§38. Application of a Fast Video Camera for Study on Triam-2M Peripheral Plasma and Plasma-surface Interactions

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Dust in plasma is produced as a result of the plasma-wall interaction. Therefore, the generation of dust suggests the degradation of the first wall. Also, dust behavior affects impurity content in the main and SOL/divertor plasma. Moreover, for nuclear fusion reactor dust affects tritium inventory. Thus, dust study is very important for future nuclear fusion reactor and this is ITER relevant.

Triam-1M is suitable machine for dust study, because of limiter discharge and long pulse discharge (>2hr world record). Plasma-wall interaction mainly occurs at the limiter surface. Therefore, it is very easy to observe the in si-tu plasma-wall interaction. Long pulse discharge enables us to heat up the wall surface such as fusion experimental reactor.

In this study dust behavior measurement using fast video camera is proposed and first results are reported. This study is very fruitful now, and the similar attempt is proceeding in the other machine (e.g. NSTX). Hiroshima Univ. provides fast camera and it is installed at the small horizontal port for a far-infrared camera. Fig. 1 shows the schematic of camera setting. The distance between plasma and fast camera is around 2400mm. Fig.2 shows the typical view from this port. The camera view has 256x256 pixels, and recording speed is 4500 frames per second (FPS). In this view the horizontal direction is horizontal (normal view). The bright region in the center is main plasma, and the both sides are the port . The left hand side of plasma is the edge of the limiter. During long pulse discharge (more then 30 s) the obvious number of dust are found by fast camera. The white arrows in Fig.2 indicate small bright region due to dust. The camera image is two-dimensional (2-D). The movement of dust along the line of sight is unknown, however, the parallel movement along the image plane can be calculated. The parallel velocity of this dust is around 10m/s. If we get 3-D view, it will enable us to get the real velocity and we can compare the dust velocity and theory prediction. This is the future plan.

As far as numbers of dust generated in single discharge, the degree of the plasma-wall interaction or first wall degradation can be estimated. The fast camera images show the dust particle one by one. Then, the numbers of dust can be counted by manual. When dust results from the limiter surface, the limiter is brighter than usual. Fig.3 shows the relationship between discharge time and the number of dust found by fast camera. The recording time of fast camera is shorter than the discharge, therefore, the trigger fired by the light monitor signal of the limiter surface from the bottom port. Unfortunately the limiter temperature is not measured precisely this time. Therefore, the relationship between the discharge time and the limiter temperature is unknown.

In the near future we will try to get 3-D information for dust behavior measurement. The idea is very simple. If dust can be seen from two different lines of sight such as human eyes, it is not so hard to identify the position of dust.

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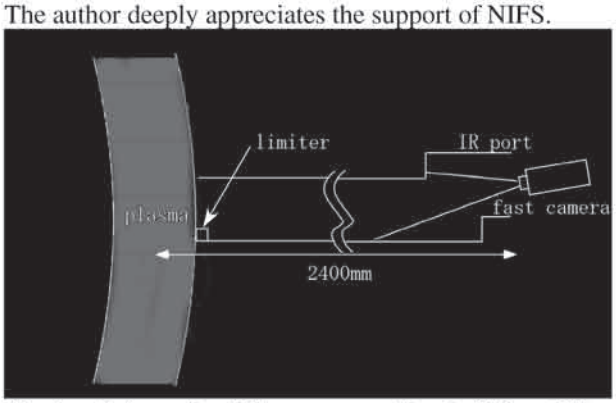

Fig. 1. Schematic of the camera setting in Triam-1M

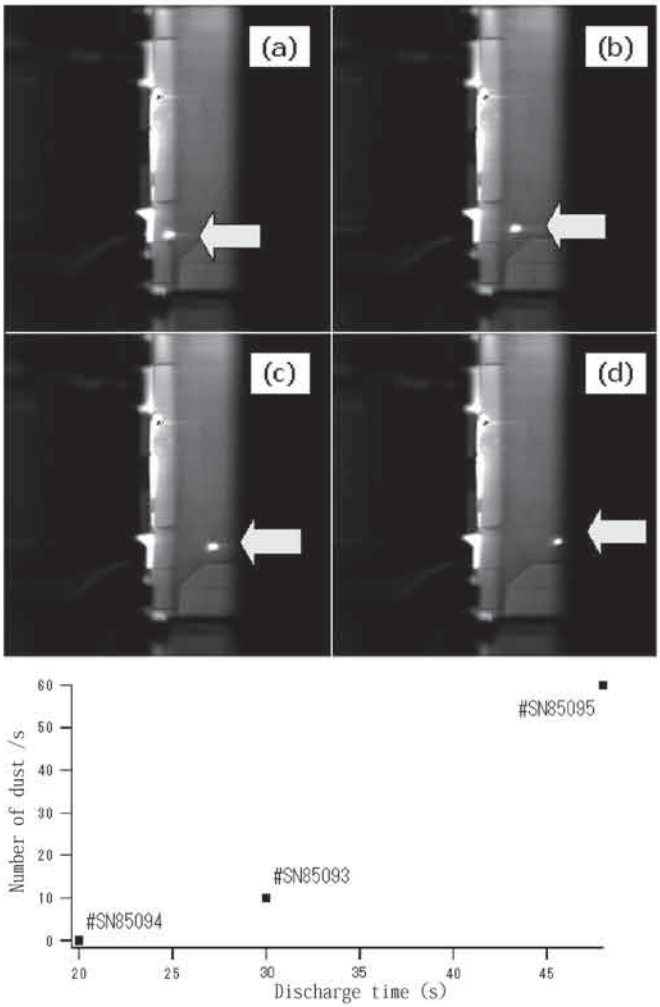

Fig.3 Relationship between the number of dust and discharge time