**Modeling of gas breakdown with “particle in cell” method**

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A numerical theoretical model has been developed that allows calculating the breakdown voltage of a gas between electrodes of arbitrary curvilinear shape. Such parameters of the model as boundary conditions for electric field calculation, time step between iterations of the model, distribution of loaded ions, modeling time required for breakdown detection were studied and optimized. A breakdown detection algorithm and a voltage feedback simulation algorithm have been developed that allows simulations to be performed accounting for the accumulation of surface charge on the chamber walls. Methods for acceleration of the modeling process were also proposed, which allowed to speed up the calculations several times. Comparison of the simulation results with previously obtained experimental data for the cases of flat and hemispherical electrodes in a wide range of distances between the electrodes showed a good correspondence at different gas pressures. It is shown that in the case of flat electrodes for a sufficiently large distance between the electrodes, the Paschen similarity law is not satisfied. It is concluded that the reason for this is the loss of charged particles on the dielectric walls of the discharge chamber due to radial diffusion and the defocusing geometry of the electric field lines. For the system with hemispherical electrodes it is shown that the physical reason for the formation of a horizontal section on the breakdown curve is the change in the breakdown path when the gas pressure changes, diffusion processes expand the breakdown channel, and the trajectory of particles in a curved electric field does not repeat the shape of the force line due to the inertia of motion. It is shown that due to the accumulation of surface charge, the losses of charged particles are reduced, and breakdown becomes possible at much lower voltages.