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The sheath structure under the Localized Secondary Electron Emission

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The effect of secondary electrons emitted from the solid on the sheath structure is very important, since the heat flux to the solid is limited by the sheath potential. According to Shangleby's text, when the secondary electrons emission increases, the sheath potential depth becomes smaller and its ionisation effect of primary electron heat flux from the plasma to the solid becomes weaker. Recently, the Nagaoka university group derived a new analytical sheath model which includes the secondary electron effects and confirmed it experimentally. According to their model, if sufficient secondary electrons with the finite temperature are emitted, the virtual cathode would be formed in front of the target. These works, however, have been restricted to one dimensional modeling, locally defined potential acts as if an electrostatic lens to concentrate or divide ion heat flux. At the heat flux to the target plate equally but the non-uniform profile, we can expect that some local hot spots are formed on the target surface. If the temperature there is sufficiently high, the charged electrons emitted locally and the sheath structure and the heat flux distribution are affected by them. In order to simulate the local secondary electron emission and study this situation, we install a small-collector gun in the target plate and exposed it to low pressure gas plasma. We have made particle simulations and study the condition of the virtual cathode formation and compare it with the one-dimensional model. In the no secondary electron case, the potential is almost one dimensional and dependent only on the distance from the target surface. In the secondary electron current increases, localized potential holes (below than the target surface values) are formed near secondary electron source. The effect of this delayed potential on plasma flux is under way. In this simulation, when the second electron temperature decreases, the potential hole become short and the simulation becomes unstable, which may fix the relation between plasma instability.

Experimental Investigation of Dual Plasma Layer Formation around the Anode in Magnetized Radio Frequency Inductively Coupled Plasma (ICP)

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A dual plasma layer is created in magnetized radio frequency (RF) inductively coupled plasma (ICP). The effects of the external magnetic field and anode voltage on the evolution of the cylindrical luminous dual plasma layer from the anode glow are investigated in magnetized hydrogen plasmas. The anode glow is initially produced from the additional DC discharge which forms when a cylindrical anode platform inserted into the plasma discharge region is positively biased. If the anode voltage is sufficiently high, the anode glow is transformed into an elongated luminous dual layer around the anode in the plasma diffusion region, in which a diverging magnetic field is coupled with an external magnetic field. The weakly magnetized plasma is needed for the formation of the dual layer, and there is an upper limit on the magnetic field strength, beyond which the dual plasma layer disappears. The dependence of the dual layer structure on the magnetic field strength, anode voltage and the neutral gas pressure are also studied. The double layer structures are visually apparent because of the enhanced light emission from the neutrals excited by the energetic electrons. Some photographs of these structures will also be shown to demonstrate the phenomenon.

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