Estimation Of The Space Potential By Probe Methods In Low-Temperature Magnetized Discharge Plasma

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The space (or plasma) potential is most widely estimated by using a Langmuir probe. From the probe's current voltage characteristics many plasma parameters can be found. In periodic plasma fluctuations the time-resolved probe measurements are possible. However, the time-resolved probe measurements in irregular fluctuations are rather complicated, see e.g. [1]. If only the variations of the space potential have to be determined the direct probe methods of its estimation are useful, e.g. the emissive or, in case of a magnetized plasma, the ball-pen probe [2]. The ball-pen probe consists of a metallic collector, which is shielded by an insulating tube; the probe head itself must be oriented perpendicular to magnetic field lines. The ball-pen probe floating potential should yield the space potential. However, the internal impedance of the ball-pen probe at floating potential as a signal source is much larger that of classical Langmuir probe. Hence the ball-pen probe signal was measured using a high-input-impedance voltage follower (~1GΩ). In the irregular discharge fluctuations the ball-pen probe as well as the Langmuir probe measured the time-averaged data while the emissive probe was able to follow the plasma fluctuations.

In this work we compared the space potential measurements by ball-pen probe in the slightly magnetized discharge argon plasma by measurements using the classical Langmuir probe and the floating, sufficiently emitting, emissive probe. In Langmuir probe measurements the plasma potential was estimated from the abscissa of the maximum of the current-voltage Langmuir probe characteristic. During measurements all three probes were inserted in the discharge vessel simultaneously using three vacuum ports. The measurements were performed in argon within the pressure range 1-14 Pa, discharge current 60-100 mA and the magnetic field 40 mT. It was found that the data from all three diagnostics coincided within comparatively narrow pressure range of several Pa.

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