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Characteristics of atmospheric plasma generated by water-dielectric multi-layer electrode

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In order to generate the atmospheric plasma for sterilization and disinfection of fruits and foods which have large volume and complex shape, discharge method using water-dielectric multi-layer electrode were developed. The inner glass tube (3.5mm in inner diameter) was inserted center of the outer glass tube (16mm in inner diameter and 90mm in length). And the internal fluid of water was enclosed in the region between inner and outer glass tube and was sealed by silicone rubber cork. The high voltage ac power supply (10kHz, 9kV_{p-p}) was connected with inner electrode, which is inserted center of inner glass tube, and outer cylindrical electrode, which has contacted the outer side of outer glass tube. The discharge gas flows in the inside of the inner glass tube. Ar and O₂ gas were used, pressure is 1 atm and flow rate is 3 L/min. By applying discharge voltage to inner and outer electrode, the stable atmospheric plasma was generated in the inner glass tube, and was ejected from the edge of inner glass tube to the outside. The increase of temperature and decrease of dielectric constant of internal fluid affects the improvement of plasma density and stability of atmospheric discharge. In the case of using O₂ gas, ozone of 1500ppm was generated. And water-dielectric multi-layer electrode is effective for the spatial stability of atmospheric plasma. In addition to previous setup, glass bulb condenser (300mm in length) and measuring flask of 250ml as the inner glass tube were used in order to generate the large volume and complex shaped atmospheric plasma. The uniform plasma along internal wall of the inner glass tube were generated in spite of change of the diameter of the inner glass tube. This result suggests that water-dielectric multi-layer electrode is effective on large volume and complex shaped atmospheric plasma which is necessary for the plasma sterilization and disinfection of fruits and foods.

Keywords

Atmospheric plasma
water-dielectric multi-layer electrode
sterilization
disinfection
food