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プラズマ技術を用いた医用電気機器の特性
Characteristics of the medical electrical equipment using plasma technologies

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Recently, atmospheric pressure plasmas have been attracting special attentions for biomedical applications including blood coagulation [1]. The argon plasma coagulator (APC), which is an equipment intended for thermal coagulation of tissues, has been practically used in an endoscopic submucosal desection (ESD), ablation of residual tumor cells and control bleeding [2]. However, there are some risks of occurring carbonization, vaporization and deep tissue injuries with prolonged application [3]. To overcome problems from these thermal tissue damages, a nonthermal atmospheric pressure plasma with a high level of nonequilibrium has been considered as an alternative technique of high temperature plasma. The medical plasma equipment using the low-temperature atmospheric plasma is defined as “a minimally invasive plasma (MP)” for blood coagulation.

The studies on blood coagulation using a dielectric barrier discharge (DBD) air plasma [4], a non-thermal air plasma torch [5] and a microwave-excited argon plasma jet [6] have been reported. Also we have developed the technology of blood coagulation using an originally-designed nonthermal plasma jet [7]. The plasma jet is based on DBD using helium or argon gas.

In this study, we have performed experimental comparison between an APC apparatus (ERBE Elektromedizin GmbH, Germany) and our MP coagulation system. In experiments, an optical emission spectroscopy (OES) and an infrared camera are used to analyze thermal properties of both plasmas. The rotational temperatures of nitrogen molecules, which have been widely used to investigate neutral gas temperature in plasmas [8], are measured with using the OES. The spatial distributions of temperatures in plasma applications are measured with using the infrared camera.

This presentation will be concerned with motivation and latest experimental results of our work. In addition, we will discuss on the plasma characteristics in a conventional APC and a nonthermal atmospheric pressure plasma source for blood coagulation.

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