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BIOELECTRICS: Action of Plasma on a Living Body
バイオエレクトリクス：プラズマの生体相互作用

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Bioelectrics refers to the use of pulsed power, powerful pulsed electric or magnetic field for extremely short periods of time, non-thermal plasmas in gases or liquids and shock waves, to give novel physical stresses to biological cells, tissues and/or organisms as well as bacteria. Here, with the overview of Bioelectrics the plasma production in high pressure gas, liquid and supercritical fluid by pulsed power is described, and also a recent development of Aoko treatment apparatus is described in detail.

1. What is Bioelectrics?

Bioelectrics refers to the use of pulsed power, powerful pulsed electric or magnetic field for extremely short periods of time, non-thermal plasmas in gases or liquids and shock waves, to give novel physical stresses to biological cells, tissues and/or organisms as well as bacteria. Bioelectrics is an interdisciplinary academic field that includes physics, chemistry, biology, medical science, agriculture, environmental, mechanical and electrical engineering, and is expected to open up new science and technology. For example, nanosecond pulsed electric field can impart an unique stress on cells based on dielectric and electrostatic effects to sub-cellular bio-molecules and organelles, which is expected to lead to new biological reactions. Also, intense pulsed electric fields can be used to kill bacterial spores in liquid. Pulsed electric fields can have effects at the molecular level as well as be used to delivery molecules or eliminate cancer cells. Atmospheric pressure, non-thermal plasmas produced by pulsed power can be used not only for bacterial, viral and chemical decontamination, but also for medical treatments such as wound healing. Plasmas can be created even in liquid and used for the bacterial and chemical decontamination of water environment.

2. Plasma Production in High Pressure Gas, Liquid and Supercritical Fluid by Pulsed Power

Plasmas are able to be produced in many media, such as high pressure gases, liquid and supercritical fluid, by using a pulsed power. The characteristics of pulsed power are extremely high peak voltage and current, and considerably shorter pulse width. These characteristics cause discharge plasmas with a large volume even in high density media. The plasmas produced in high density media give an influence to animals, plants and bacteria. Especially, the supercritical fluid has been used as a solvent for extractions and chemical reactions, waste processing and others. I think that the large volume plasma produced in the supercritical fluid gives a living body a strong effect, and these phenomena becomes one of important fields of Bioelectrics. Here, the basic phenomena of discharge plasmas produced by pulsed power are presented in detail.

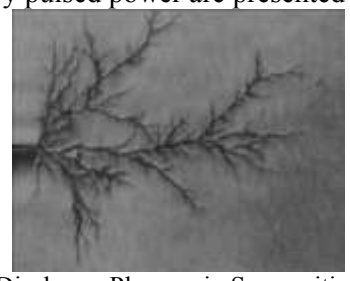

Fig.1. Discharge Plasmas in Supercritical Fluid

3. Recent Development of Aoko Treatment Apparatus

The active multiplication of Aoko (Microcystis) in dam and lake is one of large environment problems in the world. The Aoko looks like a green water, and multiplies at high water temperature with nutrition of nitrogen and phosphorus. We have tried to treat Aoko by discharge plasmas in water. Here, the recent development of Aoko treatment is described in detail.

Fig.1. Aoko Treatment Apparatus