PIC MCC AND FLUID SIMULATION OF PROCESSING PLASMAS: COLLISION RADIATIVE MODELS AND ION ENERGY DISTRIBUTION FUNCTIONS

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Abstract. Argon based low-temperature plasmas are widely used both for fundamental process research and in technology applications. The long-lived Ar excited species act as energy reservoirs and have an influence on the discharge structure through the energy transfer to other species and surfaces. VUV photons from the Ar resonance states can substantially influence the properties of the processing materials, both in positive and negative ways. In this sense the simulation of plasma processing ICP (Kropotkin et al. 2020) and CCP discharges should correctly predict the Ar excited states densities in the plasma using collision-radiative model (Kovalev et al. 2019). Material modification on the atomic layer scale requires precise control of the ion flux and ion energy distribution function at the electrode. The experimental research combined with numerical simulations could provide better diagnostics for RF discharges. Such approach was used to determine the plasma density from the ion current to the Langmuir probe: with the PIC MCC simulation for a cylindrical (Voloshin et al. 2015) and a flat (Voloshin et al. 2016) probes. The relation between the ion flux and plasma density in an RF CCP discharge was studied both experimentally and with the 2D PIC MCC simulation (Bogdanova et al. 2018). The ion composition and energy spectra was studied both experimentally and numerically with PIC MCC model in Ar-H2 plasma of RF CCP discharge: see Bogdanova et al. 2019. The results of fast model for IEDF calculation in pure gases: Ar, Xe and N2 are presented in comparison with experimental measurements. Results in a pulsed CCP plasma: measurements of metastable and resonance states in the afterglow and application of CRM for the afterglow phase are also shown.

References

Bogdanova, M. et al. : 2018, *Plasma Sources Sci. Technol.*, **27**, 025003.
Bogdanova, M. et al. : 2019, *Plasma Sources Sci. Technol.*, **28**, 095017.
Kovalev, A.S. et al.: 2019 *Phys. Plasmas*, **26**, 123501.
Kropotkin, A. N., Voloshin, D. G. : 2020, *Phys. Plasmas*, **27**, 053507.
Voloshin, D. et al. : 2015, *Eur. Phys. J. D*, **69**, 23.
Voloshin, D. et al. : 2016, *Plasma Sources Sci. Technol.*, **25**, 015018.