

High order fluid model for ionization fronts in streamer discharges

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When non-ionized or lowly ionized matter is exposed to high electric fields, non-equilibrium ionization processes, streamer discharges, can develop. Streamers occur in nature and as well in many industrial applications such as the treatment of exhaust gasses, polluted water or biogas. A third order hydrodynamic model is developed for the streamer dynamics by closing the system after the 4th moment of the Boltzmann equation. The high order pressure tensor appearing in the heat flux equation is specified in terms of previous moments. Simulations of the negative streamer planar ionization fronts in nitrogen are performed both with the classical so-called “minimal model”, where the local field approximation is used, and with the present higher order model. The results are compared and conclusions on future simulation approaches are drawn.