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Property of three dimensional atmospheric plasma used by water-dielectric multi-layer electrode

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In order to generate the three dimensional atmospheric plasma for various application, plasma treatment of various products, sterilization or plasma treatment of the fruits or foods, development of discharge method were carried out. Since the localization of the electric field around the discharge electrode, the generation of the atmospheric pressure plasma with complicated three-dimensional shape is difficult. The discharge method of the complex shaped plasma using water-dielectric multi-layer electrode [1-2] was developed. To clarify the property of plasma using water dielectric multi-layer electrode, observation of discharge structure of atmospheric plasma using simple shaped electrode was carried out. In the case of using the coaxial electrode constructed by strait shaped cooling tube, the comparatively uniform plasma beside of inner surface of inner glass tube was generated. The water temperature in the coaxial glass cooling tube was controlled up to 70 °C by water bath. The rod electrode with ceramic tube and outer electrode were placed in the inner tube and outside of outer tube. Ar gas (1 atm, 3 L/min) is supplied from the gas inlet connected with inner glass tube. AC high voltage (10 kHz, 9 kVp-p) was applied between the electrodes. The structure of electric discharge along inside surface of inner glass tube was observed using digital camera. The filamentary discharge structure moves at high speed with the rise in the temperature with the increase of water temperature, and, it is seen uniform plasma in the macroscopic observation. In the case of 70 °C, it was observed that the filamentary structure by the high shutter speed observation of 1/1000[s], and moving speed was 200-500 [mm/s]. In the case of using the complex shaped glass electrode, the sterilization performance for actual agricultural products was evaluated.

[1] Tatsuya Misawa, Nobuya Hayashi, Japan patent: JP6083093B, USA patent: US9,114,373B2, EU patent: EP12848289.0.

[2]Tatsuya Misawa, et al., Frontier of Applied Plasma Technology, Vol.6, No.1, pp.1-5(2013) (ISSN: 1883-5589).

Keywords

atmospheric plasma
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plasma sterilization