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Plasma ionisation in the low pressure operating regime of capacitively coupled radio-frequency plasmas D. O'CONNELL, Ruhr University Bochum, Germany, A. MEIGE, Ecole Polytechnique, France, T. GANS, Queen's University Belfast, Northern Ireland, E. SEMMLER, P. AWAKOWICZ, Ruhr University Bochum, Germany, R. BOSWELL, RSPhysSE, ANU, Australia — Fundamental plasma sustaining mechanisms in the low pressure operation regime of a single frequency capacitively coupled plasma are investigated with radio-frequency (rf) excitation at 2 MHz. Both hydrogen and rare gas discharges are explored. The discharge is operated at relatively low voltages to prevent plasma sustainment through secondary electron emission. Two pronounced ionisation mechanisms are observed; one as the retreating sheath approaches the electrode and a second as the advancing sheath expands towards the plasma bulk. The ionisation during the phase of the retreating sheath dominates in the low pressure operation limit (approx. 1 Pa) of all investigated gases. This mechanism is caused by an electric field accelerating electrons towards the electrode. It is believed that the electric field builds up due to inertia preventing electrons following the rapidly retreating sheath over the relatively large sheath width of a few centimetres correlated to the very low plasma density. In the case of rare gases ionisation during the sheath expansion phase becomes more important with increasing pressure and dominates above 5 Pa.
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