Characterization of Atmospheric Pressure Air Plasma Jet Powered by Sinusoidal High Voltage and Nanosecond Pulses for Plasma Products Control

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Plasma application for life-science (i.e. plasma medicine, plasma sterilization, etc.) has been reported by numerous papers [1-3]. On the sterilization effect, the roles of the reactive species [2] generated in the plasma have been reported as a key factor. Not only for the plasma sterilization but also for many of plasma life-science applications, atmospheric pressure plasma devices that allowed us to control the reactive species composition are deserved to resolve the roles of the reactive species.

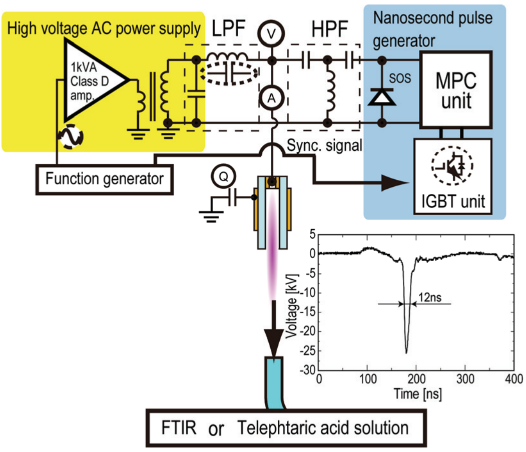

Fig. 1. Experimental setup

Dielectric barrier discharge (DBD) plasma generated by nanosecond high voltage pulses are expected to have higher electron temperature due to the high reduced electric field than that generated by low-frequency AC high voltage. In this study, DBD atmospheric pressure plasma device, powered by both the AC voltage and nanosecond pulses, is developed for continuous connection of those discharges to control the plasma chemistry. (Fig.1)

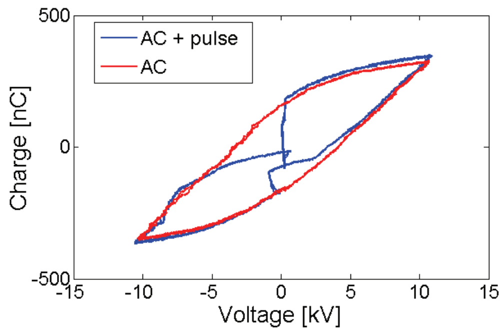

Fig. 2. Nanosecond-pulse-imposed voltage – charge cycle

Figure 2 shows a voltage-charge cycle of the nanosecond pulse imposed DBD in a coaxial geometry plasma jet. When the nanosecond pulse (-12 kV) is superimposed at 0 and 180 degree of AC sinusoidal voltage phase, step-like charge increase and decrease occurs at around the zero AC voltage. The charges in both phases move toward zero, which indicates the removal of the residual charges on dielectric wall. Modulation of the pulse-imposed phase resulted in -14% to +40% changes in the AC discharge power. As well as the discharge power, Ozone and N_2O production, measured with Fourier transform infrared absorption spectroscopy (FTIR), are also influenced by the pulse-imposed phase and the density ratio of Ozone and N_2O are modulated up to ±10%. Further experimental data and discussion will be presented.

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[2]. E. Takai, S. Ikawa, K. Kitano, J. Kuwabara, and K. Shiraki: *J. Phys. D: Appl. Phys*. **46** (2013) 295402.
[3]. H. M. Joh, J. Y. Choi, S. J. Kim, T. H. Chung, and T. H. Kang: *Sci. Rep.* **4** (2014) 6638.