

The effect of insulating oil on controlling the temperature of a ground electrode during long time irradiation

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Introduction: Atmospheric pressure plasmas jet is widely used in the medical and agricultural fields. With this plasma jet, various kinds of stimuli are electrical, chemical, temperature, and affect the biological responses. However, to improve the cost and performance is still a challenge of a plasma source [1]. Recently, insulating oil bath to containing electrodes is considered as a new method to prevent spark generation, in which plasma performance is promoted by increasing supplied voltage [2]. I also checked the same effect with our two ring electrodes plasma source. Small spikes have disappeared with an insulating oil coverage. Based on these ideas, the insulating oil was used to controlling the temperature on the ground electrode, and the plasma jet length of needle electrode configuration [3].

Experiments and results: The glass tube with a needle power electrode and ring ground electrode. A needle power electrode has the length of 250 mm and diameter of 0.2 mm. The ground electrode included the copper tape covering the outside of the glass tube with wide of 5mm. The insulating oil bath is constructed to contain a plasma jet device. Particularly, the electrodes were completely covered with an electrically insulating oil (transformer oil, Shin-Etsu silicon, KF-96-10CS, Japan). The temperatures of ground electrode and insulating oil are measured by thermocouples.

According to Fig. 1a, the combination between needle electrode configuration and argon gas is applied as a good solution for reducing operation cost. However, its disadvantage comes from large joule heating in a glass tube and limits the plasma treatment time to a few minutes to keep tube temperature below 150°C. Figure 1b shows the ring ground electrode was immersed in insulating oil. The limits of the needle power and ring ground electrodes configuration can be easily solved when using insulating oil. This configuration improves the range of operating parameters, and prevents thermal damage to the glass tube. The insulating oil can controlled ground electrode temperature below 50°C during long time irradiation.

In order to elucidate the radical productions by our plasma source, we monitored the color of the chemical probe. The calculated results also suggest the changes in plasma jet length by using insulating oil. The results will be summarized at the conference site.

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References: [1] H. Matsuura et al., Plasma Medicine 4(1-4), 29-36 (2014). [2] D. B. Nguyen, Y. S. Mok, and W. G. Lee, IEEE Transactions on Plasma Science, 2019, 1-7. [3] Tran. T. Nguyen, ICPIG and ICRP-10, (July, 14-19, 2019, Sapporo), PO16PM-054.

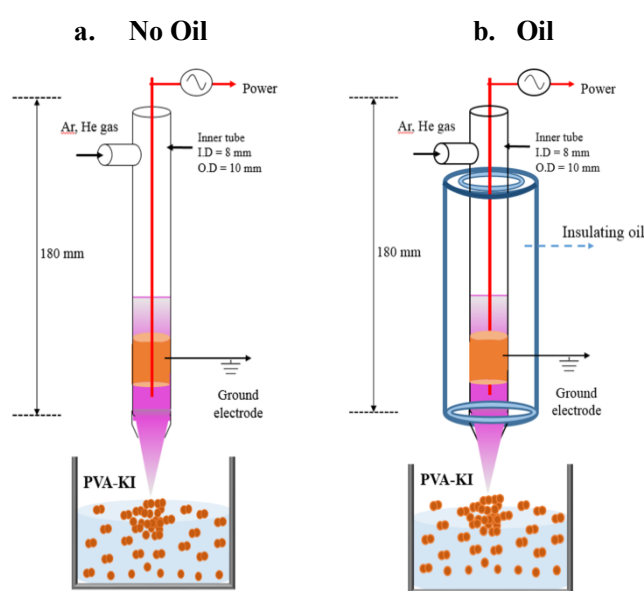


Figure 1. the configuration of plasma sources (a) a needle power electrode and a ring ground one, (b) is advance of (a) configuration with insulating oil bath.