Dust Dynamics and Tritium Retention in SOL/Divertor Plasma of ITER

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The dynamics and the tritium retention of dust particles released from the first wall are studied in SOL/divertor plasma of the ITER tokamak with a lower single-null configuration. In this study a simple model of the dust dynamics is applied, where a dust particle has a spherical shape and the dominant forces on a dust particle are ion drag forces due to Coulomb scattering and due to the plasma ion absorption. In this study the OML theory for charging of a dust is applied. In the case of SOL/divertor plasmas the charging time of a dust is so fast compared to the characteristic time of dust dynamics. This means local steady charging due to plasma ions and electrons is applicable during dynamics. In SOL/divertor plasma of tokamaks with the lower single-null divertor configuration there are strong parallel plasma flows along the magnetic fields from the stagnation point at the upper midplane to the divertor plates. These plasma flows accelerate the dust particle to the divertor plates along the magnetic field lines due to the ion drag forces. The plasma and filed distributions in SOL/divertor region obtained from the B2-EIRENE code give us the background plasma and field parameters to calculate the orbit of the dust particle. The plasma density and temperature around the outer region of the SOL/divertor in the ITER tokamak are around 10^{19} m^{-3} and few tens eV, respectively. The parallel flow speeds are 10 km/sec and 30 km/sec at the high and low field sides (HFS/LFS), respectively. In ITER one of the candidates of the first-wall material is berylium. It is clarified that at the high-field side the berylium dust with 1μm radius is accelerated to 1400 m/s in 140 ms at the HFS, while it can reach 1200 m/s in 60 ms at the LFS. During these acceleration the dust particle with 1μm is heated up to around 1000 K. The dust particle, which is released from the first-wall near the divertor plate, is less accelerated and becomes lower temperature. The tritium retention of the dust particle, which depends on the dust temperature, can be estimated.

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