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16th International Congress on Plasma Physics
Stockholm, Sweden, 2-6 July 2012

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Fluid modelling of capacitively coupled radio-frequency discharges: a review

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Capacitively coupled radio-frequency (ccrf) discharges are still among the most powerful and flexible plasma reactors, widely used both in research and in industry. The continuous investment in studying these discharges is therefore well justified, not only to understand the phenomena describing their operation but also to project modified versions of ccrf-reactors.

This paper reviews the basis and the successes with the fluid modelling of ccrf discharges, produced within a parallel-plate cylindrical setup (similar to the so-called GEC cell).

The two-dimensional, time-dependent model used in the simulations, accounts for the production, transport, and destruction of the charged particles (via the electron and ion continuity and momentum-transfer equations, and the electron mean energy transport equations) and the excited species and/or radicals (via their rate balance equations, including a very complete kinetic description with several collisional-radiative production/destruction mechanisms, coupled to the two-term electron Boltzmann equation), accounting also for the self-consistent development of the rf field (via the solution to Poisson's equation).

Simulations are carried out at (single) 13.56-80 MHz frequencies, 6×10^{-2} –6 Torr pressures, and 50-1000 V rf-applied voltages, in different gases or gaseous mixtures: SiH₄-H₂ [1,2], H₂ [3,4], and N₂ [5]. In the case of silane-hydrogen mixtures, the model further includes a phenomenological description of the plasma-substrate interaction, to calculate the deposition rate of a-Si:H thin films.

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