SIMULATION OF PULSED BREAKDOWN IN HELIUM BY ADAPTIVE METHODS

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Abstract

The paper deals with the processes occurring during electrical breakdown in gases as well as numerical simulation of these processes using adaptive mesh refinement methods. Discharge between needle electrodes in helium at atmospheric pressure is selected for the test simulation. Physical model of the accompanying breakdown processes is based on self-consistent system of continuity equations for streams of charged particles (electrons and positive ions) and Poisson equation for electric potential. Sharp plasma heterogeneity in the area of streamers requires the usage of adaptive algorithms for constructing of computational grids for modeling. The method for grid adaptive construction together with justification of its effectiveness for significantly unsteady gas breakdown simulation at atmospheric pressure is described. Upgraded version of Gerris package is used for numerical simulation of electrical gas breakdown. Software package, originally focused on solution of nonlinear problems in fluid dynamics, appears to be suitable for processes modeling in non-stationary plasma described by continuity equations. The usage of adaptive grids makes it possible to get an adequate numerical model for the breakdown development in the system of needle electrodes. Breakdown dynamics is illustrated by contour plots of electron densities and electric field intensity obtained in the course of solving. Breakdown mechanism of positive and negative (orientated to anode) streamers formation is demonstrated and analyzed. Correspondence between adaptive building of computational grid and generated plasma gradients is shown. Obtained results can be used as a basis for full-scale numerical experiments on electric breakdown in gases.

Keywords: plasma modeling, gas breakdown, adaptive methods, streamers, pulsed discharge

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