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Fluid modelling and analysis of the constriction of the dc positive column in argon MYKHAYLO GNYBIDA, DETLEF LOFFHAGEN, DIRK UHRLANDT, INP Greifswald, Felix-Hausdorff-Str. 2, 17489 Greifswald, Germany — A self-consistent fluid model describing the positive column of a DC argon discharge was developed. This model consists of the coupled solution of balance equations for the charge carriers, excited species, mean electron energy, and gas temperature in the plasma, Poisson's equation for the radial potential, and a current balance determining the axial electric field. Different assumptions concerning the electron energy distribution function (EEDF) were adapted to calculate electron transport and rate coefficients as a function of the electron mean energy. Simulations were carried out for currents from 1 to 100 mA and pressures from 100 to 500 Torr. The predicted voltage-current characteristics and electron density profiles are used to identify the transition from glow to constricted mode of the argon discharge. The results are compared with data from experiments. The impact of the various assumptions for the EEDF (Maxwellian, Druyvesteyn, solution of 0D Boltzmann equation with and without inclusion of electron-electron collisions) is discussed. The influence of cumulative ionization, electron-electron collisions, and gas heating in forming the EEDF as well as electron-ion recombination are found to be main reasons for the constriction of the glow discharge.

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