3rd Asia-Pacific Conference on Plasma Physics, 4-8,11.2019, Hefei, China

Ion energy distribution at the wall of a radio-frequency plasma contaning energetic ions

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Plasma sheath plays a very important role in determining the plasma-wall interactions. In tokamak devices, the ions bombard on the wall after accelerate across the sheath region, which decreases the lifetime of the material. The impurities from the wall by the ion bombardment can modify the edge-plasma properties, and even cause discharges end by disruption. During the plasma-wall interaction, the ion energy distribution (IED) function at the plasma material interface affects strongly the physical response of the material properties such as particle reflection coefficients, energy reflection coefficients, and sputtering yields. In an unmagnetized sheath, the ion motion is mainly determined by the electric field which is in turn determined by the sheath structure, therefore, the IED at the plasma material interface is fairly insensitive to the sheath dynamics. In order to predict accurately the IED, it is important to investigate the factors that change the characteristic of the sheath under the different plasma discharge conditions.

With one-dimensional model consisting of the hydrodynamic sheath model and equivalent circuit model. The sheath model employs Maxwell-Boltzmann electrons, and both the background and energetic ions described by all time-dependent terms in ion fluid equations. The equivalent circuit model is determined self-consistently the relationship between the instantaneous potential at wall located a current disturbance in the ICRF and the sheath thickness. Our results shown that the IEDs depend strongly on the energetic ion concentration and energy. When the impurities such as C and Li are taken into account, multiple peaks may appear in the IEDs. It is also shown that the frequency of the ICRH and the dc potential are the crucial for determining the shape of the IEDs. In additional, effect of the ion temperature and plasma density on the IEDs is also discussed.

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