Toward Medical Applications of Atmospheric Pressure Plasmas
~ Physics, Chemistry, Biochemistry, Molecular biology, Medicine ~

Katsuhisa KITANO

Center for Atomic and Molecular Technologies,
Graduate School of Engineering, Osaka University,
2-1 Yamadaoka, Suita, Osaka 565-0871, Japan.
kitano@plasmabio.com

Medical application of plasma is one of attracting interdisciplinary fields. Atmospheric pressure plasmas, as shown in Fig. 1, with room temperature have been used for a wide variety of medical fields. Especially, plasma treatment of human body is thought to be applicable to disinfection, wound healing, blood coagulation and so on. Many interesting experimental results have been reported, but the discussion about function mechanism of plasma (the role of plasma) is not sufficient. For that purpose, I have formed a collaborative research group including many researchers of plasma physics, numerical simulation, physical chemistry, analytical chemistry, chemistry, biochemistry, molecular biology, dentistry and medicine.

Considering human body, some reaction should be induced inside body fluid by plasma exposure. The concept of "plasma-induced chemical reaction in liquid" is very important. In gas phase, various species (ions, electrons, radicals UV, and so on) are generated inside/surface plasma. Some of them diffuse outside plasma plume as an air ion. Hence, active species can be supplied from the interface between gas and liquid phases. In the liquid phase, active species penetrate from the surface of the liquid. The penetration is limited by many chemical reactions, and each concentrations of species are distributed. Unlike usual chemical reaction, spatially non-uniform reaction field is obtained. Then, supplied active species react with biomacromolecules (protein, amino acid, lipid, sugar and so on.). As a result of many types of reaction (oxidation, nitration, hydrolysis...) to biomacromolecules, several types of biological processes occur. Some of processes are beneficial for health.

Plasma is not an instrument of magic. It is important for beneficial use of plasma to find applications which can not be treated by other methods. One of our answers is the disinfection of human body. Plasma can bring strong bactericidal activity limited on the surface of human body, which avoid ill effect for living body. For that purpose, we developed the reduced pH method which changes D value (1 log reduction time of bacteria count) to 1/100. It has been also found that the presence of superoxide anion radicals (O_2^{-}•) in water and the air is essential. The critical pH value may be associated with pKa of the dissociation equilibrium between O_2^{-}• and hydroperoxy radicals (HOO•), which is known to be approximately 4.8. This means that O_2^{-}• can be changed into HOO•, which have much stronger bactericidal activity, in lower pH. Half lifetime of O_2^{-}• is adequate for the disinfection. Now animal experiments have been done for dental and medical application.

Luncheon Seminar

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[27 September 2012 (Thur.) 12:00～13:10]

Venue: 4F Room 414
Time: 12:00-12:15 (registration)
12:15-13:10 (Seminar)
Speaker: Prof. Katsuhisa KITANO (Osaka University)
Language: English
Fee: Free of charge (A boxed meal will be provided to the first 50 people)