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Balanced / unbalanced planar magnetron plasma behaviour. Microscopic analysis by PIC-MCC modelling of the ion flux on thermal probes

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Magnetrons are worldwide used for thin film deposition for many applications such as microelectronics, hard coating, anticorrosion protective films, etc. The experimental knowledge accumulated on the operating process has supported the fast industrial development. However, nowadays requirements in terms of optimization and product quality can be achieved only by the deeper understanding of the magnetron plasma behavior at microscopic scale.
A 2D PIC-MCC code - called PICMAG - has been used to model the plasma steady-state of a DC planar magnetron reactor operating in Argon at low pressure. It follows charged particle composing plasma in the self-consistently calculated electric field from Poisson's equation. Particle collisions with background neutral gas are treated by Monte Carlo approach. PICMAG gives the local plasma potential between electrodes due to the space charge and the applied voltage drop, the currents on the cathode and the substrate (biased or floating), and estimates the electron energy distribution function (eedf).
The present study compares the plasma under different balanced/unbalanced magnetic field configurations in terms of sheath formation, plasma shape and density in the crossed field region, eedf. It also describes the charge current densities and fluxes at the electrodes and the anode plasma potential in order to discuss the ion flux on thermal probe measurements.

Keywords
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