§25. Study of Dust Transport in LHD Plasmas

Ohno, N., Yamada, T. (Nagoya Univ.),
Ashikawa, N., Masuzaki, S., Komori, A., Morisaki, T., Sagara, A., Tomita, Y.

Recently, various kinds of dust particles have been observed and investigated in many fusion devices, mainly related to the safety hazard, such as tritium inventory and steam-induced hydrogen explosions. The dust transport mechanism in the fusion devices, however, has not been fully understood yet. It is necessary to identify the dust transport mechanism in fusion edge plasmas. In fusion devices, dust particles are observed in the devices after a lot of shots with different plasma parameters and wall conditions, which make it difficult to interpret the transport mechanism. Simulated experiments to introduce well-known dust particles into the edge plasma in large fusion devices can contribute much to the basic understanding of the dust transport process.

In this study, we used the pellet injection device (TESPEL) and the material probe system installed in the LHD device to introduce known dust into a plasma, and measure its transport with a high-speed camera.

First, we have conducted experiments to introduce Fe dust particles with various size and number to stable LHD plasma by using the TESPEL device, to be aimed for adjustment of a measurement condition of the high-speed camera. It is found that at the frame rate up to 4500 fps, sufficient light intensity from dust particles can detected to trance the dust motion and the data of the movie can be recorded between the plasma shots (3 minutes). Fig. 1 (a) shows typical photograph taken by the high-speed camera. The light spot surrounded with the circle corresponds to a Fe dust particle, which moves across the poloidal cross-section. Fig. 1(b) shows the radial profile of the light intensity due to the ablation of Fe dust particles. It is found that the dust particles are ablated at the periphery of normalized minor radius ρ =0.8-1.0.

We've also performed experiment on carbon dust transport. Spherical carbon particles whose radius is about 10 micron were put on the dust feeder having a bowl-shaped container located at the bottom of the vacuum vessel. The dust feeder can be moved vertically to reach the divertor region. When the strike point of the divertor leg attaches the center of the dust feeder, a lot of carbon dust particles were ejected from the dust feeder as shown in Fig. 2. The dust particles were transported in almost same direction and were reflected at the camber wall. Finally, the dust particles came back near the dust feeder. The transport mechanism of the dust particles observed here will be analyzed by dust transport code (DUSTT code)

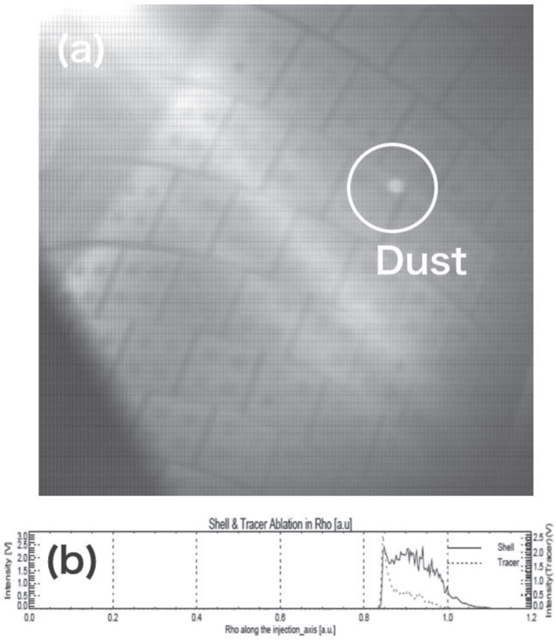

Fig. 1(a) photograph showing the Fe dust motion taken with a high-speed camera, (b) radial profile of light emission intensity from Fe ablation cloud.

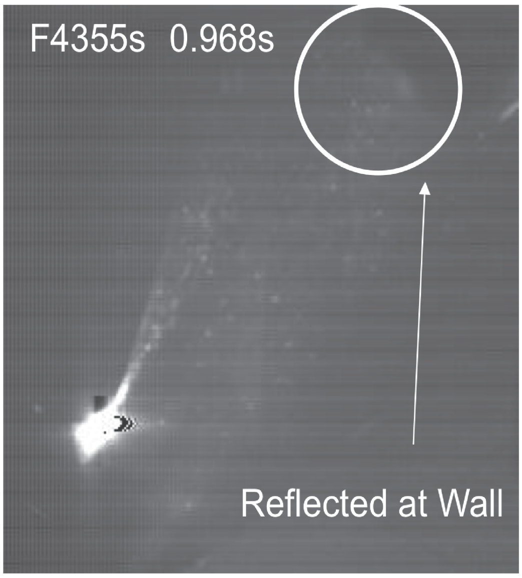

Fig. 2 photograph showing the motion of carbon dust particles injected from the material probe system.