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Numerical Analysis of Ion Dynamics in RF ICP Discharge

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Radio Frequency (RF) Inductively Coupled Plasmas (ICPs) have been utilized in the wide variety of fields, e.g., material processing [1], accelerator [2], fusion [3]. Although such RF-ICPs play important roles in their fields, the operation of the RF-ICPs is difficult to control because of the complexity of their discharge process. In the previous work, an ElectroMagnetic Particle in Cell Monte Carlo Collision (EM PIC-MCC) code has been developed to obtain the insight of such complex discharge process of RF-ICP. The code is able to track the dynamics of the charged particles (e^-, H^+, H_2^+) in the RF ICP discharge. We have worked on the step-by-step upgrade of the simulation code to make the more detailed physics analyzable.[4,5,6,7] The work presented in [7] enables the code to reproduce the discharge mode transition (E-to-H) in a self-consistent manner. The results indicate that the dynamics of the positive ion may affect the discharge process especially during/after the mode transition.

Acknowledgement

The present study investigates the dynamics of ions in the RF-ICP discharge with some upgrades, e.g., H_3^+ will newly be taken into account, more consistent determination of the initial condition. Using the upgraded simulation code, we discuss the relation between the dynamics of the ions and the typical discharge parameters such as plasma density/temperature, spatial profile of each particle species and the power deposition inside the plasma, etc.

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