NUMERICAL SIMULATION OF RADIO FREQUENCY ATMOSPHERIC PRESSURE GLOW DISCHARGES FOR THE APPLICATIONS IN THE MICROBIAL GENOME MUTATION

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Due to the outstanding features of the radio-frequency atmospheric-pressure glow discharge (RF PAGD) plasma sources produced using a plasma generator with a pair of water-cooled bare-metallic electrode configuration, such as the low capital cost, low and controllable gas temperature, high number densities of chemically reactive species, flexible operation procedure, etc., it would have bright prospects in the biological fields for the treatment of organisms. In this paper, the characteristics of the RF APGDs and their applications in the genome mutation for the improvement of the industrial microbes are discussed.

For the microbial genome mutation, the gas temperature level, the uniformity, the concentrations of the chemically reactive species, as well as the high throughput screening method for the mutants, are very important for obtaining the desired strains. In the first part of this study, the physical characteristics of helium RF APGDs are studied numerically with the one-dimensional fluid model to reveal the discharge characteristics. The calculated spatiotemporal distributions of the plasma parameters are also compared with the grayscale contour distributions of the discharge images based on the visible image processing method to evaluate the uniformity of the discharges. The results exhibit the high stability and uniformity of the RF APGD plasmas. In the second part of this paper, some examples concerning the mutation breeding of the industrial microbes are presented using a commercialized instrument based on our study, which is called ARTP (atmospheric and room temperature plasma) mutation breeding system. The microbial mutation breeding of different kinds of microbes is successfully achieved and a large mutant library with high diversity and genetic stability is constructed.


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