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Sheath and electron density dynamics in a micro hollow cathode discharge in argon CLAUDIA LAZZARONI, PASCAL CHABERT, ANTOINE ROUSSEAU, LPP, NADER SADEGHI, LSP — A microplasma is generated in the 400 μm diameter microhole of a molybdenum-alumina-molybdenum sandwich (MHCD type) at medium pressure (30-200 Torr) in pure argon. Imaging and emission spectroscopy are used to study the sheath and electron density dynamics. Experiments are performed during the normal regime and the self-pulsing regime. The evolution of the microdischarge structure is studied by recording the emission intensity of the Ar ($5p[3/2]_1$-$4s[3/2]_1$) line at 427.217 nm, and Ar^+ ($4p'^2P_{3/2}$-$4s'^2D_{5/2}$) line at 427.752 nm. The maximum of the Ar^+ line is located in the vicinity of the sheath-plasma edge. In both regimes, the experimental observations are consistent with the position of the sheath edge calculated with an ionizing sheath model. The electron density is deduced from the Stark broadening of the H_β-line. In the self-pulsing regime, the electron density can reach a maximum value of 4×10^{15} cm^{-3} at 150 Torr, a few tens of nanoseconds later than the discharge current maximum. The electron density then decays with a characteristic decay time of about 2 μs, while the discharge current vanishes twice faster. The electron density in the steady-state regime is two orders of magnitude lower, at about 6-8$\times10^{13}$ cm^{-3}.

Claudia Lazzaroni
LPP

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