§12. Deposition Layer Study Using Material Probes on the First Wall in LHD

Bawankar, P.S. (Grad. Univ. Advanced Studies), Masuzaki, S., Tokitani, M.

The erosion of plasma facing materials in current fusion devices is inevitable. The eroded materials transported by plasma in complex manner during main plasma operation or discharge cleanings. These materials get re-deposited at several places on the wall in unequal amount. Thus erosion and deposition do not occur at the same places. In Large Helical Device (LHD) this phenomenon is studied by post mortem analysis of material probes which is exposed to plasma operations in whole experimental campaign. Si specimens installed on the wall of LHD at the torus outboard side each 36° toroidal angle section (#1~#10). The specimens were stand witched between two supporting stainless steel plates. Surface morphology and deposition profiles of the deposited materials, mainly C, B, Fe and Ti were examined by using Scanning Electron Microscope (SEM) and Energy Dispersive Spectroscopy (EDS).



Fig.1 The deposition pattern has been formed by incident deposited materials across the probe holder in a particular direction.

After exposure visible deposition (band) pattern has been formed on almost all the specimens (Fig 1). However the SEM images for all specimens shown similar smooth surface conditions except few probes which were near to GDC anode^{1,2)}. All specimens have light brown color bands on their right side. The widths of the bands are around 1.5 mm to 2.5 mm. Some specimens have left side bands accompanied with bottom horizontal bands.

EDS analysis showed that main deposited material was C. Other deposits were B, Ti and components of SUS316. As can be seen right side of visible bands has angle at the top side. It seems that materials deposition on the specimens has followed a particular direction of incidence. As shown in Fig. 1 the holding plate has the conic section at top and bottom corner of its rectangular opening. Making use this typical geometry it became possible to calculate two angles of line of incident direction. The incident deposited materials have projected top angular section of the holder plate on the specimen plane resulting in the top angular section of deposition band.



Fig.2 Horizontal EDS scan of Ti. Horizontal pink line shows the EDS counts of Ti on fresh Si. On the graph also shown SEM scan on left band of the specimen.

The incident line of deposited material has been traced in CAD. The incident line calculated for right side band shown to be pointing to the specific divertor plates. It suggests that eroded materials from divertor plates directly reached to the specimen. It is not clear, however when the materials came from the divertor plates whether during GDC or main plasma operation. Similarly left side band formed due to incoming of Ti. EDS scan of Ti shows that deposition is much lower than that of at the middle and at right band of the specimen (Fig 2).

These results were summarized in reference 3).

Tokitani, M. et al.: Nucl. Fusion 45 (2005) 1544.
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