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4P11 - Properties of the energy-controlled atmospheric pressure plasma driven by multi-step external ballast capacitors

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Atmospheric-pressure plasma sources have been intensively studied because of their various industrial applications. Especially atmospheric pressure plasma has a strong potential for biomedical and surface treatment applications. In this paper, we report properties of the energy-controlled atmospheric pressure plasma. The independent control of the voltage and the discharge current is suggested to make high degree of process selectivity and competitiveness of a functional atmospheric pressure plasma source.

The developed plasma has external ballast capacitors. Energy of the external ballast capacitor is injected directly into plasma region. Therefore, the discharge current and voltage can be controlled independently through the capacitance and the charging voltage. In this study, two external ballast capacitors are used. The capacitors are connected in parallel during the charging period, and the capacitors are connected in series during the discharge one. The connections of the capacitors are controlled by an Insulated Gate Bipolar Transistor(IGBT)s as switching devices.

Plasma formation process is observed by the synchronized Intensified Charge Coupled Device(ICCD) image along with monitors, such as optical emission line, voltage and discharge current. Characteristics of two different plasma modes are compared at the same discharge energy. One is low capacitance with high voltage and the other is high capacitance with low voltage. Light intensity, optical emissions, gas temperature, discharge current, plasma duration are controlled, depending on discharge current and voltage. For this reason, the developed plasma source is expected to be used for promising applications, such as, plasma activated water (PAW), surface treatment and biomedical applications.

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