§28. In Situ Sampling of Dust Particles in LHD and Their Characterization

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Of late there has been growing concern over formation of dust particles due to plasma-surface interaction [1-3], because dust particles pose two potential problems: those remained in a fusion device are dangerous, as they can contain a large amount of tritium and can explode violently; they may lead to deterioration of plasma confinement. Therefore, it is important to reveal their formation mechanism, their transport as well as their accumulation area. Investigation of dust in fusion plasma research devices has been carried out mainly using the filtered vacuum collection method [1-3]. To obtain information about the transport of dust particles formed in LHD, we have carried out in situ sampling in main discharges and glow ones during the 10th campaign [4] using a polyhedral holder as shown in Fig. 1 and analyzed them by SEM. We describe the results and discuss the transport of dust particles formed in LHD.

In situ sampling reveals existence of three kinds of dust particles: spherical dusts below 1 μm in size, flakes above 1 μm in size, and agglomerates whose primary particles are about 10 nm in size [5, 6]. These three kinds of dust particles suggest three formation mechanisms: CVD growth, carbon films peeled from walls, and agglomeration [5, 6]. The major composition of spherical dusts and agglomerates is C, while that of flakes is Fe and Cr, which are the components of the first wall [6]. Table 1 shows the kinds of dust particles collected in LHD and their area number density. During the main discharges, agglomerates were collected at (a) and (b): suggesting that agglomerates are transported from plasmas: and flakes were collected at any directions. During the glow discharges, spherical dusts, flakes and deposits were collected, while no agglomerates were collected. These results indicate that agglomerates are formed during the main discharges and they were removed or transported during the glow discharges. We have also confirmed an important fact that a large number of dust particles move during vacuum vent. Therefore, results of the ex situ sampling method do not suggest exactly a deposited position of dust just after the final discharge of the experimental campaign [6].

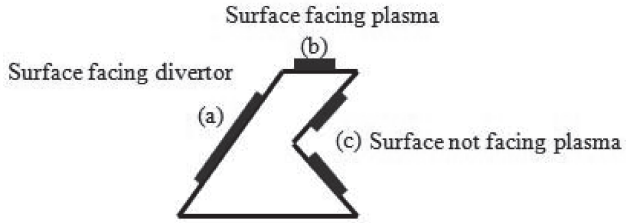

Fig. 1 Schematic view of polyhedral holder for in situ dust sampling.

	In situ sampling in main discharges	In situ sampling in glow discharges
(a) Surface facing divertor	・Agglomerate 1.9 mm^{-2} ・Flake 0.2 mm^{-2} ・Spherical dust	・Flake 10.91 mm^{-2} ・Spherical dust
(b) Surface facing plasma	・Agglomerate 0.6 mm^{-2} ・Flake 0.6 mm^{-2}	・Flake 8.8 mm^{-2} ・Spherical dust
(c) Surfaces not facing plasma	・Flake 8.07 mm^{-2} ・Deposit	・Flake 6.74 mm^{-2} ・Spherical dust ・Deposit

Table 1 Dust particles collected in LHD and their number

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