment Division, Health and Environment Systems Group, Sharp Corporation



As technologies advance, new products are being developed one after another, making our daily lives more easy and comfortable.

Actually, there exist a large number of invisible harmful substances suspended in the air in our houses and working places. “Plasmacluster” is the technology that can remove such harmful airborne substances so that we enjoy more comfortable and healthier lives.

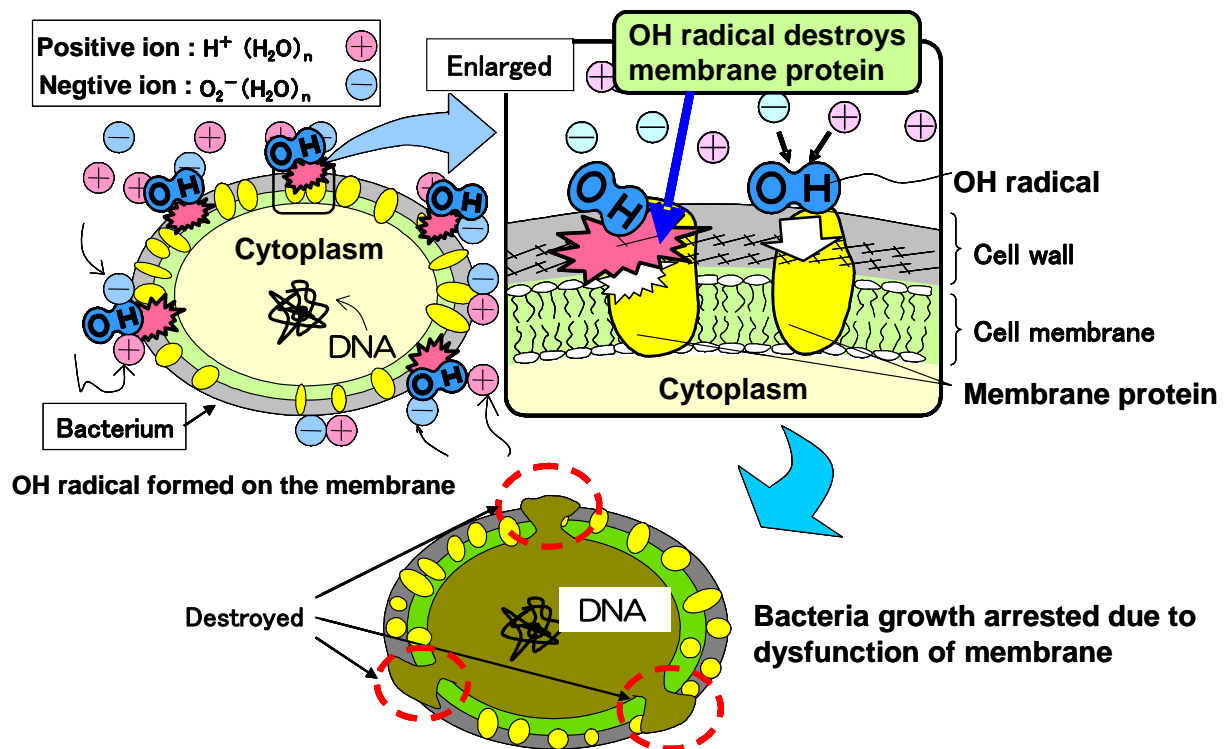
Overcoming various challenges in the development of Plasmacluster technology required knowledge in the different fields of electricity and microbes. Mr. Nishikawa, the inventor, explains how he solved these problems and enjoyed the process of development.

Introduction of the product/technology

Plasmacluster is a technology that generates positively and negatively charged ions, which are the same as those ions that exist in the natural world, and releases them, thereby inactivating airborne viruses and eliminating airborne molds, etc. in the air. In other words, it is an air purification technology in which positive ions of hydrogen and negative ions of molecular oxygen are generated by plasma discharge* from water and oxygen in the air, and then released into a room, thereby inactivating harmful substances such as airborne mold, viruses, and allergens in the air. When these ions come into contact with harmful substances in the air, the positive and negative ions undergo chemical reactions on the surfaces of the harmful substances to form hydroxyl (OH) radicals, which

have a strong oxidizing potential. And these OH radicals remove the hydrogen from, and thereby decompose, proteins in the surface membrane of harmful airborne substances. The destruction of the proteins disables and inactivates the harmful substances.

*Plasma: A physical state of matter that consists of a mixture of free-moving positive ions and electrons, which are balanced as a whole.



Working mechanism to inhabit bacteria

What inspired you to invent or develop the product/technology?

I undertook the research and development of Plasmacluster technology in 1998, when filtering systems remained the most popular means of eliminating dust, dirt and odor in the air. A filtering system purifies air as the air passes through a filter provided therein. The problem with the filtering method was that the air in a room could not be cleaned until it was brought to an air purification system. Then I thought, at that time, about how I can enable in-situ purification of the air one way or another.

In addition, while consumers often requested the removal of cigarette smoke and odor, an examination of the air in a room revealed a health risk, as the air contained fungus and mold, which

could cause asthma.

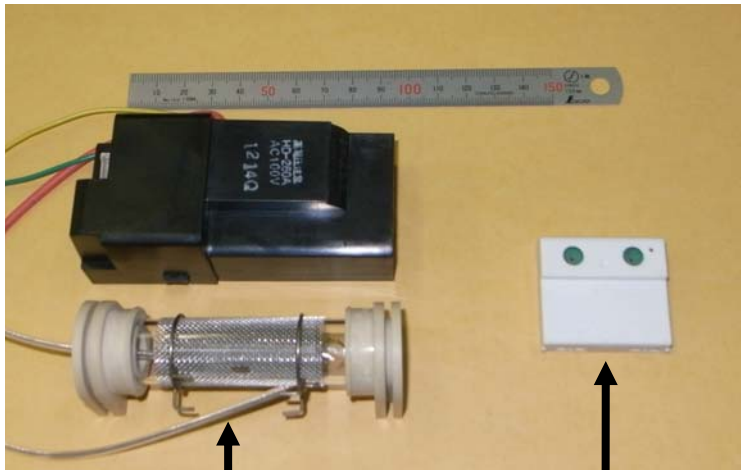
Based on such findings, my development efforts were also meant, along with in-situ purification of the air, to eliminate not only odors of cigarette smoke, etc. but also microbes and other harmful substances that could cause harm to health.

What specific ideas and difficulties have you faced in inventing or developing the product?
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As an integral part of Plasmacluster, positive ions (hydrogen ions) and negative ions (molecular oxygen ions) are generated, by causing plasma discharge under atmospheric pressure, from water molecules and oxygen molecules in the air. In the process used to produce these ions, positive and negative high voltages were alternately applied to discharge electrodes, but initially, only harmful substances such as ozone and NO_x were generated. I had much difficulty in producing my intended ions. So I made several adjustments, including the control of voltage applied and the electrode structure, and finally succeeded in producing the targeted ions by controlling the plasma discharge intensity.

In addition, such ions needed to be released by wind throughout a room before harmful airborne substances could be eliminated in situ, and yet there remained a problem that those ions could collapse as they collided with a device body. Seeking to allow a quantity of ions required to be released outside, I worked with product design engineers to review ion-generating device layout and so on, and even provided the first model with a separate air trunk for Plasmacluster Ions.

Furthermore, a demonstration of effectiveness was required to commercialize Plasmacluster. Our company, being an electronics manufacturer, had no knowledge of microbes, but we were able to proceed with the project by acquiring a wide range of knowledge from third party laboratories and research institutions for microorganisms. Starting with a search for institutions capable of handling airborne microbes, we developed a reliable testing method, together with specialists and specialized institutions, through trial and error; i.e., laboratory demonstration of efficacy followed by clarification of the working mechanism and then verification of actual efficacy in the real environment. In this way, Plasmacluster technology was developed by combining electric discharge techniques and microbial analysis techniques.



First-generation ion-generating device
used in 2000 model

Small ion-generating device
used in 2010 model

➡ With technological advances, we have successfully developed a compact, low power consuming ion-generating unit.

What gives you joy as an inventor/researcher/developer?

My development work involves a repetition of a process in which I independently formed a hypothesis, constructed a prototype apparatus, and determined the effectiveness of the apparatus through testing. Sometimes, there was a string of failures that resulted in a dead end. Nevertheless, despite such difficulties, it was very satisfying for me as a developer when my own idea or hypothesis was verified. And I find the multiple processes of hypothesizing and testing, through which a new technology is being completed, to be very exciting. Also, one can greatly enhance his or her own technology by combining it with technologies of other fields through discussions with external research institutions or engineers from different industries instead of secluding oneself in a company laboratory. Furthermore, it gives me great pleasure to publically announce technical developments jointly with external institutions and thereby share a sense of accomplishment with their staff. For the purpose of Plasmacluster technology development to date, we have collaborated with more than 20 external institutions. This has brought me an extended network of contacts, different perspectives from my own specialty, and unexpected directions in technology development. And when I see a product on the street that incorporates a technology that I myself developed, memories of the hardships encountered in the development process disappear.

In the future, serving as a nurturing parent, rather than a natural parent, of this technology, I am looking forward to fostering it to the extent that people willingly embrace it all over the world, as I strive to realize my goal contained in the slogan – “Bringing Plasmacluster Ions to wherever there is air!”