# BIFURCATIONS OF STEADY-STATE SOLUTIONS IN DC GLOW MICRODISCHARGES

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Self-organization in DC glow microdischarges has been observed for the first time a decade ago and represents a very interesting and potentially important phenomenon. Since then, a number of experimental reports on this phenomenon have been published, as well as a theoretical interpretation in terms of multiple solutions existing in the theory of glow discharge; see [1] for a review and detailed discussion.

Recently, quasi-stationary, continuous and reversible transitions between the 2D mode with a spot at the centre of the cathode and a 3D mode with four spots has been observed [2]. Also in [2], a transition from small spots to ring segments which subsequently merge into a ring has been observed. The above-mentioned transitions can be regarded as direct proof of the existence of bifurcations of steady-state solutions.

The present work is concerned with the modelling of such transitions and with the comparison of the results with available experimental data. Modelling was performed with Comsol Multiphysics software for a discharge with plane parallel electrodes in xenon under the pressure of 30 Torr. The model comprises equations for conservation of electrons and a single ion species written with the drift-diffusion transport approximation, Poisson's equation; the local-field approximation is employed. Processes considered are direct ionization and dissociative recombination.

It was found in the modelling that the transition between the 2D mode with a spot at the centre of the cathode and a 3D mode with four spots should be stationary, which conforms to the experiment [2]. Also found are transitions from small spots to ring segments which subsequently merge into a ring, similarly to what has been observed in the experiment [2]. No continuous transition between modes with four, five and six spots has been found in the modelling, which conforms to the experimental result that transitions between these modes are not continuous and are accompanied by hysteresis.

1. M. S. Benilov, "Multiple solutions in the theory of dc glow discharges and cathodic part of arc discharges. Application of these solutions to the modeling of cathode spots and patterns: a review", Plasma Sources Sci. Technol., vol. 23, no. 5, pp. 054019, 2014.

2. W. Zhu and P. Niraula, “The missing modes of self-organization in cathode boundary layer discharge in xenon”, Plasma Sources Sci. Technol., vol. 23, no. 5, pp. 054011, 2014.

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