

大気圧プラズマ探針計測における中性粒子衝突の影響

Influence of plasma-neutral collisions on probe measurements in atmospheric pressure plasmas

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Many application studies using the atmospheric pressure plasma have been conducted because of the easy productivity and inexpensive facility compared with the conventional low-pressure plasmas. From scientific point of view, atmospheric pressure plasmas are interesting fields as strong plasma-gas and/or plasma-surface interactions. Under the high-collisional condition, mean free path of the electron-neutral, λ_{e-n} , and/or ion-neutral collisions, λ_{i-n} , are the order of μm which are much shorter than the Debye length, λ_D (several tens μm). This fact means that collisional sheath is formed around the probe electrode under atmospheric pressure. In this paper, we discuss the influence of plasma-neutral collisions on probe measurements comparing the experimentally obtained probe current-voltage characteristics in atmospheric pressure microwave plasmas torch with two dimensional particle-in-cell simulation using XOOPIC[1,2].

As shown in Fig.1, probe characteristics when a single Langmuir probe is placed on the axis of the plasma torch show that probe current, I_p in both saturation regions increases with the input microwave power[3]. The ratio of electron saturation current, I_e , and ion saturation current, I_i is about 4, which looks like an asymmetric double characteristic. In order to realize the experimental results, relation between potential structure (Fig.2) and particles influx to the simulated probe electrode is also discussed.

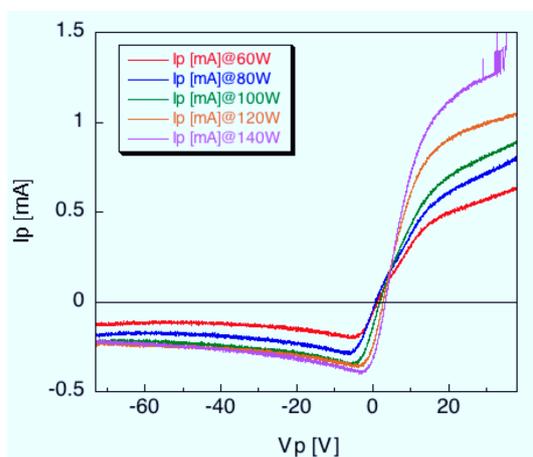


Fig.1: I_p - V_p characteristics obtained by a single Langmuir probe in the atmospheric microwave plasma torch.

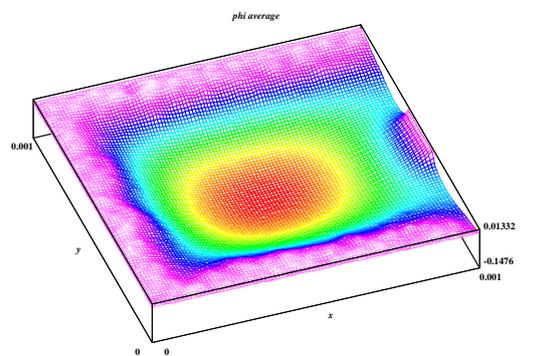


Fig.2: Snapshot of a potential profile in front of a grounded electrode placed on the right-hand side calculated by 2D-PIC Code, XOOPIC, under atmospheric pressure condition.

[1] J.P. Verboncoeur, A.B. Langdon, N.T. Gladd, *Comp. Phys. Comm.* **87**, 199 (1995).

[2] <http://ptsg.eecs.Berkeley.edu>.

[3] N. Ezumi, N. Kodama, K. Akahane *et al.* to be appeared in *Contrib. Plasma Phys.* (2012).