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Authors	Mao Xu, Motoaki Yamauchi, Akitoshi Okino
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3-Dimensional Plasma Actuator for Flowing Gas Containing Reactive Species

[1]Mao Xu*, [1]Motoaki Yamauchi and [1]Akitoshi Okino

[1]*FIRST, Tokyo Institute of Technology, Japan*

[1]*J2-32, 4259 Nagatsuta, Midori-ku,Yokohama 226-8502, JAPAN*
phone: +81-45-924-5689, fax: +81-45-924-5689
e-mail: xumao@plasma.es.titech.ac.jp

1. Introduction and Experments

Sterilizing techniques by low-temperature atmospheric pressure plasma is a highly potential alternative to conventional methods. Accordingly, we developed a sterilizing system equipped with dielectric barrier discharge (DBD) plasma, which showed a powerful bactericidal effect, besides found that long-lived reactive species such as ozone help to more effective sterilization. For that reason, recycling gas-containing reactive species is one approach to enhance sterilizing efficiency. However, since conventional pumps tend to be eroded by highly reactive gas, which are not suitable for circulation of the reactive gas, we propose the circulation of reactive gas by plasma actuators. In addition, to increase the gas circulating capacity, we have developed a PA tube with a 3-dimensional(3D) structure in which PAs are placed on the upper and lower walls of the flow path. The PAs that comprise 3D-PA tube are fabricated by printed circuit board (PCB) process, whose characteristics including Ozone concentration, power consumption, flow velocity, and so on were evaluated.

The basic PA is 2D-configuration as shown in Fig.1 is composed of an exposed upper electrode, a buried lower electrode and a layer of dielectric between them. With this configuration, we fabricated 7 types of PA-row which contains 7 identical 2D-PAs with length of 70 mm, placed at 5mm intervals on 100×100 mm PCBs whose electrodes and dielectrics are copper and epoxy resin respectively. Depending on the thickness of board (0.6 mm, 1.0 mm or 1.6 mm), the distance between electrodes (0 mm, 1 mm or -1 mm) and the shape of electrodes (straight, 1 mm-serrated or 2 mm-serrated), for each PA-row, evaluations including flow velocity measured by current meter, Ozone concentration measured by gas-detecting tube, and power consumption measured by oscilloscope were conducted. Next, through comparing the performance of the PA-row to attain a relatively suitable composition for the flow path of 3D PA tube.

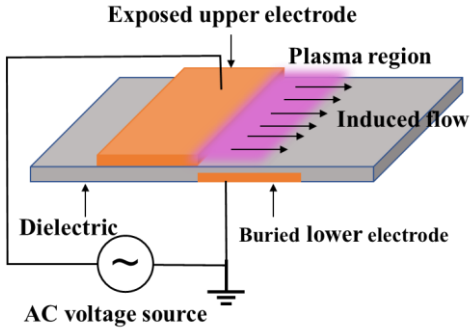

Fig. 1 Schematic diagram of PA

One of the PA-row with 1 mm thick board, 0 mm-distance and 2 mm-serrated electrodes is as shown in Fig. 2, discharging at a V_{pp} of 8 kV, 16 kHz.

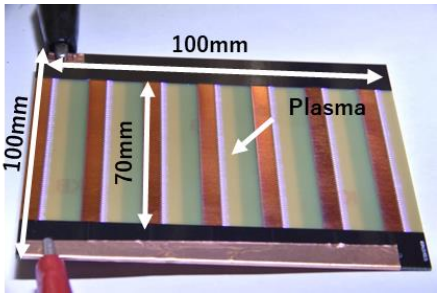

Fig. 2 Surface discharge of PAs fabricated by PCB process

2. Results and Conclusion

7 types of PA-row were fabricated and evaluated to sort out a relatively suitable composition for 3D -PA tube. In the presentation, the structure of the 3D-PA tube as well as the measured results will be reported.

References

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