COMPUTING DC GLOW AND ARC DISCHARGES BY MEANS OF COMSOL MULTIPHYSICS: TIME-DEPENDENT VS. STATIONARY SOLVERS*

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The most commonly used solvers in models of DC gas discharges are time-dependent solvers. Solutions are obtained by specifying an initial state and following the evolution of the discharge over time until a steady state is reached. The use of time-dependent solvers is so standardized in gas discharge models that the Plasma Module of COMSOL MultiPhysics does not support stationary solvers.

In the last 15 years multiple modes of arc-cathode attachment have been computed in high-pressure arc discharges by means of stationary solvers, see review [1]. This procedure has now become standard practice; an online tool for simulation of the mode of arc-cathode attachment in high-pressure arc plasmas which employs a stationary solver can be found in [2]. Apart from computing the multiple modes of arc-cathode attachment, stationary solvers have revealed the existence of complex behavior of the modes of arc-cathode attachment in high-pressure arc discharges in the form of loops and S-shaped sections.

Recently, multiple DC glow discharge modes have been computed by means of stationary solvers of the commercial software COMSOL MultiPhysics [3, 4]. Some of the modes computed comprise patterns of cathodic spots which are similar to those observed in experiments [5]. Stationary solvers have also revealed complex behavior in the form of loops and s-shaped sections in glow discharges, even in apparently simple situations.

This work is aimed at finding whether multiple modes and complex behavior can be found by means of time-dependent solvers in both glow and arc discharges.

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