2nd Asia-Pacific Conference on Plasma Physics, 12-17,11.2018, Kanazawa, Japan

Magnetical asymmetric effect in geometrically and electrically symmetric capacitively coupled

Shali Yang[1], Ya Zhang[2], Wei Jiang[3]

[1,3] School of Physics, Huazhong University of Science and Technology, [2] School of Science, Wuhan University of Technology, Wuhan

e-mail: 94yangshali@gmail.com

By applying the asymmetric magnetic field to a discharge, the dc self-bias and asymmetric plasma response can be generated. This is called magnetical asymmetric effect (MAE) [1,2]. MAE in the geometrically and electrically symmetric capacitively coupled plasma is investigated by a one-dimensional implicit Particle-in-cell/Monte Carlo collision simulation [3,4]. We applied four types of asymmetric magnetic field parallel to the electrodes and the discharge operates at a single-frequency rf source of 13.56 MHz and 150 V in argon with the pressure of 30 mTorr. The simulation results show that the asymmetric magnetic field can generate a significant dc self-bias, which is the result of a particle-flux balance applied to each electrode. The asymmetric magnetic field with variable gradient can produce controllable asymmetry in the plasma density and ion flux profiles to each electrode, together with a significant change on IEDF shape and width on the powered electrode. It has demonstrated that the MAE is a promising approach to increase the ion flux and still make the ion energy be adjusted in a certain range, that is, independent control of ion flux and energy to the electrode. The results suggest that the MAE can be an effective means to control the plasma properties as an augmentation to conventional measures.

References

[1] Yang S, Zhang Y, Wang H, Cui J and Jiang W 2017 Plasma Processes and Polymers 14 1700087
[2] Yang, S, Chang, L, Zhang, Y and Jiang, W 2018 Plasma Sources Science and Technology 27 035008.
[3] Wang H y, Jiang W and Wang Y n 2010 Plasma Sources Science and Technology 19 045023
[4] Jiang W, Wang H y, Bi Z h and Wang Y n 2011 Plasma Sources Science and Technology 20 035013